MIDDLE EAST WATER CONSERVATION AWARENESS PROJECT
BEST PRACTICES RESEARCH
ACADEMY FOR EDUCATIONAL DEVELOPMENT
REGIONAL PUBLIC AWARENESS AND EDUCATION PROGRAM
MULTILATERAL WORKING GROUP ON WATER RESOURCES

ENVIRONMENTAL EDUCATION AND COMMUNICATION PROJECT
USAID / GreenCOM

DOMESTIC WATER CONSERVATION BEST PRACTICES IN THE PALESTINIAN TERRITORIES

(West Bank and Gaza Strip)

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ABBREVIATIONS

ACE - Associated Consulting Engineers - Palestine
Article 40 - Article 40 of the Interim Oslo Peace Accords
BGL - below ground level
BOD_5 - Five-day biological oxygen demand
CDM - Camp Dresser & McKee International Inc.
CEP - Center for Engineering and Planning
Chemonics - Chemonics International Inc.
CI - Ionic Chlorine
COD - Chemical Oxygen Demand
CPF - Comprehensive Planning Framework
DANIDA - Danish International Development Agency
DEH - Department of Environmental Health
Dia - Diameter
Du - Dunum
EAP - Emergency Assistance Programme
EAPC - Executive Authority of the Palestinian Council
EHRP - Education and Health Rehabilitation Project
ERR - Economic Rate of Return
ERP - Emergency Rehabilitation Project
FINNIDA - Government of Finland
FMP - Facility Master Plan
GIS - Geographic Information System
GTZ - Deutsche Gesellschaft Fur Technische Zusammenarbeit
GWH - Gigawatt Hours
Harza - Harza Environmental Services, Inc.
ha- hectare (10,000 m^2)
in. - inch or inches
INWC - Israelli National Water Carrier
IWRMP - Integrated Water Resources Management Plan
JM - Jerusalem Municipality
JWC - The Joint Water Committee
JWU - Jerusalem Water Undertaking
KFW - German Development Bank
Km - Kilometer
kWh - Kilowatt hour
L/c/d - Liters per capita per day
m - meter or meters
M&I - Municipal and Industrial
m^3 - cubic meters
m^3 /d - cubic meters per day
m^3 /du - cubic meters per dunum
m^3 /hr - cubic meters per hour
m^3 /s - cubic meters per second
mcm - million cubic meters

mcm/yr - million cubic meters per year
mg/l - milligrams per liter
ML/day - megaliter /day (1,000 m^3 /day)
mm - millimeters
mmsl - meters above mean sea level (elevation)
Morganti - Morganti Group
MOPIC - Ministry of Planning and International Cooperation
MOA - Ministry of Agriculture
MOH - Ministry of Health
MPN - Most Probable Number
MSF - Multi-Stage Flash Desalination
MW - Megawatt
Na^+ - ionic sodium
NFAC - No Further Action Condition
NIS - New Israeli Shekell
O&M - Operation and Maintenance
PA - Palestinian Authority
PALGRIC - Palestinian Geographic Center
PCBS - Palestinian Central Bureau of Statistics
PHG - Palestine Hydrological Group
PECDAR- Palestinian Economic Council for Development and Reconstruction
PLO - Palestinian Liberation Organization
PWA - Palestinian Water Authority
TA - Technical Assistance
TATF - Technical Assistance Trust Fund
TOR - Terms of Reference
TDS - Total Dissolved Solids
TSS - Total Suspended Solids
USAID - The U.S. Agency for International Development
UNDP - United Nations Development Programme
UNRWA - United Nations Relief and Works Agency
WB - West Bank
WBG - West Bank Gaza Strip
WBWD - West Bank Water Department
WHO - World Health Organization
WSSA - Water Supply and Sewerage Authority of Bethlehem-Beit Jala-Beit Sahur
GDP - Gross Domestic Product
IDA - International Development Association
JWU - Jerusalem Water Undertaking
WWCG - Water and Wastewater Company for Gaza

CHAPTER 1

1. INTRODUCTION

1.1 General

In support of the ***Middle East Peace Process***, the U.S. State Department has requested assistance from the United States Agency for International Development ***(U.S. AID)*** in the development of a ***Regional Public Awareness and Education Program*** around water conservation practices in the Middle East. This initiative falls under the aegis of the ***Multilateral Working Group on Water Resources.***

U.S.AID through the ***Environmental Education and Communication Project (GreenCOM)*** conducted a rapid assessment of domestic water conservation ***Best Practices*** in each of the seven regional parties, namely : the Palestinian Territories (West Bank and Gaza Strip), Israel, Jordan, Oman, Tunisia, Morocco, and Egypt. A research of quantitative nature regarding awareness and knowledge of water conservation practices was conducted in each country including the work of the ***Multilateral Working Group on Water Resources***. GreenCOM will facilitate an ***Intercessional Technical Meeting (ITM)*** on water conservation public awareness and communication that includes experts and representatives from Regional and Non-Regional Parties. Also, a ***Draft Strategy*** will be prepared by GreenCOM and submitted to the U.S. State Department following the ***ITM***.

Activities carried out under this Delivery Order will bring together experts in environmental education and communication and representatives from the United States of America, Israel, Jordan, the Palestinian Territories, Oman, Tunisia, Morocco, Egypt, and Non-Regional Parties in the development of ***a Regional Strategy for Public Awareness and Communication*** highlighting ***Best Practices*** around ***Domestic Water Conservation***. The campaign will feature positive messages about model programs that are replicable, existing water conservation programs. It will also recognize the water scarcity by building on Best Practices/Programs already in existence in each site/country and promoting them regionally. The Draft Strategy for the awareness and education campaign will promote water efficiency while recognizing that water scarcity is an age-old problem.

This report covers research conducted in the Palestinian Territories (West Bank and Gaza Strip) by the Consultant during the period (August 10 - September 20, 1997). The "Detailed Terms of Reference" of the consultant are shown in Appendix I and "List of Personnel Met and Agencies, Organizations, or Institutes Contacted During the Mission" are shown in Appendix II of this report. The ***Palestinian Water Authority (PWA)*** was assigned by GreenCOM for supervising and approving this study and through which the Consultant was selected. Appendix III of this report describes briefly the "Formation of the Palestinian National Water Authority".

1.2 Research Objectives

The primary research objective is to generate a list of Best Practices around domestic water conservation in each of the here above mentioned seven sites/countries. GreenCOM emphasized the need for the same type of information to be collected by all consultants selected for conducting the research in the seven sites in order to provide a basis for regional findings and comparative data. This information will be used to develop a regional communication strategy to : (i) increase public awareness and understanding of regional water conservation practices to meet the growing needs of an expanding population in the Middle East, and (ii) increase public awareness across the region of the existence and the various activities of the ***Multilateral Working Group on Water Resources.***

The results of this research will not only contribute to the design of the public awareness strategy, but also impact the selection of the target populations and messages. The results will further contribute to a common understanding of the needs, attitudes, beliefs and behaviors across the breadth of the region, and provide insights that technicians can use to address real delivery, communication, and management questions in ways that are focused and productive. Results of the research efforts in each country will be presented at the ***Intercessional Experts Workshop***.

1.3 Research Approach / Methodology

The research was developed and prepared for the Palestinian Territories in a phased approach. All information gathered are either from available literature when refered to, or collected by the consultant from existing organizations including ministries, and NGO's. The scope of services encompass the activities outlined in Appendix I. To facilitate the development of a realistic and goal-oriented public awareness strategy for domestic water conservation, a ***Focus Group*** has been interviewed. This group is comprised of individuals actively involved and interested in the various aspects of water supply systems for domestic and light industrial uses in the Palestinian Territories (West Bank and Gaza Strip). Accordingly, it includes representatives of Palestinian water institutions (the PWA and utilities), municipalities, universities, and research institutions, non-governmental organizations, and governmental, public, and donor agencies. The group is intended to provide a diverse set of inputs, and to review the subject study process. The primary activities of the focus group are to :

- Assist in the collection of available basic water supply data including existing water consumption rates and patterns and other pertinent data and conditions such as future water demand rates and patterns, and potentially available water resources
- Review the proposed methodology and criteria for selection of Best Practices
- Integrate and internalize the results of the Consultant's efforts with on-going water resources planning and management activities including other relevant activities in the West Bank and Gaza Strip

... Facilitate linkages with international funding institutions which could be exploited in the future by the Palestinian Water Authority (PWA) to secure financial support for Public Awareness Campaign in the West Bank and Gaza Strip.

This research provides guiding principles, rationale, and strategy for the planning and development of Public Awareness Campaign for the Middle East Region.

The capability to analyze and evaluate Best Practices of domestic water conservation at the present time is limited due to economic, logistic, environmental and political considerations that are not presently known in the Palestinian Territories. Numerous water resources management and supply options have been proposed for the Palestinian territories over the past few decades. Some of them rely on technologies or concepts that are not presently known to be feasible. Attempts are made in this research to consider a wide range of views and options to be implementable and widely accepted.

1.4 Acknowledgments

This Report is the product of an intensive study conducted by the Consultant with the help of the staff of the PWA, and numerous other contributors within the West Bank and Gaza Strip whose names are listed in Appendix II of this report. In particular, the consultant is indebted to Mr. Fadhel Kawash/ the Deputy Head of the PWA for providing the proper orientation and list of points of contact (agencies, institutions, NGO's actively involved in the Water Sector) and to Mr. Musa Abu-Gharbieh / the Director General of the PWA for making available all files related to the subject study. Miss Mary Sebold of AED/GreenCOM was very instrumental in coordinating and supervising the project activities in Palestine and in Washington, D.C., and her efforts are greatly appreciated. Mr. Abdelhay Abu-Gharbieh / General Manager of Universal-Dar for Engineering and Environment facilitated the mission in the Palestinian territories tremendously by joining the Consultant in his travels and meetings and in coordinating the activities of the Consultant while working in the Palestinian territories. Also, Mr. Abdelhay Abu-Garbieh accompanied Ms. Sebold during her visit to the West Bank in July 1997 and introduced her to several officials and organizations of the Palestinian Authority. Mr. Ali Masad / General Manager of Universal Engineering Consulting assisted the Consultant in the Internet search for related literature and in providing all services needed for producing the report including transportation, communication, reproduction, etc. Thanks are due to Miss Laila Abu -Nada and Mr. Dirar Ibrahim for their extra effort in typing and reproducing the report, respectively.

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CHAPTER 2

(This chapter was abstracted from a paper titled "Water Disputes in the Jordan Basin Region and their Role in the Resolution of the Arab-Israeli Conflict", ENCOP occasional paper No.13. Center for Security Policy and Conflict Research-Swiss Peace Foundation. Zurich/Berne, August 1995, by Stephan Libiszewski)

2. GENERAL CLIMATIC AND HYDROLOGICAL CONDITIONS OF THE MIDDLE EAST AND THE SOCIO-ECONOMIC IMPACT OF THE WATER CRISIS

The Middle East lies in a transitional zone between equatorial and midlatitude climates. Because of general atmospheric circulation patterns, a characteristic of these latitudes is the prevalence of aridity. Scarcely any precipitation occurs during the summer months, average temperatures being at over 30°C and up to 50° in some zones. In winter the jet stream moves southward, reducing the temperatures somewhat and bringing small amounts of precipitation up to North Africa's coasts. In all, annual precipitation remains low. In most areas of the Middle East rainfall lies under the agronomic aridity limit of 200mm/year and evaporation exceeds rainfall for most parts of the year. In some areas aridity is tempered by westerly winds which move moist air masses from the Mediterranean and the Black Sea onto the land. These provoke orographic precipitations along the northwesterly coast (the so-called levant), which therefore has a Mediterranean climate, and on mountainous areas in the interior. The Taurus, Anti-Taurus, and Pontic Mountains in eastern Turkey benefit from these precipitations, as do the Elzburg and Zagros Mountains on the border between Iran and Iraq, the Jebel Alawin in Syria, the Lebanon and Anti-Lebanon Mountains in the country sharing their name, and the hills of the West Bank (Palestinian Territories) and northern Jordan. Here precipitations reach amounts large enough to ensure a positive water balance, or to put it in other words, a "Water Surplus". These are the recharge areas of the region's few fresh water supplies, which, depending on quantity, geomorphology and soil structure, collect in surface streams or percolate into underground aquifers (Kolars 1992).

The bulk of the water resources consumed by both Palestinians and Israelis are shared. These main shared water sources are the Jordan River System (in whose basin lie Israel, Palestine, Jordan, Syria, and Lebanon), the Mountain Aquifers (of which two of its three basins underlie Palestine and Israel) and the Coastal Aquifer's extension into Gaza (connecting Gaza and Israel in one common hydrological system). These are the main water resources upon which Palestinians may legitimately draw and since in any case they constitute the majority of the water resources and are the main subject of contention between Palestinians and Israelis.

The Jordan Basin region is one of the zones in the Middle East that profits from these peculiar conditions. The Jordan River and tributaries drain parts of the Anti-Lebanon massif and the Jebel Alawin in Syria. Some of the surrounding areas on the Mediterranean coast and on the hills in the interior possess a precipitation - which collects in groundwater layers.

Israel, the Kingdom of Jordan, the Occupied Palestinian Territories (West Bank) cover about 80% of the drainage area of the Jordan River catchment system. They must be seen as the core part of the basin also in respect to the fact that they do not have other major surface water sources, and only limited groundwater sources. Thus, they are particularly dependent on the resources in question. Syria and Lebanon are the possessors of important headwaters of the Jordan River system and therefore an integral part of the region as defined, and crucial political protagonists, too. But the main part of their territory, and their most important agricultural areas, are touched by other river systems, partly of far more importance. The bulk of Syria's water demand is covered by the Euphrates, which crosses the country from north to east. Furthermore, the country is crossed by the Orontes in the northwest. Lebanon, for its part, is a mountainous country and has several smaller internal rivers.

A country-by-country review tells much about each nation's present water situation and probable future. But, it tends to undervalue the transboundary nature of most water resources. It also creates problems in accounting when these resources are claimed by different parties. In official statistics, shared waters are often accounted for more than one time in the water budget of each single country, distorting the real picture of the regional situation. Therefore, an eco-geographic rather than a nation-state approach is normally chosen. The eco-geographic approach regards the catchment area of water basins, both surface and underground, as the unit to be examined.

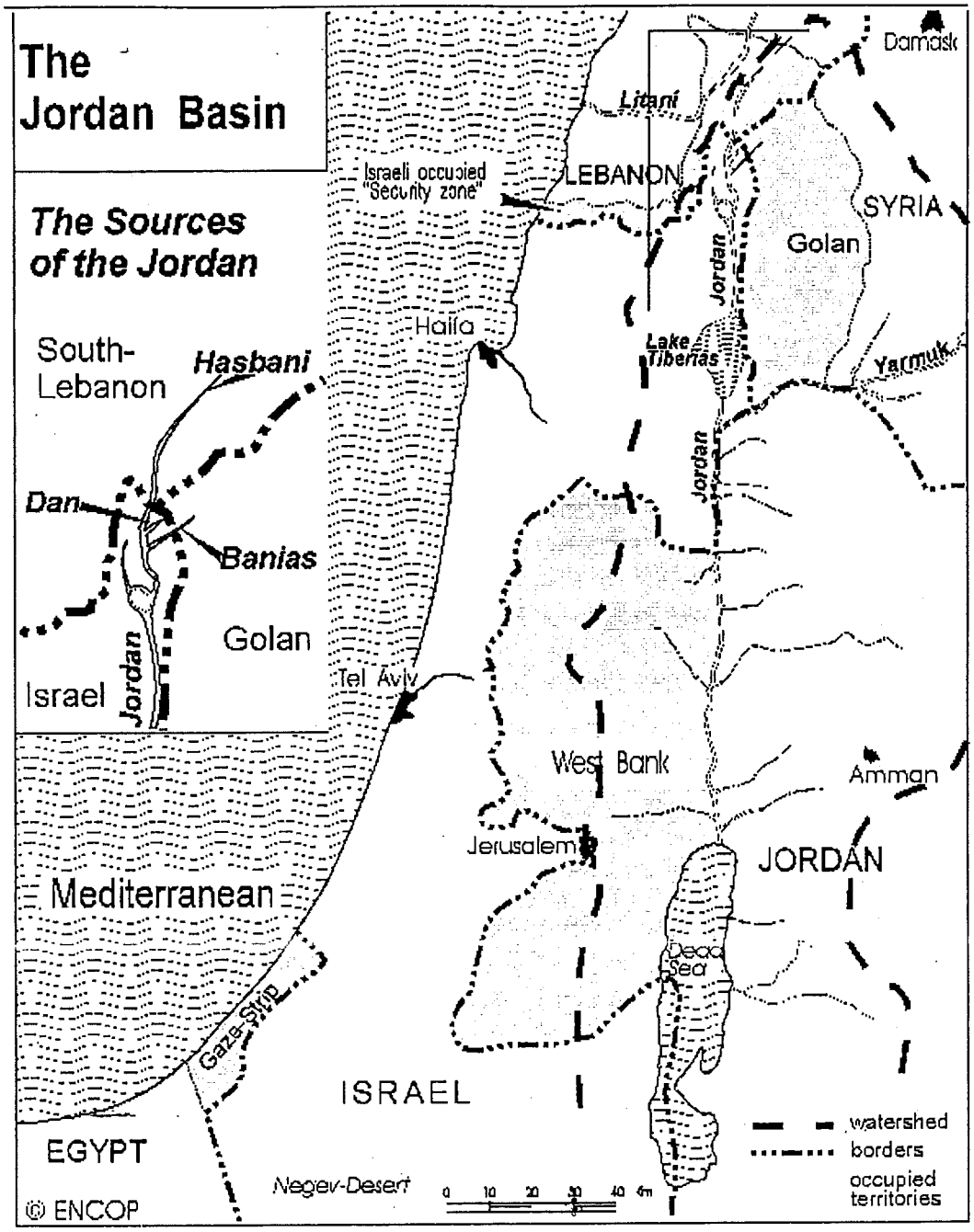
2.1 Surface Water Resources

2.1.1 The Jordan-Yarmouk River System

The most important single water source of the region is the Jordan River system (See Map 2.1). It's main axis rises on the western and southern slopes of Mount Hermon in the triangle between Lebanon, Syria, and Israel, and discharges into the Dead Sea, nearly 400 meters below sea level. It must be kept in mind that the real dimensions of this stream in no way match its biblical fame. Compared with other rivers of the world, the Jordan River is a very tiny stream, rather a rivulet than a river in the proper sense of the word. All tributaries considered, the basin drains an area of only some 18,300 km^2. From its furthest source in Lebanon to the Dead Sea, the Jordan River measures about 230 km as the crow flies, and somewhat more if one takes into account all the meanderings it makes in its course. For comparison : the Rhine and the Rhone in Europe drain 145,000 and 96,000 km^2 respectively, while the drainage areas of the big river systems of the world like the Nile, the Mississippi, or the Amazon cover several millions of square kilometers (Gleick 1993).

Even more ephemeral are the water quantities in question. The total natural discharge of the basin-including all the tributaries - averages around 1,500 million cubic meters (mcm) (Kolars 1992 ; U.S. Army Corps of Engineers 1991), with some authors giving even lower figures (Salameh 1992; Beschorner 1992). This is about 50 times less water than the Rhine's, 65 times less than the Nile's, and 400 times less than the Mississippi's

MAP 2.1


The
Jordan Basin
The Sources
of the Jordan
South-
Lebanon
Hasbani
Dan
Banias
Golan
Israel
Jordan
Israeli occupied
"Security zone"
LEBANON
Litani
Damask
SYRIA
Golan
Jordan
Haifa
Lake
Tiberias
Yarmuk
Jordan
Tel Aviv
West Bank
Amman
Jerusalem
JORDAN
Mediterranean
Dead
Sea
Gaza Strip
ISRAEL
EGYPT
Negev-Desert
0 10 20 30 40 km
watershed
borders
occupied
territories
© ENCOP

discharge (Gleick 1993). Furthermore, this already small amount is subject to extreme seasonal and annual variations. In February, for example, the river may carry as much as 40% of its total annual flow, but in each of the summer and autumn months, when water is most needed, it carries only 3-4% of its annual discharge (Lowi 1993). In drought periods like 1987-91 the water discharge of the Jordan Basin can be reduced by up to 40% throughout the whole year (Kliot 1994).

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

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

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

2.1.2 The Utilization of the Jordan-Yarmouk Waters

In analyzing human interventions on the Jordan River system it is important to keep in mind that the area of the basin in question is not just of very limited extent. It also

covers only a small part of the countries concerned. Apart from Lebanon, which is well endowed with rainfall, the other riparians of the Jordan basin have wide areas with arid climate. Territory classified as arid covers 80-85% of Jordan, 60% of Israel, and 50-65% of Syria (Kliot 1994). Therefore, efforts to exploit the Jordan and the Yarmouk often tried to extend geographically the benefit of their waters by diverting them into areas outside the Jordan Valley proper.

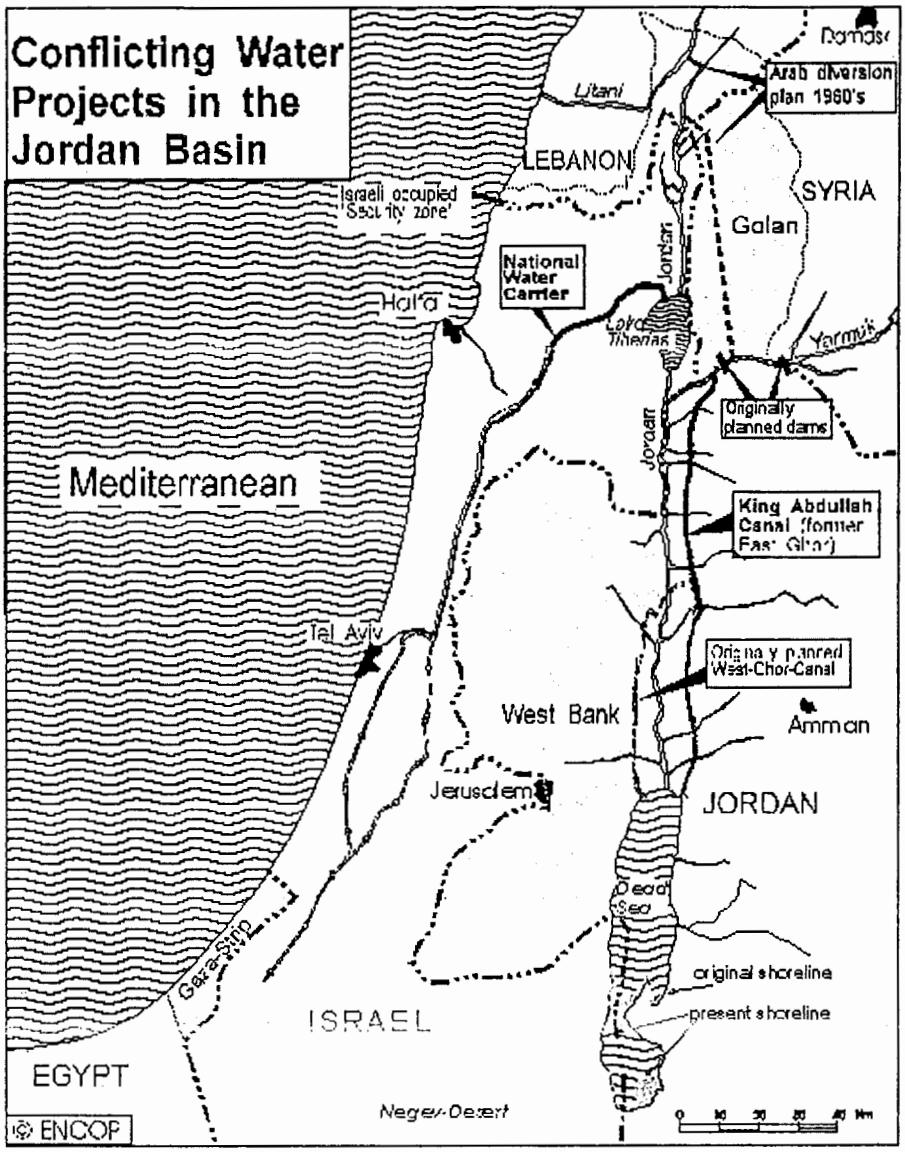
Plans to exploit the Jordan-Yarmouk waters date back to the turn of the century when the World Zionist Organisation began to assess the natural conditions of Palestine in view of the planned settlement of large numbers of Jewish immigrants (Wolf 1995; Gehriger 1994). But significant projects were realized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

After the founding of the Jewish state in 1948/49, its principal concern was the development of the coastal plain. Israel's first national water plan, made public in 1953, aimed at integrating "all the water resources of the country into a country-wide network which would collect water wherever it is available and distribute it to the areas where it is needed" (quoted from Lowi 1993). The main component of the plan was the diversion of the Upper Jordan waters from Lake Tiberias into a central conduit leading through the coastal plain up to the northern Negev (See Map 2.2). Completed in 1964, this National Water Carrier can transport more than one mcm per day. Water conveyance by the conduit gradually increased from 195 mcm in 1965 to an average of 350 mcm per year in the 1970s. In the 1980s the carrier was conveying 420-450 mcm (Kliot 1994). With direct water extractions in the Upper Jordan Valley and on the shores of Lake Tiberias (together about 100 mcm/year) this sums up to virtually the whole discharge of the river in its northern section (Upper Jordan River).

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

The original plans of the Jordanian project included construction of two dams on the Yarmouk. The first was planned at Mukheiba, near the intake of the King Abdullah Canal. The second dam was envisioned more upstream at Maqarin, on the Jordanian-Syrian border. These dams should have allowed storing the winter flow of the river, increasing conveyance into the King Abdullah Canal-eventually making possible its enlargement to the Western Bank of the valley - and producing hydro-electric power. Although it was repeatedly revived, the plan to build storage reservoirs on the Yarmouk River could never be realized, mainly due to Israel's political opposition and to

MAP 2.2


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

financial problems. As a result, up till now Jordan was able to tap no more than 120-130 mcm of water on the average from the Yarmouk (Al-Mubarak, Al-Weshah 1992). The rest of the river's flow has increasingly been exploited by Israel and Syria. From the 1950s onwards, the former received 25 mcm during the summer months for irrigating the so-called Yarmouk Triangle between the southern shore of Lake Tiberias, the Jordan and the Yarmouk River. But in the 1970s, after Israel occupied the Golan Heights, these extractions began to increase. According to different sources, Israel pumped up to 100 mcm from the Yarmouk in the mid-1980s (U.S.Army Corps of Engineers 1991; Lowi 1993; Brooks & Lonergan 1993). Since then, extractions seem to have decreased due to the drought in 1987-91. In the Israeli-Jordanian peace negotiations, an amount of 70mcm was assumed to have been the long-term average Israeli diversion quota over the last decades (Hof 1995).

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

In sum, the utilization patterns of the Jordan and Yarmouk rivers must be characterized as a far-reaching transformation of the basin. The combined diversions by the riparians have changed the river in its lower course into little better than a sewage ditch. From the 1,300 mcm of water which used to discharge into the Dead Sea in the 1950s only a pittance remains at present. In normal years Israel allows a flow downstream from Lake Tiberias of just 60 mcm of water (about 10% of the natural discharge in this section), basically consisting of saline springs which previously used to feed the lake, and sewage water (Kliot 1994). These are then joined by what is left of the Yarmouk, by some irrigation return flows, and by winter runoff , adding up to a total of 200-300 mcm. Both in quantity and quality this water is unsuitable for irrigation and does not sufficiently supply natural systems either. The salinity of the Jordan River reaches up to 2,000 parts per million (ppm) in the lowest section, which cannot be afforded by any crop (Brooks & Lonergan 1993). Only in flood years, occurring once or twice in a decade, is fresh water released into the lower Jordan Valley. (see tables 2.1a and 2.1b)

Table 2.1a
Defacto Distribution of the Jordan and Yarmouk Waters in the Early 1990's

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

* Data on the utilization of the Yarmouk belong to the most controversial figures in the Arab-Israeli water disputes. The figures given here reflect the range of estimations given by independent sources.

Sources : US Army Corps of Engineers (1991) : Water in the Sand : A Survey of Middle East Water Issues. Washington DC : Beschomer, Natasha (1992) : Water and Instability in the Middle East. Adelphi Paper, No. 273 London; Lowi, Miriam R. (1993) : Water and Power : The Politics of a Scarce Resource in the Jordan River Basin. Cambridge. Stephan Libiszewski

Table 2.1b
Jordan and Yarmouk Rivers Distribution Before and After the Israeli- Jordanian Peace Treaty of 1994 (in million cubic meters)

Jordan River

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

Table 2.1b Continued

Yarmouk River

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

Additional Sources

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

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

2.2 Groundwater Resources

2.2.1 The Mountain Aquifer of the West Bank

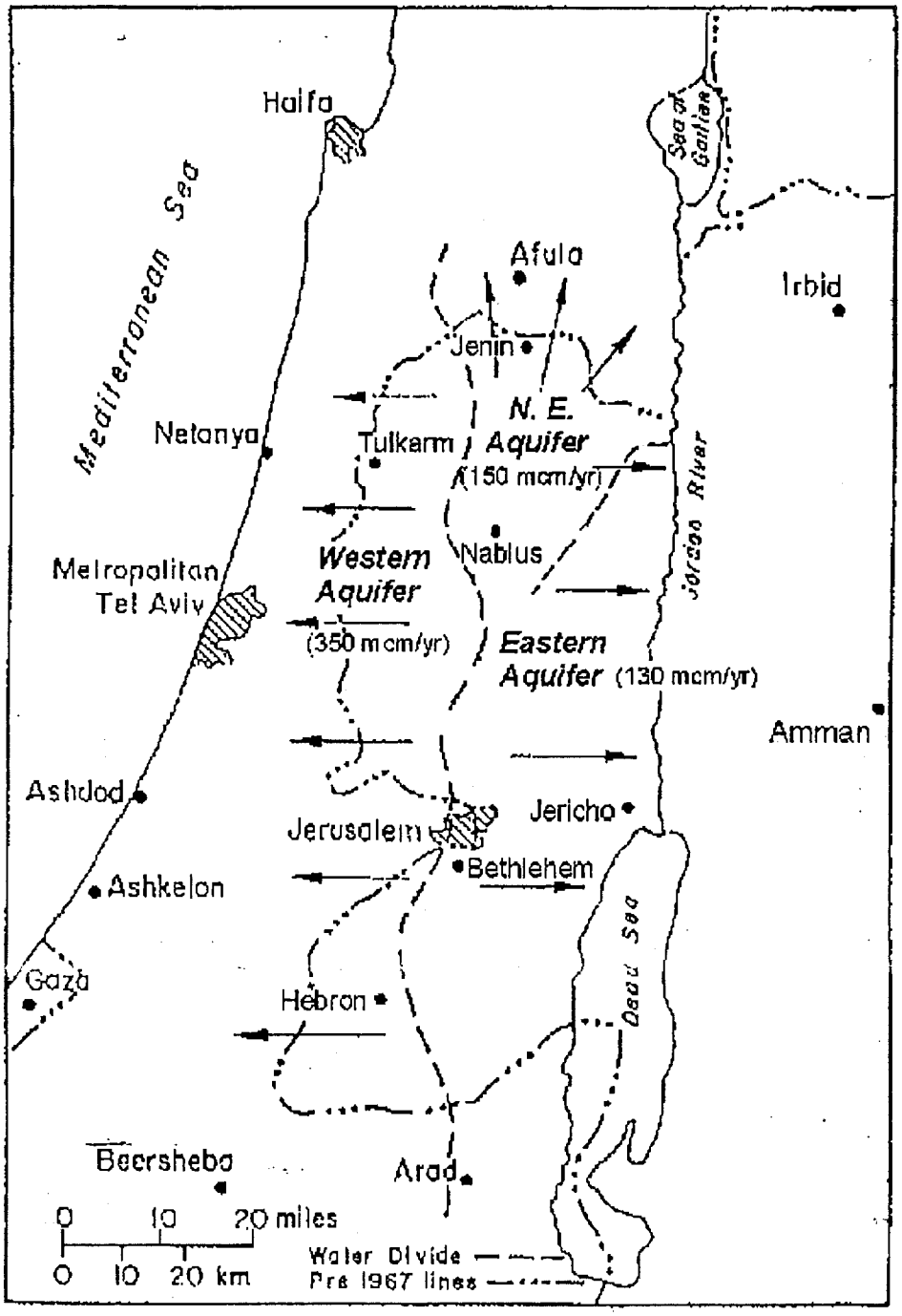
The aforementioned rivers and lakes are the most visible water resources of the region, but they do not cover the bulk of the water demand in Israel, Jordan, and the Occupied Palestinian Territories. In all of these three areas more than 50% of the available renewable supply is provided by groundwater. In the case of the Palestinians this source makes up nearly the totality of present consumption. The main groundwater basin of the region and also the most critical politically is the aquifer originating on the West Bank, also called the Mountain Aquifer. This groundwater layer covers the central area of the Occupied Palestinian Territories and a strip of adjacent Israeli territory. The aquifer consists mainly of karstic limestone/dolomite formations with recharge areas mostly along the upper mountain slopes and ridges at levels above 500 meters above sea level. Figures on the potential of the aquifer vary from 600 mcm per year to as much as 900 mcm; but the higher estimates seem to refer to the total water budget of the West Bank including surface runoff and eventually a share of the Jordan River. In the following, a safe yield of 632 mcm will be assumed, including the natural discharge of springs and 180 mcm of brackish water. This estimate is given by a joint team of Israeli and Palestinian water experts, representing a shared consensus on the matter (Assaf et al. 1993).

The mountain aquifer (See Map 2.3) can be divided schematically into three general basins : 1) the Western Aquifer (called Yarkon-Taninim Aquifer in Israel and called El-Ouja Al-Timsah basin in Palestine), which is the most abundant, providing more than half of the total yield, i.e. 350 mcm, 40 of which are brackish; 2) the North-Eastern Aquifer known in Palestine as Nablus-Gilboa basin and in the Hebrew literature as the Harod-Beit Shaan basin which is contributing about 130 mcm (of which 70 mcm brackish); and 3) the Eastern Aquifer with about 150 mcm (of which 70mcm brackish). Only the last mentioned of the three lies entirely within the West Bank. The other two, including the most important Western Aquifer, must be qualified as transboundary, since they cross the 1949 United Nations Armistice Demarcation line, better known as the **"Green Line"**. It is estimated that some 80-90% of the Western Aquifer and nearly 100% of the Northeastern Aquifer are recharged by precipitations falling within the West Bank area. But the water then flows underground in a westerly direction towards the Mediterranean coast and in a northerly direction into the Bet She'an and Jezreel Valley. Both aquifers have natural outlets, namely the Yarkon and the Tanninim springs on the western slopes and the Ma'ayan Harod Springs in the north, which lie within Israel's pre-1967 borders (Shuval 1993). The situation is somewhat comparable to that of a transboundary river, since the two aquifers have their replenishment areas in a political entity other than their discharge areas. This creates the notorious upstream-downstream riparian dilemma.

Historically, use of the western aquifer by the local Palestinian population was limited to part of the flow of springs as well as some 20 mcm from traditional dug wells in the coastal area. Intensive exploitation of groundwater was initiated by Jewish settlers

MAP 2.3

West Bank Mountain Aquifer



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

starting in the 1920s and 1930s. Prior to establishment of the State of Israel, Jewish settlers already used a significant portion of the aquifer. The remaining potential was developed mainly by Israel in the period between 1948 and 1967, and by Israeli settlements on the West Bank after its occupation in the Six Days' War. A similar history and use pattern can be drawn up for the northeastern section of the Mountain aquifer (Shuval 1993; Assaf et al. 1993). The groundwater being mainly of good quality, this source is largely used for municipal supply. Because Israel's coastal aquifer has deteriorated the Mountain Aquifer now constitutes the country's main supplier of drinking water (State of Israel 1992).

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

In sum, the use of the western and northeastern basins of the aquifer reached the limit of safe yield already in the mid-1970s. Only the eastern basin seems to contain an unutilized portion of about 60 mcm of mainly brackish water, which would require treatment before use (Assaf et al. 1993). Even so, in several parts of the Eastern Aquifer wells have been over-pumped. For instance, in the Jordan Valley the water table has dropped by 16 meters since 1969. Over-pumping has also resulted in deterioration of water quality. In many places, nearby saline aquifers underlie the fresh water layers. Over-exploitation can thus lead to seepage of brackish water into the fresh water body. Detailed studies in the Jordan Valley have revealed a rise in total salt concentration by 130% and of chlorine by 50% in the period 1982-1991 (Awartani 1993; Jaradat 1993). Quality of water has also declined markedly in some parts of the western basin. In its national report on the Environment in Israel, prepared for the 1992 Earth Summit in Rio de Janeiro, the Israeli Ministry of Environment itself points out that "the potentially rapid rate of saline water infiltration to the aquifers constitutes a real danger" (State of Israel 1992).

2.3 The Water Crisis in the Gaza Strip

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

The hydrological situation is very critical as the Gaza Strip is not an area with conspicuous water resources. Rainfall occurs only in the winter months and averages

between about 400 mm/year in the north and 200 mm/year in the southern part of the strip. Because it has no permanent rivers, the strip is wholly dependent upon rainfall on its surface and the immediately adjacent areas. These rains percolate into aquifers or concentrate seasonally into temporary flows (wadis).

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

A recent water balance prepared by the Palestinian Environmental Protection Authority reports a natural inflow into the Gaza Strip aquifer of about 50 mcm, consisting of 40 mcm of rainfall infiltration on the strip itself and 10 mcm inflow from adjacent areas beyond the border in the east (Palestinian Environmental Protection Authority 1994). Other sources give somewhat higher figures mainly due to an assumed higher inflow from Israeli territory. According to data released by official Israeli sources to an investigation team of the European Community in 1992 the natural inflow into the Gaza aquifer consists of 47 mcm of rainfall infiltration and about 20 mcm of eastern groundwater inflow (The Commission of the European Communities 1995). Yet, the Palestinian side claims that this external inflow has been reduced due to pumping from wells adjacent to the border and damming of the Wadi Gaza in its upper catchment area lying in Israel (Tamimi 1991; Palestinian Environmental Protection Authority 1994). The aquifer is additionally fed by irrigation returns and sewage on the order of 20 mcm per year. As will be set below, these infiltrations represent a serious danger for the aquifer's integrity.

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

In the course of the years an enormous deficit has accumulated resulting in a continuous drop in the groundwater level throughout the strip. The general trend is about 15-20 cm per year. The result is that sea water seepage has extended some 1.5 km into the fresh water aquifer. Further to the east, a saline groundwater stratum partly even brinier than sea water underlies the Gaza shallow aquifer. Digging into this deeper layer has perforated the impermeable stratum dividing the two and led to mixing the brackish with fresh water (Shawwa 1993). The salinity of Gaza's groundwater

typically increases at average rates of some 10-15 ppm chlorine annually. Moreover, growing nitrate and chemical concentrations from fertilizers, microbial contamination, and pollution by heavy metals and fuels from sewage effluents are aggravating the hydrological situation. More than 60% of households lack any well-controlled and-organized sewer networks. Waste water facilities are lacking or inoperational (The Commission of the European Communities 1993).

Since the PLO has assumed responsibility in parts of the Gaza Strip the situation even seems to have worsened. Delays in establishing an efficient water administration and resulting lack of monitoring, coupled with the harsh economic situation, led to uncontrolled drilling activity for agricultural and other uses. According to a Palestinian report, by the end of 1994 over 500 new shallow wells had been dug since September 13, 1993, the day the Oslo accords were signed (Center for Engineering and Planning Ramallah 1994). This information corresponds with statements by Israeli inspectors that since Israel's pullout from the Strip the water quality in the area has deteriorated significantly.

2.4 Water Pollution

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

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

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

Industrial and municipal sewage effluents are another source of pollution. Dumping is common in all countries of the region, often directly into water courses or into wadis which, at the next rainfall, allows contaminants to seep into underlying aquifers. A typical example is the Zarqa River in Jordan. It rises near Amman and receives

effluents from industrial suburbs of the capital before entering the King Talal reservoir. It is intended to provide water to irrigate the lower Jordan Valley during the summer months. A treatment plant in Khirbet As-samrah is supposed to decontaminate the water. But, misconceived and too small in size, the plant does not afford its purpose. Silt and other pollutants accumulate in the artificial lake. During years of drought from 1988-1991 this led to a situation in which the authorities were forced to prohibit use of water from the reservoir (Lavergne 1993).

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

2.5 Long-Term Prospects for Changes in Water Balance

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

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

Table 2.2

Fresh Water Availability in the Jordan Basin Region in 1990 Compared to Selected Other Countries in the World

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

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

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

precipitation projections for the region). This would have obvious implications for the amount of water supplied to replenish streams and aquifers. ***Thirdly***, the variability of precipitation might change, resulting in even more accentuated extremes between dry and wet periods.

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

2.6 The Socio-Economic Impact of the Water Crisis

2.6.1 The Importance of Fresh Water Supplies

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

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

For pure survival a human being needs between two and five liters of fresh water a day. Bedouin tribes afford to live with 20-30 liters per capita per day including cooking and washing. For settled populations, 100 liters per person and per day for domestic use are said to be the minimum requirement for safe hygienic conditions and a reasonable

standard of life. Households in industrialized countries typically consume daily 250-350 liters per person in Europe and over 500 liters in North America.

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

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

2.6.2 Water Balances in the Countries of the Jordan Basin Region in the Light of Expected Demographic Growth

Table 2.1 shows the fresh water availability in the Jordan Basin region at the beginning of the 1990s, and compares it to other selected countries in the Middle East and outside. It must be noted that the figures give the de *facto* water availability for each party, thus reflecting not only natural conditions but also the distribution patterns of shared resources. Although with great asymmetries between them, the three core parties of the Jordan Basin region, including Israel, Jordan, and the Occupied Palestinian Territories, all lie under the absolute scarcity line of 500 cubic meters of water per person/year mentioned above. Thus the area belongs to the zones with the lowest per capita fresh water supply in the world, second only to the desertic regions in the Sahara and on the Arabian peninsula. But unlike the oil monarchies on the Arabian Gulf and Libya, the parties in the Jordan Basin region possess neither own energy supplies to desalinate sea water at low costs nor greater reserves of fossil water to mine. They rely basically on the renewable resources supplied by the natural water cycle. Syria and Lebanon, for their part, show higher values. But it must be born in mind that Syria shares the bulk of

its waters with Turkey and Iraq who both claim a part of the water listed in this table. Lebanon, on the other hand, owns the headwaters of the Orontes, which it shares with Syria.

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

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

2.6.3 The Social Impact of the Water Crisis

2.6.3.1 Insufficient Fulfillment of Basic Human Needs

Table 2.3 shows that the greatest water consumer in the Jordan Basin region is agriculture. Nevertheless, the most direct consequences of the lack of water on human life and well-being will be those affecting domestic use. Although demand of private households will by nature be the last sector to be curtailed in a scarcity situation, the water crisis in the Jordan Basin region has had a marked impact on the living conditions of people in their homes (see table 2.4).

Table 2.3
Water Consumption by Sector

	Population (in millions)	Total water consumption	Agricultural (in %)	Industrial (in %)	Domestic (in %)
Israel (1993)	5.1	1,754 mcm	63	6	31
Jordan (1992)	4.3	875 mcm	74	5	21
Palestine (1990 est.) (West Bank/Gaza)	1.8	210 mcm	62	38*	
Lebanon (1990 est.)	3.3	1,060 mcm	74	7	18
Syria (1990 est.)	12.5	9,500 mcm	79	5	16

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

Table 2.4
Daily Domestic Water Consumption per Capita in the Jordan Basin Region (in liters)

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

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

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

constraints imposed by water scarcity situation and by unequal distribution of shared resources imposed on the Palestinians by Israeli Military Rules and Regulations..

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

2.6.3.2 Negative Effects on Human Health

In both Jordan and the Occupied Palestinian Territories the hydrological situation is below supportable standards, and in many places it is imperiling public health. Apart from the quantity crisis, both areas are affected by quality problems as well. While in Jordan and the West Bank this causes widespread nuisances and occasional diseases, the crisis in the Gaza Strip is generalized. Gaza's water resources have been chronically over-exploited for decades, resulting in a constant drop in the groundwater level and intrusion of brine water from the sea and nearby brackish water. Shawwa (1993) states that in 1992, 60% of the water supply had reached a salinity of over 400 ppm, rendering it hardly usable. The problem's order of magnitude is confirmed by other authors who in part draw an even worse picture (Hosh et al. 1992; Bruins & Tuinhof 1991 as quoted in Zarour et al. 1993). Earlier measurements dating back to the late 1980s showed that at the time only 22.5% of the groundwaters analyzed had a chloride content of less than 250 ppm, which is the World Health Organization's guideline limit for drinking water (The Commission of the European Communities 1993). Moreover, the Gaza aquifer is highly polluted by irrigation return flows due to improper agricultural practices and the high porosity of the soils. The nitrate content reached an average of 116 mg per liter in Gaza city, with some wells reaching 280 mg, while the WHO limit is 50 mg (Ahiram & Siniora 1994).

Figures can only give an abstract picture of the discomfort to which Gazans are exposed in their everyday life due to hydrological crisis. The salinity of drinking water is clearly noticeable, since it leaves an unpleasant aftertaste which makes it hard to drink for Westerners. (Note that in Switzerland and in the European Union the quality target for chloride content in drinking water lies 10 times lower than the WHO's

recommendation). But unfortunately the poor water quality is not just a matter of taste; it has serious effects on human health. The continued consumption of water with a high mineral content is likely to increase dysentery, kidney, and cardiovascular diseases, as well as development of gynecological and pregnancy-related pathology (Bellissari 1994).

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

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

2.6.4 The Economic Impact of the Water Crisis

2.6.4.1 Constraints to Agricultural Production

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

To get an idea of agricultural water demands in arid and semi-arid areas, one should keep in mind that 10,000 cubic meters of water to one hectare per year is a fairly typical irrigation rate (Postel 1993). However, water requirements per hectare vary considerably depending on crops, irrigation methods, soil structure, and microclimatic conditions. Where modern irrigation techniques are used, these rates can be reduced by up to about half that amount. On the other hand, in arid areas and for water-intensive crops the irrigation requirements might be twice that and more. In Israel, e.g., the

average irrigation duty was about 6,000 cubic meters per hectare in the mid-1980s, compared with 17,000 cubic meters per hectare in Egypt and some 11,000 cubic meters per hectare in Jordan (Kliot 1994). Translated into product output, these figures mean that growing a kilogram of tomatoes on the Jordanian side of the Jordan Valley requires 118 liters of water. Under the same conditions citrus fruits, bananas, and wheat need 418, 1,383 and 2,352 liters of water per kilogram of output, respectively (Schiffler 1993). Agricultural water requirements can be lowered by technology, but only to a certain degree. In Israel, the pioneer in developing water-saving irrigation methods, irrigation rates still reach 0.6 cubic meters or 600 liters per square meter of land (Kliot 1994).

Table 2.5 shows some further basic indicators related to agriculture and water. Although all parties to the Jordan Basin region are restricted in their agricultural opportunities, the points of departure differ. Syria is the only country with large expanses of arable land, going into the tens of thousands of square kilometers. It must be pointed out, though, that the bulk of these areas is situated in the Euphrates valley and on the Mediterranean coast in the northwest of the country, i.e. outside the Jordan basin region proper. Lebanon, Israel, Jordan, and the Occupied Palestinian Territories, on the other hand, have to content themselves with very tiny areas of fertile land, in part accounting for a small share of their national territory.

Table 2.5
Socio-Economic and Natural Resources Balance Indicators

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

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

(c) Stephan Libiszewski

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

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

Even Israel, which is self-sufficient with respect to many agricultural products and an exporter of fruits and vegetables, is far from self-reliant in its supply of cereals. But the situation is most strained in Jordan, which has to import 80% of its food. This is one of the reasons for a chronically deficitary balance of trade, and , as a result, one of the highest external debt ratios of the world compared to the GNP. If one considers that half of Jordan's present agricultural production is obtained on irrigated land - which constitutes only 15% of the cultivated area - one gets an idea of how much the performance could be improved if enough water was available (Schiffler 1993). (see table 2.6).

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

Table 2.6
Food Security Indicators

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

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

Unlike the oil-producing countries of the Middle East, which have high revenues from their exports and therefore strong trading positions, the parties to the Jordan Basin Watershed belong to the second of these two categories. Their trade balance is chronically negative and, with the exception of Israel, they have very limited resources to improve water management systems and/or diversify their economies.

This situation has been described as being subject to 'food politics', food supplies being an important leverage mechanism to the US - as the main cereal supplier worldwide - to advance a pro- American attitude among countries of the region (Allan 1994; also Kliot 1994)

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

the Occupied Palestinian Territories, the economic dependency on agriculture is far higher, holding shares between 20 to 30% on the relevant indicators (see table 2.7).

Table 2.7
The Socio-Economic Importance of Agriculture in the Jordan Basin Region

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

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

Beyond the strictly economic significance of agriculture, however, one should also bear in mind its socio-political and ecological importance, especially in developing societies; e.g. providing income to the rural population and thus keeping it from joining the already overcrowded cities, helping to stop desertification, and ensuring a certain degree of food self-sufficiency. Another - intrinsically political - dimension of agriculture is that populating and cultivating the land means controlling it physically and symbolically strengthening the claim over it. Especially in the context of the Arab-Israeli conflict this latter aspect has to be taken into account in order to understand all implications of the water issue.

2.6.4.2 Constraints to Industrial Development

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

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

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

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

Since available water resources are already fully exploited, it seems inevitable that further industrial development, in Jordan as in the other areas of the region, will need a shift in the sectoral allocation of water. In the present situation this can only mean at the expense of agricultural use. Economically, this would make sense, since the product value of one cubic meter of water consumed in industrial production is very much

higher than for the same amount consumed for irrigating wheat fields or orchards. In Jordan, for example, productivity per unit of consumed water is 40 times higher in industry than in agriculture, and employment effect is 13 times higher (Schiffler et al. 1994). Comparable values can be assumed for other countries in the region including the Palestinian territories.

2.6.5 The Struggle Over Water Rights as an Integral Part of the Palestine Question

2.6.5.1 Historical Background

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

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

By these measures, Israel is preventing the Palestinians from developing the groundwater resources of the West Bank in accordance with their growing social and economic needs. Since the aquifer is transboundary, this assures unaltered water flow into the Israeli territory. In the meantime, Israel built new Jewish settlements in the Occupied Palestinian Territories. At present, about 140,000 Israeli settlers live on the West Bank and about 3,000-4,000 in the Gaza Strip, in addition to about 160,000 in East Jerusalem (*Neue Zürcher Zeitung*, 18 January 1995, according to figures given by

the Settlement Movement itself; and others). Since settlements are usually supplied with water from local sources, they increased the burden on the limited water supply in the Occupied Palestinian Territories. Moreover, to exacerbate tensions between settlers and the indigenous Palestinian population, the settlers are systematically favored over their Palestinian neighbors regarding water allocation, regularity of supply, and pricing. While in 1992 Jewish settlers on the West Bank had at their disposal 50 mcm of water for a population of approximately 125,000 at the time, Palestinian consumption amounted to 110 mcm for more than one million people, thus showing a ratio in per capita use of nearly 4 to 1 in favor of the settlers. In the Gaza Strip, despite relatively low total consumption by the settlers (due to their limited absolute number), per capita ratio of use between the two communities shows even more disproportionate levels of 12:1 and more (Assaf et al. 1993).

2.6.5.2 The Israeli - Palestinian Water Conflict Setting

As a result of these policies, Israel, including the settlers, is presently utilizing nearly 80% of the shared waters of the West Bank, while Palestinians are left with less than 20%. To compound the inequity, Palestinians on the West Bank are forced to pay higher rates for their water supply. Many different figures have been published on this matter (e.g. Elmusa 1993; Beschorner 1992; Brooks & Lonergan 1994). These reflect variations between areas and whether Palestinian consumers are supplied by Mekoroth or by local Arab sources. However, all agree that there is a high imbalance between prices paid by the settlers and those demanded of their Palestinian neighbors. According to Brooks & Lonergan (1994), Mekoroth charges Palestinian municipalities 1.8 New Israeli Shekels (NIS) - about US$ 0.90 - per cubic meter and NIS 2.1 -per cubic meter for individuals, whereas it charges Israeli settlements only NIS 0.5 on the West Bank and NIS 0.3 in the Gaza Strip. They conclude "that the issue is not the absolute price that Palestinians pay for water, which may indeed reflect real costs. The issue is one of blatant and formalized discrimination on the part of the Israelis" (see table 2.8).

Table 2.8
The Distribution of West Bank Waters

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

Source: Assaf, Karen: al khatib, Nader; kally, Elisha; Shuval, Hillel (1993): A proposal for the Development of a Regional Water Master Plan. Israel/Palestine Center for Research and Information PCRI : Jerusalem (c) Stephan Libiszewski

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

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

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

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

In the Gaza Strip, the hydropolitical situation is the opposite of that on the West Bank. Since the Gaza aquifer is in part recharged by water inflows from the adjacent Israeli territory, replenishment depends on Israeli behavior. Palestinian sources claim that, due

to groundwater extraction by Israeli wells near the border and construction of low dams upstream in Wadi Gaza, Israel is diminishing the natural recharge of the aquifer (Palestinian Environmental Protection Authority 1994). Palestinian authors often point out the contradiction between Israel's insistence on its downstream riparian rights to the West Bank groundwaters on one hand, and its practice of making the best use of its upstream position in the case of the Gaza Strip aquifer on the other.

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

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

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

development (see also the well done survey on Israeli-Palestinian claims and counterclaims in Shuval 1993).

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

- The *nature of the Palestinian political entity* which is supposed to be established in the Occupied Palestinian Territories as an outcome of the negotiations is intimately linked to the powers this entity will have over natural resources. Whether it will be an independent state or state-like entity, or just an autonomous body with administrative powers over people, will influence its ability to reclaim own "water rights". The latters are understood as sovereignty rights over state land and national resources (in opposition to the simple *individual human* right to a life-sustaining water supply). From the Palestinian perspective, the claim to water rights is a logical and integral part of their national aspirations. From the Israeli viewpoint, this might be one of the reasons for denying them a full right to statehood.
- The future of *Jewish settlements* in the Occupied Palestinian Territories is obviously linked to the water dispute. Since the settlements are mainly supplied with water from local sources, their consumption occurs directly at the expense of the Palestinians. As long as the settlements remain in the territories, this will always raise the question from which sources and according to which standards they will be supplied.
- Relating to the permanent status of the Occupied Palestinian Territories, the dispute over water rights is narrowly linked to the question of the *definitive borders* of an eventual Palestinian State. The territorial extension of Palestine will determine access to wells and springs, and consequently the claim to water rights and shares. The question is very delicate because the storage area of the Mountain Aquifer where the best pumping sites are located stretches along the plain on both sides of the border between Israel and the West Bank. Although not specifying details, Israeli officials always stress that an eventual independent Palestinian entity will not encompass the whole West Bank but that Israel will insist on territorial adjustments. Now, Israeli strategists who are designing plans for the permanent settlement propose to shift the border

between Israel and the West Bank to the East, annexing just that strip of land where most wells and springs are located. The argument that the strip in question is only a few kilometers large and that ceding part of this area could be compensated by territorial exchanges in other sections of the border (Alpher 1993) is misleading, since by that shift the Palestinians would lose the greatest part of their water resources.

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

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

2.7 Water Management Options for the Jordan Basin Region

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

The second approach, which will be referred to in the following as the *political* one, views the water conflict as a question of shared resources distribution. The instruments resorted to for dealing with the problem from this perspective belong to the field of international law and might be called *water diplomacy*. However, the main emphasis lies in the argument that an integrated political-technical approach is required for coping with the water conflicts in the Jordan Basin region.

2.7.1 Supply-Side Water Management Options

2.7.1.1 Fully Developing Existing Resources

In a situation of scarce water availability, management will presumably first try to develop remaining natural resources. Unfortunately, no unused river or groundwater body remains in the Jordan Basin region. But increased catchment of winter flood water

anywhere along an already partially used system can also add resources to the water budget. The most important single source not fully developed is the Yarmouk River. Since no storage facility on the river's main stream has been built so far, an estimated 60-150 mcm/year of the winter floods still flow unused into the Dead Sea via the Lower Jordan (Shuval 1993). Building a storage system on the main stream of the Yarmouk is one of the measures called for in the Israel-Jordan peace treaty of 1994. Thus, this option will presumably be realized in the near future.

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

2.7.1.2 Water Harvesting

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

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

relief for domestic supply. If stored for use during the summer months, they would be a welcome alternative to the very expensive delivery by water trucks.

2.7.1.3 Mining Fossil Water

Below all Middle Eastern countries bordering the Sahara-Arabian deserts extend thick layers of sandstone which in some areas contain large quantities of groundwater. These aquifers are called fossil because they were collected at greater depth during earlier geologic ages when other climatic conditions prevailed in the area. At present, they have no recharge rate or only a very low one. Some countries, among them Libya and Saudi Arabia, have already started using these stocks on a large scale (Postel 1993). In Israel and Jordan fossil water is pumped in some areas in the south of the two countries. Some authors have proposed augmenting these extractions as a temporary safeguard against strife (Issar 1994). However, the data basis on the reserves in the Jordan Basin region is uncertain. In general, they seem to be much smaller than in other areas of the Middle East. For the northern Negev, Issar (1994) concludes that extractions could be increased from 20 mcm/year at present to 50 mcm/year if certain precautions are taken. For Jordan, studies have concluded that some 100-150 mcm/year can be exploited in the south for a period of 50 years, including what has already been tapped (Al-Fataftah & Abu-Taleb 1992). But the greatest problem is that fossil supplies are finite and thus will last only for a limited time anyway.

2.7.1.4 Cleaning up Polluted Sources

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

2.7.1.5 Wastewater Recycling

After having exploited all remaining natural resources, a supply-oriented water management strategy will go on to develop new resources. A first promising source of unconventional, technology-intensive supply consists of purifying and reusing industrial and domestic wastewater. It is assumed that about 65% of the water consumed by industry and the households can be recycled if collected by sewage systems and properly treated (Assaf et al. 1993). At present, between 20% and 30% of total water consumption in the countries of the Jordan Basin region is attributable to the private and industrial sectors (see table 2.3). This share is likely to increase rapidly as a consequence of population growth, improvement of living standards, and economic development. Assaf et al. (1993) have estimated that in the year 2023 Israel and

Palestinians on the West Bank and in the Gaza Strip will have available some 650 mcm/year and 325 mcm/year of wastewater respectively (the latter figure presupposes, however, that in the future Palestinians will get a substantially larger share of the waters shared with Israel). With similar standards applied to Jordan, the Kingdom will produce some 500 mcm/year of wastewater as well. In sum, these quantities make for more than half of the presently available renewable fresh water sources in the area. Without fully developing these resources, there will be only small quantities of endogenous water for agriculture.

In the Middle East, Israel has been a pioneer in recycling wastewater. At the beginning of the 1990s, 90% of the wastewater in Israel was seweraged, and about 70% was reused, accounting for 195 mcm/year of water, or about 10% of total supply. By the end of the century, recycled wastewater could provide as much as 400 mcm/year (State of Israel 1992). Yet throughout the rest of the region, wastewater reclamation has a great expansion potential. On the West Bank and in the Gaza Strip most cities and all villages still lack sewerage systems to collect wastewater, although such systems are presently under construction in some towns (Sbeih 1994). In Jordan, sewerage systems and treatment plants have been built or are under construction in most towns. However, only a minor part of that is beeing purified. It was expected that treated wastewater reuse would provide about 45 mcm/year of irrigation water by 1995 (Al-Mubarak Al-Weshah 1992). Compared to some 230 mcm/year of water consumed in the domestic and industrial sector, this is an amount which still leaves a great potential to be exploited.

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

2.7.1.6 Sea Water and Brackish Water Desalination

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

The greatest constraint to widespread use of sea water desalination is its cost. In fact, the technology remains very expensive, making it currently impracticable for most

applications. A survey submitted by the Commission of the European Communities (1993) at the multilateral talks on water shows typical product costs between US$ 1 to US$ 1.7 per cubic meter, depending on process techniques and scale of application. Some Israeli companies active in the business have been offering plants on the drawing board which are supposed to desalinate sea water at product water costs of U.S$ 0.65 to 0.70 per cubic meter (Hoffman 1994). However, product costs of the plant do not include expenses for water storage and transport from plant to consumer. Thus, even if these relatively low figures are accepted as realistic, total water cost for the consumer would probably amount to at least around U.S$ 1.

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

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

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

2.7.1.7 Water Imports

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

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

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

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

2.7.1.8 Canals From the Oceans to the Dead Sea

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

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

As regards environmental effects, the main problem is that the balance between water inflows into the Dead Sea and evaporation from its surface is a very complex matter. Among other things, it depends on the salinity of the water, and on possible macro- and microclimatic changes, possibly even induced by the artificial input of sea water. Such

a balance is therefore not easy to achieve and much less to foresee. Miscalculations and unexpected effects might result in flooding a greater area than originally planned or require decreasing sea water input, inevitably jeopardizing the project's economical viability. Moreover, studies prepared by Jordanian hydrologists in the 1980s warned that even stabilization of the Dead Sea water table at the planned level of -390 meters below sea level would increase salinity in the nearby fresh water aquifers, submerge several inhabited centers, roads as well as tourist establishments, and affect the potash extraction works in the southern part of the lake. Increased pressure on the Dead Sea bottom by the greater volume of the lake might also increase the likelihood of earthquakes and volcanic eruptions in this area very prone to tectonic activities (Hamadneh 1985 also Salameh 1985).

2.7.2 Demand-Side Water Management Options

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

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

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

2.7.2.1 Water Conservation in Municipal and Domestic Uses

Municipal use of water includes a great variety of end uses, such as fighting fires, cleaning, irrigating parks, public swimming pools, and supplying households and businesses. Opportunities for conservation and use of recycled water at the user level are evident. However, the first aspect of the municipal system to be addressed is the system itself: reducing pressure, valve maintenance, and, above all, repair of leaks. Unfortunately, the latter problem is widespread in the Middle East. In Jordan and the Occupied Palestinian Territories, losses in the municipal networks amount to 55% of the carried water due to leaks in pipes and careless operation (Beschorner 1992; Center for Engineering and Planning Ramallah 1994). Even in Israeli cities water losses of 10 to 15% are quite common, with peaks up to 30% (Brooks & Lonergan 1993). Identification and repair of leaks in the water distribution system is expensive and requires an efficiently organized administration. But generally it is one of the most immediate and cost-effective ways of decreasing water demand.

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

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

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

Investigations are needed to assess the economic viability of such systems on a large scale.

For those housing units with external space, lawn and garden watering, as well as private swimming pools typically make up the bulk of residential water uses. These latter end uses, however, are more responsive to price than other domestic uses (Brooks & Lonergan 1993). Thus, progressive water charges for those uses exceeding the minimum requirement of 100 liters per capita per day might provide the right incentives to change habits and/or take measures to recycle water within the households.

2.7.2.2 Water Conservation in Commercial and Industrial Uses

Commercial and industrial water uses in the Jordan Basin region are relatively low, adding up to 5-7% of total water consumption (see table 2.3). But their importance is growing. For most commercial uses of water in the tertiary sector, *e.g.* the hospitalization industry, much of the technologies appropriate for residences are equally applicable, and others, such as self-closing valves, can be added. A Swiss company, marketing water-saving sanitary equipment, typically obtained savings of 30% and more by installing taps and shower heads which blend air into the water, and automatic flow-variable toilet flushes in the rooms of hotels and lavatories of restaurants. These systems had a payback within a few months, sometimes even within weeks. It is difficult to estimate what the savings might be in Middle East countries, since the starting point is different from Western Europe. But a study on use of water saving devices carried out in Jordan by the Consultant indicates that there is a great and mostly undeveloped potential.

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

Israeli industry also already seems to have comparatively high water-efficiency standards (Brooks & Lonergan 1993). Thus future industrial water demand in the Jordan Basin region is likely to increase in proportion to productive output. Nevertheless, price regulations might give the right incentives to optimize water

efficiency further. Industry is the sector with the highest value output per water unit consumed. It therefore seems to be that branch which could best afford water price increases without being unduly affected in its overall productivity and competitiveness.

2.7.2.3 Improving Irrigation Efficiency

Since 65-70% of water in the Jordan Basin region is used in agriculture, this is where conservation measures will have the greatest impact in absolute terms. As in the municipal sector one must discern water conservation at the network and end-user level. Intervention at the farm level offers the largest saving potential, although improvement in overall distribution systems may also help saving considerable amounts of water. (see table 2.9)

Table 2.9
Water Efficiency of Different Irrigation Techniques

Surface Irrigation	40 - 70 %
Sprinkler Irrigation	60 - 85 %
Drip Irrigation	70 - 95 %

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

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

Yet these techniques are already widely applied in the Jordan Basin region. Israel has been the pioneer in developing water-saving irrigation technologies. Modern techniques are applied today on the whole irrigated area, and half of it is under drip (note that drip-irrigation is not applicable everywhere, and sprinkler irrigation performs better for

some crops). The efforts to increase the efficiency of agricultural water use at the farm level have been highly successful. Total irrigation water consumption reached a peak of 1,434 mcm in 1985-1986 and is slowly decreasing since then (1993: 1,112 mcm), although agricultural output has continued to increase both in product quantity and value. Water consumption per hectare has declined from nearly 6,400 cubic meters per hectare in 1975 to 4,500 in the late 1980s (Kliot 1994). Over the same period of time the volume of water consumed per one U.S.$ of agricultural output has declined by half, from 1.53 to 0.75 cubic meters (Fishelson 1994).

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

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

In Jordan, 26% of irrigated land is still fed with open surface canals, above all the northern section of the King Abdullah Canal. After more than 30 years of operation, the condition of this network has markedly deteriorated and its conveyance efficiency averages only 60%. That means that 40% of the water carried is lost before reaching the farms. Moreover, farms fed by open conduits are more reluctant to introduce modern drip-irrigation systems, since they need further investment to pressurize the water. In the southern section of the King Abdullah Canal, which consists of pressurized pipes, losses still amount to 15% due to leaks in the conduits and improperly operated sluices and valves. Therefore, while Jordan's water efficiency is fairly high at the farm level (76%, see above), the combined efficiency of water conveyance and farm irrigation is only 55% (Schiffler 1993; The Kingdom of Jordan 1992). Thus investments in modern conduit infrastructure, better monitoring and maintenance, and the synergy effects these would produce at the farm level would help to save considerable quantities of water.

Another form of improving agricultural water efficiency is development of species with a greater output per water unit or of salt-tolerant crops. Citrus trees, for example, cannot tolerate briny water at all, while olive, fig, and date trees can. Broccoli, tomatoes, spinach, beets and other vegetables also tolerate a certain degree of salinity (Brooks & Lonergan 1993). Salt tolerance can be improved by selecting seeds and

crossing species, as has been done to optimize other characteristics of crops since time immemorial. Brackish water is used in Israel to irrigate certain crops, and on an experimental level tomatoes have even been grown with sea water. However, irrigating with saline water affects the soil and must therefore be practiced very cautiously.

2.7.2.4 Water Re-Allocation Among Uses and Economic Sectors

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

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

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

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

The situation is somewhat different in neighboring Arab states and the Occupied and Autonomous Palestinian Territories. Jordan, for example, is no longer an agrarian society, as one might possibly assume. In fact, the country has a high level of urbanization (70%), and the agriculture's contribution to the GNP is only 7%. Somewhat higher is the agriculture's share of total labor force and exports (both 10%; see table 2.7). On the other hand, Jordan's overall economic indicators are far less promising than Israel's. Its GNP is covered to a considerable extent by foreign aid and the transfers of Jordanian migrants working abroad. 25% of the labor force is unemployed, and public resources to finance economic restructuration are limited. Nevertheless, some long-term adjustments aimed at gradually reducing irrigated agriculture and promoting water-saving industrial and commercial activities seem inevitable (Schiffler 1993).

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

2.7.2.5 Water Pricing

Taken all together, the many ways of conserving, recycling, and reallocating water resources constitute the makings of an efficiency revolution. Yet these changes need to be induced by incentives capable of consistently enforcing water-saving measures on both the micro- and macro-level. There is a consensus among experts that price

mechanisms have to play a central role in managing water demand and stimulating development of affordable sources of additional supply. As in many other places of the world, a great part of water wastes and misallocations in the Jordan Basin region stem from the failure to value water at anything close to its true worth. Grossly underpricing water perpetuates the illusion of the people that it is still plentiful and makes it uneconomic to apply water-saving measures. On the macro-economic level, it favors misallocation (Postel 1992).

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

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

In the Occupied Palestinian Territories, water taxes charged by the Israeli administration have been very high and discriminatory. Along with the constitution of a Palestinian water administration of their own, the primary tasks advocated by Palestinian experts themselves seem to be introducing graduated charges for both domestic and agricultural use, and establishing an effective fee collection system (Center for Engineering and Planning Ramallah 1994). However, the danger is that, due

to administrative inefficiency and/or short-sighted measures to gain public support, these steps might not be taken with enough determination.

2.7.2.6 Regional Water Allocation Through Trade in Markets for Water Rights

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

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

2.7.2.7 Last But Not Least: Halting Population Growth

Speaking about demand management, one should not forget the currently most important drive to increase demand: ***demography***. Population growth rates in the Middle East are among the highest in the world, and the Jordan Basin region is no exception to that. The Arab countries in general show growth rates of more than 3% due mainly to a high fertility (but due also to refugee influx as a consequence of political events). Israel has been compensating for its lower natality by an active policy of promoting immigration of Jews from all over the world. In the 1990s, mainly due to the influx of hundreds of thousands of Jews from the former Soviet Union, Israel boasted a growth rate of 2.6% (see also table 2.2).

A growing population affects the domestic demand in direct proportion, as well as indirectly, by increasing demand for goods and services, and the demand by the other sectors. Any of the policies of water management discussed will only delay the moment of collapse, if population continues to grow. Dealing with family planning and immigration control as a means to limiting water demand touches a series of complex socio-economic, cultural, and ethnic domains which go beyond the purposes of this study. Unfortunately, demographic patterns and policies in the Jordan Basin region are also very intimately linked to the very political roots of the Arab-Israeli conflict. In

competing over land, Arabs and Jews always saw the demographic balance between each other in terms of national security and existence. Gaining (or keeping) the demographic majority on the territory of historical Palestine is still seen, by both sides, as a means to enforce own political claims. Thus, the result are policies to promote natality and/or immigration.

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

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

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

2.8 Water in the Accords Between Israel and the PLO

While the Israeli-Jordanian Peace Treaty was the final stroke under a longer negotiation process, fully normalizing relations between the two countries, the same cannot be said of the agreements between Israel and the PLO. The widely regarded "Declaration of

Principles on Interim Self-Government Arrangements" between Israel and the Palestinian Liberation Organization of September 13,1993 must rather be characterized as the starting point of the process. Through their mutual recognition, Israel and the PLO only created the pre-conditions for serious negotiations. Peace itself still remains to be achieved.

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

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

2.8.1 The Declaration of Principles

Thus, the following analysis of the status of Palestinian water rights during the interim period is based on still unfinished work. The Declaration of Principles itself fails to make clear the extent to which water should be under Palestinian control during the interim period. In Article VII (4) of its main body, the treaty stipulates the constitution of a "Palestinian Water Administration Authority" to be established after the Interim Agreement within the framework of the Palestinian Council. But it is not made explicit whether "administration" only means management of water distribution systems and wastewater collection or if it includes some kind of jurisdictional control over the resources themselves.

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

2.8.2 The Gaza-Jericho Agreement

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

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

Yet, the political position of the Palestinians could have been improved if the Cairo Agreement had served as a model for the Interim Agreement and thus the powers granted in it would later be transferred to the whole West Bank. Unlike Gaza and Jericho, the West Bank is a water surplus area, and lies upstream of Israel. Jurisdiction over the waters of the West Bank would, at least formally, put the Palestinian Authority in a more convenient position. However, extension of the powers granted from Gaza and Jericho to the rest of the Occupied Palestinian Territories was not foreseen as an automatism. The Gaza-Jericho Agreement itself states in Article XXIII (5) that

"Nothing in this Agreement shall prejudice or preempt the outcome of the negotiations on the interim agreement or on the permanent status (....)"

2.8.3 The Interim Agreement

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

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

However, it is likely that Israel will achieve its main water-related demands during the interim's period. For according to the Taba Statement, the West Bank will be divided into three areas; A - the urban areas, B - the rural areas inhabited by Palestinians, and C -everything else, including state land, Israeli settlements, military installations and areas important from a security standpoint (e.g. the border region in the Jordan Valley).

Before Palestinian elections, Israeli army will withdraw from area A and redeploy in area B. This is only 27% of the West Bank area. In area C, only civil powers unrelated to territory will be transferred gradually to the Palestinians. In a later, three- staged phase to be completed in 1997 "powers and responsibilities relating to territory will be transferred gradually to Palestinian jurisdiction (....), except for the issues that will be negotiated in the permanent status negotiation". This seems to imply exclusion of water rights from talks on Palestinian self government in the interim phase, since according to Israeli interpretation of the Declaration of Principles, question of water control and distribution is part of the political core issues which shall be addressed only in negotiations on permanent status. These talks were scheduled to begin in May 1996 and to last another three years.

In Fact, on 24 August 1995 the two sides reached a further agreement on principles concerning the water issue which seems to confirm this position. In the document Israel officially recognizes " Palestinian water rights in the West Bank". But in return the Palestinians had to agree to postpone discussion on definition of these rights until negotiation on permanent settlement (Ha'artez, 25 August 1995, as reported by Israel Line, 25 August 1995). Will the rights include jurisdictional control over resources or just entitlement to certain water amounts? And which amounts of water are implied? Especially, is any increase in the Palestinian quota foreseen? These important questions remained unclarified. Thus the agreement is unsatisfactory for the Palestinian side.

2.8.4 The Israeli-Palestinian Water Dilemma

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

Issues of water management and water distribution are simply not separable. The reason for this lies in the fact that improved management is normally coupled with high economic, social and/or political costs. This is especially the case when management options imply development of unconventional resources like sea water desalination or water imports from distant regions or restructuring of water-intensive branches like irrigated agriculture. An implication of such projects within original framework will always pose the question of who will bear the burden. Each party will compare costs of

additional water with costs of conventional resources. And no party will agree to expensive solution if it believes in its outstanding claims to existing supplies.

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

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

2.9 The Multilateral Working Groups on Water and Environment

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

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

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

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

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

However, in their proper range of action, the single working groups showed quite different practical results. The group on the environment probably was the most

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

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

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

The reasons for this meager outcome lie in part with political obstacles encountered during the talks. First of all, the multilateral talks have so far been boycotted by Syria and Lebanon, which argue that the Arab states should not discuss functional matters prior to a settlement of political core issues at the bilateral talks. Thus the original idea of enforcing basinwide cooperation in the Jordan River Basin was undermined from the very beginning. Furthermore, differing views of those participating also burdened the discussions and impeded greater breakthroughs. On the one side, Israel insisted on purely technical matters, arguing that pragmatic steps in joint water management

should be dealt with independently from the question of water rights and shares. The latter, in this view, belong to the political sphere and thus must be discussed in the bilaterals. The Palestinians, on the other hand, insisted especially on this political dimension of the issue. They saw settlement of the question of water rights and shares as a precondition to cooperation and thus as pivotal to regional water management.

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

CHAPTER 3

(This chapter was abstracted from a report titled "Task 4 : Comprehensive Planning Framework for Palestinian Water Resources Development", Final Report, Volume 2-Text, 6 July 1997. This report was prepared for the Palestinian Water Authority as a part of a program funded by the U.S.AID Contract No. 294-C-00-96-90560-00), and assisted by CDM/Morganti, Contractor : Camp Dresser Mckee International Inc., Deliverable 4.03)

3. Existing Conditions of the Palestinian Water Sector

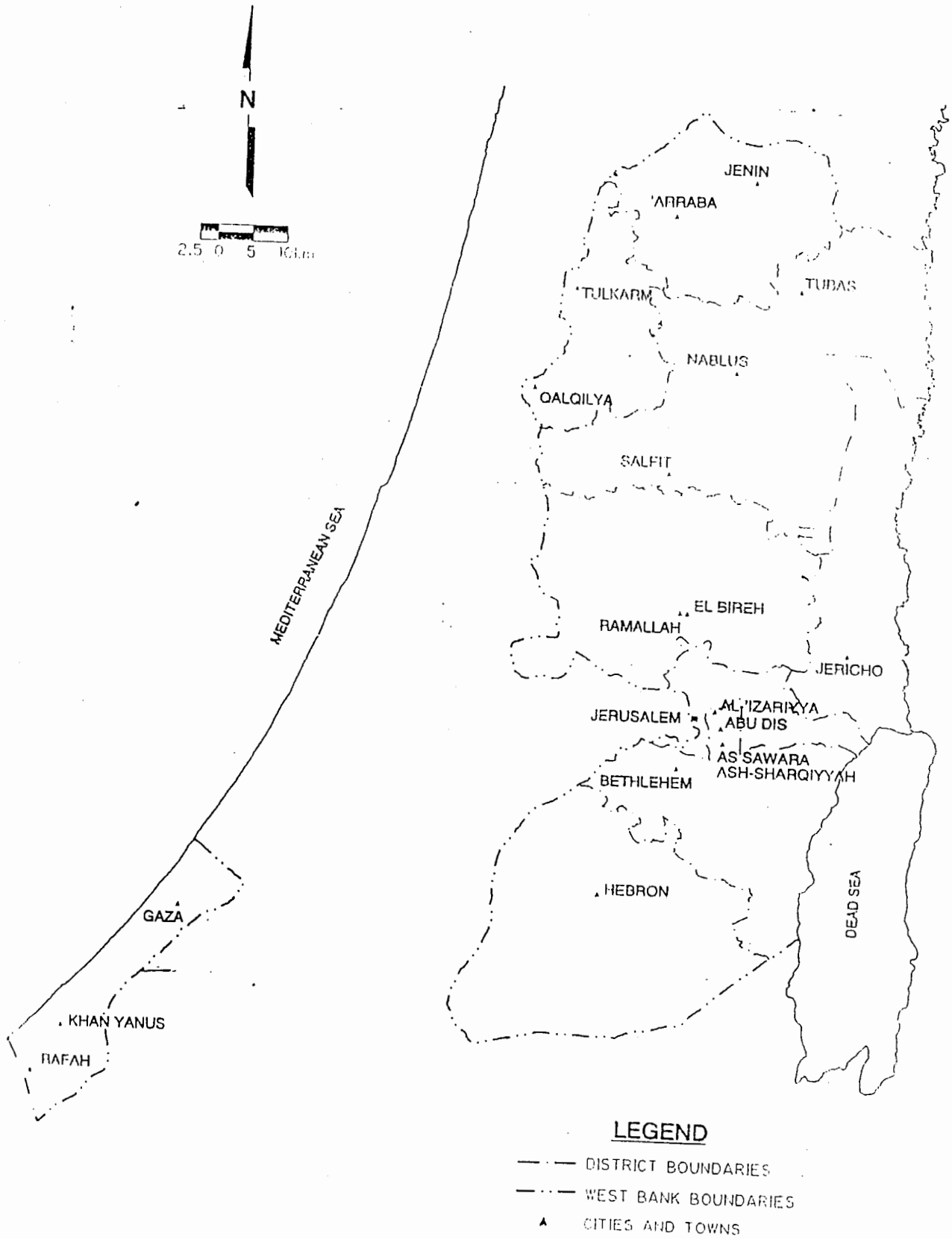
The Project Area consists of two non-contiguous areas, the West Bank and the Gaza Strip, as shown in Figure 3-1. The Project Area contains a population of more than 2.5 million people, with urban densities varying from about 4,000 persons/km^2 in Jericho to 12,000 persons/km^2 in the Gaza Strip, and a demand for water that far outreaches the available supply. Agriculture is currently the most important economic sector; however, only about one-sixth and one-half of the irrigable lands are irrigated in the West Bank and the Gaza Strip, respectively. Much of the water resource that is or could be utilized in the Project Area is regulated and shared with other regional interests. Historic water demands in the Project Area have been constrained resulting in consumption rates that are among the lowest in the world. Commercial and industrial development is limited with the major endeavors in the areas of food, textiles, and quarrying.

3.1 West Bank Area

The West Bank Area has an area of approximately 5,570 km^2 (Including East Jerusalem). Most of the area of the West Bank is considered mountainous except for the lands in the Jordan Valley, bounded by the Beisan Valley in the north and the Dead Sea in the south, and some coastal plain areas in the Tulkarm District. The main axis of the mountain series in the West Bank runs north-south, parallel to the Jordan Valley. For the purposes of compilation of data and description of the existing situation, the West Bank has been divided into eight districts : Jenin, Nablus, Tulkarm, Ramallah, Jerusalem, Bethlehem, Hebron, and Jericho.

Land Use

On the basis of estimates provided by the Palestinian Ministry of Agriculture (MOA), the total area of cultivated land in the West Bank is approximately 1,700 km^2 which accounts for about 30 percent of the total land area. A total of 100,000 dunums (du), or approximately 6 percent of the cultivated land is irrigated. The remaining 94 percent of the irrigable area is rain-fed. Pastures, forests, and grazing land represent about 28 to 30 percent of the total land area and cities, towns, and villages account for about five to six percent. This built-up area estimate does not include 21 refugee camps, which have an area of about 6,400 du. The remaining lands are mountainous or unusable. The amount of cultivated and built -up land areas has remained nearly the same for the past 30 years.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JERUSALEM
AL 'IZARIYYA
ABU DIS
AS SAWARA
ASH-SHARQIYYAH
BETHLEHEM
HEBRON
DEAD SEA
GAZA
KHAN YANUS
RAFAH
LEGEND
DISTRICT BOUNDARIES
WEST BANK BOUNDARIES
CITIES AND TOWNS

Figure No. 3-1

A total of 176 Israeli settlements also exists in the West Bank. These settlements are widely distributed throughout the area. The urban area of these settlements occupies about 81,200 du (PALGRIC, 1995) or approximately 1.5 percent of the land area of the West Bank. A portion of the cultivable area of the West Bank has been lost due to construction of these settlements, particularly in the Nablus and Jericho Districts.

Population

According to PCBS population estimates for mid-1996, there are about 1.6 million Palestinian inhabitants of the West Bank and it is estimated that about 400,000 additional persons will return to the West Bank area in the next several years. Table 3.1 provides a summary of population by district. It should be noted that the population estimate of Ramallah District in Table 3.1 is slightly higher than the PCBS 1996 estimates. This is because population estimates for Al-Bireh and Ramallah Municipalities used in this report (i.e., 40, 700 and 27,000, respectively) are based on a recent GTZ study (Dahlem, 1996) which was conducted to verify basic data for the design of the Al-Bireh wastewater disposal system.

Table 3.1
Estimated 1996 Palestinian Population in the West Bank

District	Population
Jenin	183,000
Tulkarm	176,000
Nablus	289,000
Ramallah	248,000
Jerusalem	227,000
Bethlehem	140,000
Hebron	294,000
Jericho	28,000
Total	**1,505,000**

Population densities vary dramatically throughout the West Bank. The present gross population densities (i.e., total population divided by the total land area) in the West Bank ~~are~~ estimated to vary from 80 to 642 person/km^2. The net population densities (i.e., total population divided by the total built-up land area) are estimated to vary from 4,263 persons/ km^2 in Jericho to 8,454 persons/ km^2 in Tulkarm, with an overall average of 6,747 persons/ km^2. (In Gaza, by comparison, the densities are estimated to be substantially higher, at 2,638 and 12,000 persons/ km^2 for the gross and net population densities, respectively. In refugee camps, the population density exceeds 20,000 persons/ km^2, and reaches about 100,000 persons/ km^2 in Beach Camp outside Gaza City). Table 3.2 presents a summary of population density estimated for the West Bank districts.

Table 3.2
Estimated 1996 Population Densities in the West Bank

District	Population	Area[1] (km^2)		Population Density (persons/ km^2)	
		Built-up	Total	Net[2]	Cross[3]
Jenin	183,000	23.1	592	7,918	308
Tulkarm	176,000	20.8	333	8,454	528
Nablus	289,000	39.6	1,548	7,306	183
Ramallah	248,000	32.7	794	7,573	312
Jerusalem	227,000	36.5	333	6,236	683
Bethlehem	140,000	24.6	581	5,698	241
Hebron	294,000	51.1	1,083	5,752	272
Jericho	28,000	6.6	351	4,263	80
Total	**1,585,000**	**234.9**	**5,651**	**6,747**	**281**

[1] Area estimates from PALGRIC (1996).
[2] Net density equals total population divided by built-up area.
[3] Gross density equals total population divided by total area.

Agriculture

Agriculture is currently the most important sector in the West Bank. The total cultivated land amounts to about 1.7 million du of which about 6 percent or 97,000 du are irrigated and 94 percent is rain-fed. The area of irrigated agriculture is presented in Table 3.3 for each district by aggregations of the two major crop types. Field crops are grown on about 31 percent of the rain-fed lands, vegetables on about 6 percent, and orchards are grown on about 63 percent of these lands. According to a land survey conducted in 1968 by the Department of Agriculture in the West Bank (Table 3.4), the area of potentially suitable lands for irrigated agriculture was estimated to be about 612,000 du.

Table 3.3
Irrigated Agriculture in the West Bank

District	Area (du)		
	Vegetables	Orchards	Total
Jenin	3,800	2,000	5,800
Tulkarm	15,300	13,900	29,200
Nablus	11,000	6,400	17,400
Ramallah	600	300	900
Jerusalem	-0-	-0-	-0-
Bethlehem	800	400	1,200
Hebron	800	2,500	3,300
Jericho	24,900	13,800	38,700
Total	**57,200**	**39,300**	**96,500**

Table 3.4
Potentially Irrigable Lands in the West Bank

District	Area (du)
Jenin	163,000
Tulkarm	45,000
Nablus	199,000
Ramallah	35,000
Jerusalem	3,000
Bethlehem	12,000
Hebron	110,000
Jericho	45,000
Total	**612,000**

Commerce and Industry

Development of the industrial sector in the West Bank, like other sectors, has been restricted during the last 30 years due to political instability and rules applied by Israel. There are about 300 water-intensive industrial facilities (Abd-Alraziq, 1991) distributed among the various districts. Table 3.5 includes a breakdown of these industrial facilities in the West Bank.

Table 3.5
Industrial Facilities in the West Bank

District	Number of Establishments			
	Food	Textile	Quarry	Total
Jenin	1	2	10	13
Tulkarm	10	13	21	44
Nablus	20	10	20	50
Ramallah	12	10	12	34
Jerusalem	9	2	2	13
Bethlehem	8	13	19	40
Hebron	18	25	55	98
Jericho	3	2	2	7
Total	**81**	**77**	**141**	**299**

Electric Power

Nearly all electric power is supplied by the Israel Electric Corporation (IEC). The distribution systems are generally operated by municipalities, with some exceptions where system is operated by the Israeli Jerusalem District Electricity Company (JDEC). The power supply network is limited, with nearly 140 villages without service. These villages receive part-time supply from diesel generators. The total supply for year 1992 was estimated to be about 120 MW, and an average production rate of 620 Kwh per capita (World Bank, 1993c). The system experiences high losses at an overall rate of about 20 percent. The load factor (LF), which is the ratio of the average to peak demand, or ratio of energy delivered over maximum demand, was estimated for that period at approximately 73 percent, reflecting a supply of approximately 30 to 50 percent of the demand. The bulk cost of power from the IEC during the early 1990s ranged between U.S$0.08/KWh to U.S$0.10/KWh (World Bank, 1993c: CEP, 1993b). Bulk (industrial) customers of the JDEC pay up to U.S$0.13/KWh, whereas customers of municipalities may pay up to US$0.17 (e.g., Nablus). Electricity rates for diesel generators ranges between U.S$O.11/KWh and U.S$0.17/KWh.

Economy

In recent years, the economy of the West Bank has fluctuated significantly in response to political events, both within the West Bank and in neighboring areas. The real gross domestic product (GDP) of the West Bank fell by about 8.5 percent, from approximately U.S$2.81 billion during 1992 to U.S$2.57 billion in 1996 (UN, 1996). The corresponding per capita GDP was estimated at U.S$2,167 and U.S$1,591, respectively, reflecting a decline of about 26.5 percent. Similary, the real gross national product (GNP) declined by about 24.5 percent from U.S$3.64 billion in 1992 to U.S$2.75 billion in 1996. The corresponding per capita GNP fell by approximately 39.4 percent from U.S$2808 to US$1700.

The labor market in the West Bank also fluctuates in response to political events, particularly to the Israeli closure of the territories. The labor force in the West Bank grew from approximately 200,000 in the early 1990's (World Bank, 1993a; 1993b) to about 350,000 in mid-1996 (UN, 1996). This growth of the labor force was not coincident with a growth of the job market as manifested by the rise in the unemployment rate, which increased from approximately 4 percent to 24 percent during the same period.

The distribution of the labor force among the various economic sectors experienced a distinct shift from agriculture to the industrial (including construction) and service sectors. Employment in agriculture steadily decreased from nearly 45 percent in the early 1970s to less than 20 percent in 1996. The labor force fluctuated between 16 and 18 percent in the industrial sector, and between 9 and 12 percent in construction. The labor force in the service and government sectors, however, grew from about 27 percent to nearly 50 percent. A marked increasing trend in the industrial, service, and public sectors occurred due to the recent changes in the political environment and ongoing reconstruction and development. It should be noted, however, that a sharp decrease in the employment is always observed in response to frequent Israeli closures and restrictions.

The contribution of the various economic sectors to the GDP also reflected these various economic trends (World Bank, 1993a; 1993b; 1993c). The contribution of agriculture, forestry, and fisheries to the GDP fell from about 36 percent in the early 1970s to about 25 percent in late 1980s. Between 1988 and 1992, however, the contribution of agriculture increased and fluctuated between 30 and 45 percent. This increase may be attributed to the focus on local agriculture during the Intifada as the main available economic sector. The contribution of the industrial sector to the GDP between 1970 and 1992 remained relatively constant at an average of about 7 percent.. The contribution of the construction sector remained relatively constant at nearly 14 percent between 1970 and 1988, after which it declined to about 11 percent between 1988 and 1992.

The daily wage per employee in the West Bank was estimated to be 50 New Israeli Shekels (NIS) by mid-1996 (U.S$16 at an exchange rate of 3.1), with public services and construction yielding higher wages. The average daily wage per employee from the West Bank working in Israel is generally 30 to 40 percent higher. The average real monthly wage income per employed worker in the West Bank and Gaza Strip by mid 1996 was about NIS 990 (U.S$320). Comparatively, the total real monthly average household expenditures were estimated to be about NIS, 2,340 (U.S$755), with more than 70 percent for basic expenditures (housing, food, medical care, clothing, education, and transportation).

3.1.1 Existing Water Resources

The existing water resources are derived from three groundwater aquifers, a series of springs that emanate from the groundwater, and surface runoff. At the present time the groundwater and springs provide essentially all of the consumed water in the West Bank.

The West Bank is a hilly area, with elevations varying from 400m below sea level in the Jordan Valley to 1000m above sea level in the hills. The West Bank receives rainfall averaging about 600 mm per year; however, annual rainfall generally varies from less than 100 mm in the East and South to 700 mm in the north and west.

The surface geology of the West Bank is comprised of well fractured and karstified carbonate rocks, both limestone and dolomite. Various geological formations are generally non-covered and show outcrops at the surface. This is true even for the very deep formations such as Lower Beit Kahil or Kurnub. Outcrops appear at the top of hills as a result of strong folding and faulting. Therefore, it is likely that these hills are major recharge zones for the West Bank aquifer systems, especially in the non-developed and non-covered areas.

3.1.1.1 Groundwater Resources

Water is supplied to the West Bank area from a series of groundwater aquifers contained within three groundwater systems designated as the Northeastern, Eastern, and Western Aquifers typically referred to as the Moutain Aquifer System. Groundwater flow is generally controlled by various structural features such as faults, karst conduits, and folds. The general (regional) flow pattern for West Bank aquifers is either to the east towards the Dead Sea, to the west towards the Mediterranean Sea or to the northeast. However, the flow pattern may vary locally depending on the characteristics of existing structures. Moreover, the exact magnitude of inter-aquifer flow as well discharge to the Mediterranean and Dead Sea are not presently known. Therefore, it is difficult to accurately assess the magnitude of the groundwater storage in the West Bank.

Replenishment Capacity of Groundwater Basins

It is estimated that the total renewable groundwater resources in the West Bank is between 590 and 690 mcm/year. Part of this potential is being exploited either naturally (through natural springs) or artificially (through wells). Various studies have reported different replenishment capacities for the various West Bank aquifers. In a summary of these studies, Wilks (1993) reports that the Western Aquifers are estimated to have an annual replenishment capacity of about 350 to 360 mcm, the Eastern Aquifers an annual replenishment capacities of 100 to 130 mcm, and Northeastern Aquifers about 140 to 200 mcm replenishment capacity per year. However, presently, the official estimates are those numbers which have been stated in the Oslo Agreement. The range

of reported yields (Wilks, 1993) and the Interim Oslo Agreement yields are presented in Table 3.6

Table 3.6
Estimated Recharge Rates of the West Bank Aquifers

Basin	Reported yield (mcm/year)	Total Recharge per Article 40 of the Oslo Agreement (mcm/yr)
Northeastern	140 - 200	145
Eastern	100 - 130	172
Western	350 - 360	362
Total	**590 - 690**	**679**

Wells and Natural Springs

The most important source of groundwater in the West Bank is from wells. There are about 360 major wells in the West Bank. Most of these wells belong to the Palestinians and were drilled prior to 1967.

The total annual groundwater abstractions in the West Bank is about 122 mcm, of which 36.8 mcm is pumped from 228 agricultural wells and 27.9 ±2 mcm from 43 domestic Palestinian wells. The remaining 57.3 ±2 mcm is pumped from 49 wells controlled by Israeli settlements and Mekoroth and utilized for both domestic and agriculture. Well abstractions and use are presented in Table 3.7.

Table 3.7
Well Abstractions in the West Bank

District	Palestinian			Israeli Settlements		
	Number	Abstraction (mcm/yr)	Well Types	Number	Abstraction (mcm/yr)	Well Types
Jericho	66	6.3	mostly Agriculture	35	43.5	mostly Agriculture
Jenin	5 59	2.8 5.7	Municipal Agriculture	-	-	
Tulkarm	19 123	6.4 16.0	Municipal Agriculture	1	0.9	Municipal
Nablus	3 80	3.0 8.0	Municipal Agriculture	4	7.4	Municipal
Ramallah	6	3.3	Municipal	5	3.5	Municipal
Bethlehem	6	11.1	Municipal	3	1.6	Municipal
Hebron	4	1.3	Municipal	1	0.4	Municipal
Total	**371**	**64.7**		**49**	**57.3**	

Groundwater discharge in the West Bank occurs mainly through natural springs, of which there are approximately 400 (Rabi and Tamimi, 1990). The total discharge of these springs varies between 100 mcm and 108 mcm annually. Of this total, fresh water spring discharge accounts for nearly 53 percent of the total discharge and the remaining 43 percent is being discharged by brackish water springs. The discharge of the fresh water springs per groundwater basin (Nuseibeh and Nasser Eddeen, 1995) is summarized as follows :

- 32.9 mcm is discharged by 23 major springs in the eastern basin;
- 18.4 mcm from nearly 50 springs in the northeastern basing; and
- 1.4 mcm by 25 major springs in the western basin.

In addition, there is about 2.5 mcm issued by other minor fresh water springs in the western basin (Rabi and Tamimi 1990). The discharge of brackish water springs in the Jordan Valley is estimated to be approximately 53 mcm (Gutman, 1995; Gutman and Zukerman, 1995).

The Northeastern Aquifer System

The Northeastern Aquifer System is comprised of the Hebron, Bethlehem, Chalk, and Quaternary formations and the Jenin subseries. Its reported yield in the West Bank varies from 140 mcm/yr to 200 mcm/yr.

The Eastern Aquifer System

The eastern Aquifer underlies the major portion of the West Bank; however it yields only about 100 mcm to 170 mcm to West Bank water supplies. It is the only source of geothermal waters in the West Bank and consists of formations with a wide range of yields.

The Western Aquifer System

The Western Aquifer is the most prolific of the three in the West Bank as its reported safe yield is nearly more than that for both the Eastern and Northeastern basins combined.

Groundwater Quality

Within the aquifers, groundwater quality is generally good in the West Bank. However, in some areas where the water table is shallow and the aquifer is unconfined, pollution from various human activities has been found. Pollution has been reported in the form of high nitrate ($NO_3^=$)and chloride (Cl^-) concentrations in some wells and springs in the West Bank. This may be attributed to contamination from sewage discharges or agricultural activities. Studies by PHG and Bethlehem University (1995) indicate there is evidence of pollution in wells and springs that are adjacent to sewage collection pools in the Tulkarm area or to the sewage outfalls from the Anabta or Bethlehem-Beit

Sahur areas. Moreover, large number of springs throughout the West Bank have shown some pollution indications. In some areas, Cl^- and $NO_3^=$ concentrations are high and fecal coliform bacteria are present. This pollution is probably the result of contamination by seepage from septic tanks which are scattered almost everywhere in the rural areas of the West Bank (Sinjil, Burin, Burqa, etc.). Since aquifers in the West Bank are carbonate aquifers, elevated levels of Ca, Mg, and HCO_3 are expected due to dissolution. However, due to pollution, high concentrations of Ca, $NaHCO_3$ or Ca, Na, Cl^-, and $NO_3^=$ and in some cases NaCl concentrations have been reported.

3.1.1.2 Surface Water Resources

Surface Water, both surface runoff in wadis and Jordan River flows, is not widely utilized in the West Bank apart from the very small portion that is collected in cisterns from individual household roof catchments.

Surface Runoff

The flood water in the West Bank has some potential as a water resources. Part of this water (about 70 mcm/year on the average) flows through the major dry valley beds to the east, towards the Dead Sea. Because of the seasonal nature of the runoff, the duration of the runoff occurrences, and the topographic conditions, only a small portion of this runoff can be developed into any kind of a dependable supply and the development costs will be very high. Nonethelss, it has been estimated that a quantity of about 13 mcm can be economically developed from these sources. Another part of the runoff (about 20 mcm/year) flows to the west, towards the Mediterranean Sea (ANTEA/BRL, 1995). A portion of this potential may also be utilized through constructing small dams in some of the major valleys.

Jordan River

The Jordan River is the major surface water body in the West Bank. The head waters of the Jordan River originate from Jebal Asheikh (Hermon) in the form of three tributaries: the Banyas, Dan, and Hasbani Rivers. The three tributaries join together in the Hula Valley and form the Upper Jordan, which then enters Lake Tiberias from the north and leaves the lake from its southern end. At a distance of about 12km south of Lake Tiberias, the Yarmouk River flows into the Jordan. The lower part of the Jordan River then continues along the Rift Valley until it reaches its destination at the Dead Sea. The discharge of the Jordan River varies from year to year in accordance with variation in rainfall. Flow measurements for the Jordan River are not available for recent years. However, El-Musa (1996) reported that the exploitable water quantity from the River system is estimated at 1.3 billion m^3/year. Various attempts have been made to calculate the discharge of the river by defining a relation between rainfall and runoff in its catchment. These attempts have considered the river flow measurements at King Hussein Bridge in 1967 as the base for the derivation. Accordingly, studies have correlated the rainfall and runoff. The results of these studies indicated that between 1977 and 1987, the average annual discharge of the river ranged from 422 to 435 mcm

(Abu-Fares, 1992; Salameh and Khawaja 1984). Moreover, Abu-Fares (1992) has defined rainfall-runoff relations for two different periods. The first relation covers the period prior to the 1954/55 hydrologic year, where the river discharge had not been modified by Israeli diversions upstream. The second relation covers the period after 1955, after major diversion works started. The difference between the two linear relations was found to be approximately 486 mcm/year. Abu-Fares (1992) concluded that this difference is equivalent to the amount diverted to the Israeli National Carrier beginning in the mid 1950s.

Surface Water Quality

There are no recent surface water quality data available, especially for the Jordan River. However, records from the 19950s (Rofe and Raffety, 1965)indicate that the quality of the river was high, with the pH at 7.3 and TDS at 710 mg/l during 1954. This was before the major Israeli diversions began. Because of substantial changes in the quality of the river over the past four decades, these data cannot be used today.

3.1.1.3 Existing Water Systems

In the West Bank area there are three types of water supply systems: those with their own sources, those which must import a part of their needs, and those which have no source and are totally supplied from the WBWD.

. . . Jenin Water System

The Jenin area is served from five wells that are used exclusively for municipal supply. Of these five, only three which belong to the WBWD, are dependable. The system serves 35 communities and nine Israeli settlements and camps, providing water for about 117,000 persons. The system, which is fairly new and in good condition, consists of about 50 km of pipe. In addition, there are four small systems that receive water from a Mekoroth pipeline and supply three Israeli settlements. In the near future, development plans include connecting several additional villages to the network, and, in the city of Jenin, extending the system, constructing new reservoirs, and rehabilitating sections of the internal networks.

. . . Nablus Water Systems

The water supply for Nablus is developed from five springs, three wells, and water from mekoroth. Through a network of 270 km of pipe and 12 reservoirs, the municipality serves about 21,000 connections or about 160,000 people. Future plans call for replacement of old pipelines, the construction of about 50-70 km of new pipeline to improve the system and the development of three storage tanks. Four potential new well sites have been identified and one well has proceeded through the permitting stage. This well should be contributing to the system by the end of 1997.

. . . Tulkarm Water Systems

In Tulkarm, the municipal supply is developed from three municipally-owned wells and five private wells. The system serves about 8,000 customers within the municipality and about 2,000 outside. Seventy percent of the customers are served from a network of about 80 km of pipe. It is estimated that about 50 km of the network need rehabilitation. Future plans of the municipality include the rehabilitation of certain wells to increase their capacity and the construction of eight reservoirs.

The Qalqilia municipality, which has been included in the Tulkarm planning area receives its supply from two wells. It has a 50-km pipe network to about 4,200 connections. Future plans call for the rehabilitation of about 20 percent of the network.

. . . Ramalla Water Systems

The sources of water for the Ramallah area consist of four wells owned by the JWU, water from Mekoroth, and JWU water purchased from the Israeli Jerusalem Municipal District. Most of the communities in the central and northern part of the area are served from a single pipe network that consists of main transmission lines, about 11 branch lines, and a series of regional reservoirs. The system serves the major communities of Ramallah, Al Bireh, Silwad, and Birzeit and 42 other smaller communities; plus six Israeli settlements and army camps. The system is relatively new and in good condition. The major communities in the western part of the district, are served from the Shibteen well field by the WBWD.

. . . Jerusalem Water System

Most of the populated parts of the District are connected to pipe networks. The sources of water are the Israeli Jerusalem Municipality, the JWU, and the WBWD. Most parts of East Jerusalem receive a continuous supply through a network started by the Jordanians and temporary lines constructed above ground by the Israelis. A new network has been undertaken by the Jerusalem Municipality to replace the temporary network. The replacement reached about 30 percent of the system before it was halted. Other areas, such as the Shu'fat refugee camp and the village of Al-Eizaria have either been disconnected or had their services reduced due to disputes with Israeli utilities (Jerusalem utilities (Jerusalem Municipality).

. . . Bethlehem-Hebron Water System

There are three major water systems serving the Bethlehem and Hebron planning areas; the Herodian Complex, the Western System and the Southern System. The conveyance lines from the well sources are very complex because they serve both the Palestinian and Israeli systems.

The Herodian Complex draws water from eight wells and distributes the water through five pressure zones. This system serves all or part of more than 40 Palestinian villages

and 14 Israeli settlements. In times of local shortage, the service can be expanded to include a further 10 Palestinian and five Israeli areas.

The Western System obtains all of its water from outside of the area. The system serves four Palestinian and one Israeli village through a system of interconnected pipes and reservoirs, and 17 Palestinian communities and three Israeli settlements through pressure reducing valves.

The Southern system serves a part of Hebron and the communities to the south. The system is served by six wells and delivers water to 10 Palestinian communities and one Israeli army camp. In addition, there are six Israeli settlements and one Palestinian community that are served from an isolated system supplied by Mekoroth.

There is much activity for the improvement of the systems both from the local utilities and as a result of foreign assistance. In addition to replacing some deteriorated lines and constructing new reservoirs, there are plans to construct four or five wells and to activate an existing well to provide an additional annual supply of slightly more than 9 mcm.

... Jericho Water System

The Jericho System is supplied from the Ein Sultan spring and serves both the municipality and the Ein Sultan refugee camp. The entire municipality is served by a pipe system. It consists of a 62-km network and over 2,100 connections. The system was begun in 1963 and expanded in 1973 and is now in need of extensive rehabilitation.

3.1.1.4 Present Water Resources /Supply in the West Bank

The three major sources for supplying water for use in the West Bank are :

- Groundwater wells and springs
- Cisterns
- Israeli water utilities (Mekoroth and Jerusalem Municipality)

... Groundwater and Springs

The major water source is groundwater from the Mountain Aquifer System. The total estimated yield for the year 1995, from both wells and springs is 117.4 mcm. WBWD records indicate that there are 371 active wells that are tapping the Mountain Aquifer System. Forty three (43) of these wells, with an estimated annual yield of approximately 28 mcm, are primarily used for urban and domestic purposes, as well as for livestock. These wells belong to the WBWD, municipalities, utilities (JWU and WSSA), and villages. The remaining 328 wells, with an estimated annual yield of approximately 36.8 mcm, are predominantly used for irrigated agriculture, with minor quantities used for supplementing municipal and domestic supplies in rural areas. These

wells are distributed over the three aquifer systems (i.e. Eastern, Northeastern, and Western aquifers) as shown in Table 3.8.

Available literature (Nuseibeh and Nasser Eddin, 1995; and Rabi and Tamimi, 1990) indicates that there are almost 300 springs in the West Bank, of which only 112 are considered major fresh water springs (i.e. with a yield of more than 0.1 liter/sec). The estimated total yield of these springs, based on WBWD records, is about 52.6 mcm, out of which approximately 49 mcm are primarily used for irrigated agriculture, whereas the remaining 3.6 mcm are used for municipal and domestic purposes. The majority of these springs, as shown in Table 3.8, issue from the Eastern and Northeastern aquifer systems with estimated flow rates of about 32.9 and 18.4mcm, respectively.

Based on Table 3.8, the total yield currently used by Palestinians from the three aquifer systems is about 117.4 mcm, which is nearly equal to that indicated in Article 40 (Schedule 7) of the Oslo II Agreement (1995). However, Table 3.8 indicates that the yield obtained from wells and springs for Palestinian use in each aquifer system differs from that assigned in Article 40. These differences are likely to be attributed to variations in flow estimation and means used to obtain these estimates. It can be inferred, based on aquifer use estimates reported in Article 40 and well and spring yields in Table 3.8, that there may be about 10 mcm available for further development in the Northeastern Aquifer System. Article 40, however, indirectly suggests that groundwater from this aquifer is fully utilized. Conversely, in the Eastern Aquifer System, only an amount of approximately 71 mcm may be available for further development, which is less than the 78 mcm reported in Article 40. Abstraction quantities for Palestinian use from the Western Aquifer System are relatively similar to those reported in Article 40, where the yield currently available for Palestinian use differs only by 2.5 mcm from that in Article 40.

. . . Cisterns

Cisterns are also used in the West Bank to augment available water resources by harvesting storm water locally. Department of Environmental Health (DEH) of the Palestinian Ministry of Health records document the presence of 78,400 cisterns in the West Bank. The distribution of these cisterns among the various districts in the West Bank ~~is~~ shown in Table 3.9. The average volume of each cistern is between 60 and 80m^3, with some more than 100 m^3. The total supply quantity from active cisterns is estimated to be approximately 5 mcm (assuming 10 percent of the cisterns are inactive, an average cistern volume of 70 m^3, and one filling cycle). Table 3.9 indicates that most dwellings in Hebron district are equipped with cisterns, which is indicative of water supply shortages. In contrast, records indicate cisterns are not relied on in Jericho or Tubas.

TABLE 3.8

CURRENT ANNUAL DISTRIBUTION OF GROUNDWATER OF THE MOUNTAIN AQUIFER SYSTEM [1] [2] [3] [4]

District	Use [5]	Eastern Aquifer System							Northeastern Aquifer System							Western Aquifer System							Overall Yield for Palestinian (mcm)
		Wells		Springs		Total Yield (mcm)	Israeli Use (mcm)	Total Recharge (mcm)	Wells		Springs		Total Yield (mcm)	Israeli Use (mcm)	Total Recharge (mcm)	Wells		Springs		Total Yield (mcm)	Israeli Use (mcm)	Total Recharge (mcm)	
		No.	Yield (mcm)	No.	Yield (mcm)				No.	Yield (mcm)	No.	Yield (mcm)				No.	Yield (mcm)	No.	Yield (mcm)				
Hebron	M	4	1.30	_	_	1.30			_	_	_	_	_			_	_	_	_	_			1.30
	A	_	_	4	0.13	0.13			_	_	_	_	_			_	_	6	0.19	0.19			0.32
Bethlehem	M	6	11.10	_	_	11.10			_	_	_	_	_			_	_	_	_	_			11.10
	A	_	_	2	0.38	0.38			_	_	_	_	_			_	_	12	0.48	0.48			0.86
Jenin	M	_	_	_	_	_			5	2.80	_	_	2.80			_	_	1	0.11	0.11			2.91
	A	_	_	_	_	_			59	5.70	8	0.14	5.84			_	_	_	_	_			5.84
Tulkarm	M	_	_	_	_	_			_	_	_	_	_			19	6.40	_	_	6.40			6.40
	A	_	_	_	_	_			_	_	_	_	_			123	16.00	_	_	16.00			16.00
Nablus	M	3	3.00	_	_	3.00			_	_	14	2.28	2.28			_	_	_	_	_			5.28
	A	46	3.80	1	0.70	4.50			34	5.00	28	15.98	20.98			_	_	_	_	_			25.48
Ramallah	M	4	2.60	_	_	2.60			_	_	_	_	_			2	0.70	1	0.15	0.85			3.45
	A	_	_	22	0.94	0.94			_	_	_	_	_			_	_	5	0.51	0.51			1.45
Jericho	M	_	_	1	1.10	1.10			_	_	_	_	_			_	_	_	_	_			1.10
	A	66	6.30	6	29.04	35.34			_	_	_	_	_			_	_	_	_	_			35.34
Jerusalem	M	_	_	_	_	_			_	_	_	_	_			_	_	_	_	_			_
	A	_	_	1	0.61	0.61			_	_	_	_	_			_	_	_	_	_			0.61
Subtotal	M	17	18.00	1	1.10	19.10			5	2.80	14	2.28	5.08			21	7.10	2	0.26	7.36			31.54
	A	112	10.10	36	31.79	41.89			93	10.70	36	16.12	26.82			123	16.00	23	1.19	17.19			85.90
Total (I) [6]	_	129	28.10	37	32.89	60.99			98	13.50	50	18.40	31.90			144	23.10	25	1.44	24.54			117.44
Total (II) [7]	_	_	**24**	_	**30**	**54**	**40**	**172**	_	**25**	_	**17**	**42**	**103**	**145**	_	**20**	_	**2**	**22**	**340**	**362**	**118**

[1] Total recharge and Israeli use quantities are those reported in Article 40 (Schedule 7) of the Oslo B Agreement, dated September 18, 1995

[2] Data for springs were obtained from Nuseibeh & Nasser Eddin, 1995, and Rabi & Tamimi, 1990. Only major fresh water springs, which yield more than 0.1 liter/sec each, are considered

[3] Total and overall yields are the sum of estimated average annual well and spring yields for Palestinians from each and all aquifers, respectively

[4] Data for wells were obtained from the West Bank Department/ Hydrology Division

[5] M = Municipal; A = Agricultural

[6] Total (I) is the total number and corresponding estimated average annual yields of wells and springs for Palestinians

[7] Total (II) is the reported use in Article 40, which suggests these aquifers are fully utilized, except for 78 mcm in the Eastern Aquifer which is available for future development by the Palestinians.

Table 3.9
Summary of Cistern Supply in the West Bank

District	Total Cisterns (No.) (1)	Inactive Cisterns (No.) (2)	Active Supply (m^3)(3)	Supply to Livestock (m^3)(4)	Supply to Unpiped Areas (m^3)(5)	Supply to Piped Areas (m^3) (6)
Hebron	31,000	3,100	1,953,000	586,000	241,000	1,126,000
Bethlehem	7,700	770	485,000	146,000	33,000	306,000
Jenin	14,000	1,400	882,000	265,000	176,000	441,000
Tulkarm	10,500	1, 050	662,000	199,000	132,000	331,000
Qalqilia	3,000	300	189,000	57,000	38,000	94,000
Tubas	------	------	------	------	------	------
Salfit	3,200	320	202,000	61,000	40,000	101,000
Nablus	2,000	200	126,000	38,000	25,000	63,000
Ramallah	7,000	700	441,000	132,000	88,000	221,000
Jericho	------	------	------	------	------	------
Total	**78,400**	**7,840**	**4,940,000**	**1,484,000**	**773,000**	**2,683,000**

(1) Data about cisterns were obtained from the Department of Environmental Health (DEH), 1997. Based on DEH, there is a total of 78,400 cisterns distributed as shown, with a capacity of 60 to 80 m^3 each.
(2) It is assumed that 10% of these cisterns are inactive or inoperative, and 90% actively used
(3) Active supply is the volume of actively used cisterns; An average volume of 70m^3 is assumed for each
(4) It is assumed that 30% of the annual capacity of these cisterns will be used for livestock consumption.
(5) It is assumed that 20% of the capacity of cisterns will be used for domestic consumption in unpiped areas, except for Hebron and Bethlehem, where only about 12% and 7% of this quantity is required
(6) It is assumed that 50% of the capacity of cisterns will be used for domestic consumption in piped areas.

Table 3.10
Estimated Total Water Supply in the West Bank - By Source

District	Wells and Springs		Cisterns	Israeli Sources	Subtotal
	Municipal& Domestic (mcm) (1)	Agricultural (mcm)	(mcm)	(mcm)	(mcm)
Hebron	1.3	0.3	2	0.6	4.2
Bethlehem	11.1	0.9	0.5	1.6	14.1
Jenin	2.9	5.8	0.9	0.1	9.8
Tulkarm	6.4	16.0	0.9	0.1	23.4
Nablus	5.3	25.5	0.3	1.1	32.2
Ramallah	3.5	1.5	0.4	6.3	11.6
Jericho	1.1	35.3	------	0.4	36.8
Jerusalem	------	0.6	------	6.4	7.0
Total	**31.5**	**85.9**	**5.0**	**16.6**	**139.0**

(1) This quantity accounts for 5 mcm/year supply from the WBWD (with corresponding losses) to Jewish settlements in the West Bank.

These cisterns are used as a major source of water for domestic and livestock purposes in some unpiped localities (i.e., those not equipped with a water supply network), whereas they are used to augment available water resources in piped localities. In piped areas, these cisterns are generally used for additional storage, and filled directly form the house connection, to cope with water shortages during service interruption and high demand periods. The supply from these cisterns to each sector and/or purpose in each district has been conceptualized based on the estimated consumption in various sectors and other potentially available sources.

Cisterns are not always adequately maintained. According to DEH, the majority of these cisterns is not disinfected, and only about 10 percent of them are regularly disinfected. Analytical testing of cistern water samples show frequent episodes of contamination as indicated by elevated levels of total and fecal coliform bacteria (in many cases exceeding 880 count/100 ml).

. . . Israeli Water Utilities (Mekoroth and Jerusalem Municipality)

Israeli water utilities (Mekoroth and Jerusalem Municipality) also supply water to Palestinian communities in the West Bank. Available records indicate that these utilities supply approximately 16.6 mcm to various districts, with the majority of these quantities supplied to Jerusalem (6.4 mcm). Ramallah (6.3 mcm), and Bethlehem (1.6 mcm). All supplies are to the municipal and domestic system. A breakdown of quantities is summarized in Table 3.10.

3.1.1.5 Estimated Present Water Use in the West Bank

There is no accurate or consistent measurement or metering of water consumption in the West Bank or Gaza Strip. This is attributed to an inadequate water sector infrastructure. However, efforts have been made to develop reasonable estimates of water consumption for the various districts within the study area.

Estimates of water consumption rates are based on data provided by numerous responsible authorities and utilities. These entities include the Palestinian Water Authority (PWA), Ministry of Agriculture, West Bank Water Department (WBWD), Jerusalem Water Undertaking (JWU), Water Supply and Sewerage Authority-Bethlehem/Beit Sahur/Beit Jala (WSSA), and several municipalities.

Due to the lack of a detailled database about water consumption rates, water uses have been classified into three different categories.

- Urban and domestic
- Irrigated agriculture
- Livestock

Urban and domestic water uses encompass household, public, industrial, and commercial purposes, as the current water supply data base does not segregate these categories. Finer resolution of present water use by the various sectors is not possible. Estimates of water supply and consumption rates for these uses have been made for the end of 1995.

. . . Urban and Domestic Water Use

A summary of water supply data for urban and domestic uses in each district is presented in Table 3.11. The table indicates that during the year 1995, the quantity of water supplied to areas in the West Bank with water distribution networks (i.e., areas with piped water supplies) was about 44.5 mcm. A total of approximately 41.8 mcm is supplied by the water supply network, whereas the remaining 2.7 mcm is supplied from cisterns. The total population in these areas was estimated to be 1,363,000 for the year 1995. With these data, the per capita supply rate for piped areas is estimated to vary between 61 L/c/d in Hebron and 143 L/c/d in Tulkarm, with an average of 89 L/c/d.

The supply for unpiped areas is estimated to be 2.2 mcm, with an assumed average per capita supply rate of 30 L/c/d. This quantity is supplied from cisterns (0.8 mcm) and irrigation springs and /or wells (1.4 mcm). It is conceptualized (Tables 3.9 and 3.11) that all the supply to unpiped areas in Hebron, Bethlehem, and Ramallah comes from cisterns, as irrigation wells and springs may not be available. Unpiped areas in other districts are mainly supplied from irrigation springs and/or wells.

The total water supply for the West Bank for urban and domestic purposes during 1995 was estimated to be approximately 46.7 mcm.. The overall supply rate for urban and domestic purposes in the West Bank was estimated to vary between 53 L/c/d in Tubas and 134 L/c/d in Jericho, with a weighted average (which also accounts for population and supply in piped and unpiped localities) of about 82 L/c/d.

The total water consumption for urban and domestic purposes in the West Bank was estimated based on estimated loss rates for various districts and the above mentioned supply rates. The overall loss or unaccounted-for water (UFW) rate was estimated to vary between 25 percent (in Ramallah) and 65 percent (in Jericho), with an average of 44 percent of the total supply (Table 3.11). The loss rate in unpiped areas was assumed to be 25 percent.

This UFW in piped areas comprises :

- Physical losses at the source, main transmission system, and distribution network;
- Unregistered connections, and
- Meter losses

Evidently, the use of the overall loss rate for estimating the consumption rates is not realistic. Water consumption rates should be estimated based on actual physical losses. Losses related to unregistered connections and metering do not constitute an actual loss

Table 3.11

ESTIMATED PRESENT URBAN/DOMESTIC WATER SUPPLY AND CONSUMPTION

District	Piped Areas								Unpiped Areas [6] [7]		Total Supply			Apparent Consumption [8]		Adjusted Consumption [9]	
	Population [2]	Network Supply [1]		Cisterns	Supply Quantity		Overall	Physical	Population	Supply	Population	Quantity	per	Quantity	per	Total	per
		Quantity	Sources [3]	Supply	Total	per capita	Losses	Losses		Quantity			capita		capita		capita
	(10^3)	(10^3 m^3/yr)		(10^3 m^3/yr)	(10^3 m^3/yr)	(L/c/d)	(%) [4]	(%) [5]	(10^3)	(10^3 m^3/yr)	(10^3)	(10^3 m^3/yr)	(L/c/d)	(10^3 m^3/yr)	(L/c/d)	(10^3 m^3/yr)	(L/c/d)
Hebron	268	4,800	WBWD, MW	1,126	5,926	61	45	40	22	241	290	6,167	58	3,440	32	3,736	35
Bethlehem	135	3,977	WSSA, WBWD	306	4,283	87	50	45	3	33	138	4,316	86	2,166	43	2,380	47
Jenin	111	2,701	WBWD, M, PW	441	3,142	78	40	35	69	756	180	3,898	59	2,452	37	2,609	40
Tulkarm	88	4,275	MW, PW, WBWD, M	331	4,606	143	45	40	24	263	112	4,869	119	2,730	67	2,961	72
Qalqilia	50	2,187	MW, PW, M, WBWD	94	2,281	125	45	40	11	120	61	2,401	108	1,345	60	1,459	66
Tubas (10)	19	434	WBWD, M, PW, S	_	434	63	45	40	8	88	27	522	53	304	31	326	33
Salfit (10)	29	818	M, MW	101	919	87	45	40	15	164	44	1,083	67	629	39	675	42
Nablus	176	6,730	MW, M, PS	63	6,793	106	45	40	39	427	215	7,220	92	4,056	52	4,396	56
Ramallah	236	6,366	JWU, M, WBWD	221	6,587	76	30	25	8	88	244	6,675	75	4,677	53	5,006	56
Jerico	27	1,359	PS, MS, M, PW	_	1,359	138	65	60	1	11	28	1,370	134	484	47	552	54
Jerusalem (11)	224	8,149	JM, JWU, WBWD	_	8,149	100	25	20	_	_	224	8,149	100	6,112	75	6,519	80
West Bank	1,363	41,796	_	2,683	44,479	89	44	39	200	2,190	1,562	46,669	82	28,395	50	30,619	54
Gaza	949	46,057	MW, PW, M	_	46,057	133	45	40	_	_	949	46,057	133	25,331	73	27,634	80
Total	**2,311**	**89,543**	_	**2,683**	**90,536**	**107**	**44**	**39**	**200**	**2,190**	**2,511**	**92,726**	**101**	**53,726**	**59**	**58,253**	**64**

(1) Quantities (which are rounded, account for domestic, public, commercial & industrial) are for end of year 1995, and are based on data from the WBWD, JWU, WSSA, and Municipalities. Quantities for Hebron, Bethlehem & Ramallah were reduced by an amount of 1.5, 0.35 & 0.5 mcm, respectively, from those obtained from the WBWD to account for livestock uses.

(2) Population estimates for end of year 1995 (rounded to the nearest 1000) are based on PCBS estimates for mid year 1996 and a 3% annual population growth rate.

(3) WBWD = West Bank Water Department, M = Mekoroth; JWU = Jerusalem Water Undertaking; PW/PS = Private Well/Spring; MW/MS = Municipality Well/Spring; WSSA = Water Supply and Sewerage Authority of Bethlehem -Beit Jala -Beit Sahur; JM = Israeli Jerusalem Municipality

(4) Overall losses (rounded), which were estimated based on data obtained from Municipalities, published data/or discussions with WBWD/JWU/WSSA personnel, account for physical losses, unregistered connections and meter losses

(5) Physical losses (in distribution network and conveyance systems) were estimated by subtracting 5% from the overall losses for unregistered connections and meter losses

(6) Water sources for un-piped communities include private wells, springs, and rainwater collection cisterns (assuming 1.5 mcm from cisterns and 1 mcm from wells and springs).

(7) Quantities for un-piped communities have been estimated based on average per capita supply of 30 L/c/d

(8) Apparent consumption rates, are weighted averages that were estimated by applying a 25 % loss rate for supplies in umpiped areas and the overall loss rate to the supply in piped areas.

(9) Adjusted consumption rates, are weighted averages that were estimated based on physical losses in piped areas and a 25% loss rate in unpiped areas.

(10) Losses for Salfit and Tubas are assumed to be similar to those of Nablus.

(11) Water supply has been estimated based on an average per capita supply rate of 100 L/c/d, obtained for communities in Jerusalem supplied by the JWU or the WBWD.

of water from the system. They should, however, be considered when assessing the effectiveness and operation of water utilities, as they represent a loss of revenues. The combined losses from unregistered connections and meter losses was assumed to be about 5 percent of the total supply. On these bases, physical losses were estimated to range between 20 percent (in Jerusalem) and 60 percent in Jericho with an overall weighted average of 39 percent. Accordingly, the total municipal and industrial per capita consumption rate was estimated to vary between 33 L/c/d in Tubas and 80 L/c/d in Jerusalem, with an average of about 54 L/c/d.

No accurate records of domestic water consumption rates are currently available as quantities allotted to the various sectors (i.e., domestic, public, industrial, and commercial) cannot be segregated. Domestic water consumption rates were grossly estimated to vary between approximately 30 L/c/d and 70 L/c/d with an average of about 50 L/c/d. These estimates were developed assuming that water consumption rates for public, industrial, and commercial uses are about 12 percent of the total consumption quantities, based on data available for selected areas in the West Bank. These domestic water consumption rates are substantially lower than the WHO minimum value of 100 L/c/d (WHO, 1993).

Table 3.12 summarizes existing water sources and utilities supplying water to the West Bank and Gaza Strip. The data in the table show that :

- Approximately 83 percent of water provided to piped areas is supplied by Palestinian utilities (designated P-Gross), whereas the remaining 17 percent (designated I-Net) is supplied directly by Israeli Utilities.

- Some of the water supplied by the Palestinian utilities (approximately 7 percent of the total supplied water) is purchased in bulk from Israeli utilities. Accordingly, only 76 percent of the water supplied to piped areas (designated P-Net) is owned by Palestinian utilities, whereas the remaining 24 percent is purchased from Israeli Utilities.

An inventory of water resources available for domestic and municipal purposes in the West Bank indicates that the following quantities are supplied to the network:

1.	Municipality/private wells and springs	17.5 mcm
2.	WBWD wells	14.0 mcm
3.	Agricultural springs	1.2 mcm
4.	Israeli sources (Mekorot/Jerusalem Municipality)	16.6 mcm
	Total	**49.3 mcm**

Quantities 1 and 2 are equal to the yield of municipal wells and springs in Table 3.8. A comparison between the total quantity of 49.3 mcm and the 44.3 mcm supplied to Palestinian communities (Table 3.12) indicates a blance of approximately 5 mcm. This quantity accounts for the quantity supplied to Jewish settlements by the WBWD and losses.

Table 3.12
Distribution of Network Supply in Piped Areas

District	Supply Quantity to Piped Areas ($10^3 m^3$/year)							
	Palestinian Sources				Israeli Sources (2)			Total
	ID (3)	P -Gross (4)	P-Net (5)	% Net (6)	I Net (7)	I - Gross (8)	%Cross(6)	Quantity
Hebron	WD	5,584	4,985	79.1%		599	9.5%	6,303
	M/P	719	719	11.4%				
Bethlehem	WD	942	842	19.5%	769	1,469	34,0%	4,317
	WA	2,606	2,005	46.4%				
Jenin	WD	2,314	2,314	85.7%	83	83	3.1%	2,701
	M/P	304	304	11.3%				
Tulkarem	WD	21	21	0.5%	20	20	0.5%	4,351
	M/P	4,310	4,310	99.1%				
Qalqilia	WD	36	36	1.6%	156	156	7.1%	2,187
	M/P	1,995	1,995	91.2%				
Tubas	M/P	393	393	90.8%	40	40	9.2%	433
Salfit	M/P	39	39	4.8%	779	779	95.2%	818
Nablus	WD	154	154	2.2%	739	739	10.8%	6,872
	M/P	5,979	5,979	87.0%				
Ramallah	WD	499	499	7.3%	787	4,838	70.5%	6,866
	JWU	5,580	1,529	22.3%				
Jericho	M/P	999	999	73.5%	360	360	26.5%	1,359
Jerusalem	JWU	1,712	469	5.8%	6,437	7,680	94.2%	8,149
West Bank		34,186	27,592	62.2%	10,170	16,763	37.8%	44,356
Gaza	M/P	41,125	41,125	89.3%	4,932	4,932	10.7%	46,057
Total		**75,311**	**68,717**	**76.0%**	**15,102**	**21,695**	**24.0%**	**90,413**

(1)This includes supply for domestic, commercial, industrial, public and some livestock purposes and losses.
(2) Mekoroth and/or Jerusalem Municipality
(3) WD=West Bank Water Department; M/P=Municipality/Private well or spring; WA-Water Supply & Sewerage Authority of Bethlehem - Beit Jala-Beit Sahur; JWU-Jerusalem Water Undertaking
(4) Total water supplied by Palestinian utilities which may include quantities purchased from Israeli utilities.
(5) Total water owned and supplied by Palestinian utilities.
(6) The percentage of the net water supplied by Palestinian utilities or the gross water supplied by Israeli utilities to the total water supplied
(7) Total water amount supplied directly by Israeli utilities.
(8) Total water amount purchased from Israeli utilities which may be supplied by either Israeli or Palestinian utilities.

Table 3.13

LIVESTOCK [1] WATER CONSUMPTION

Per Type Water Consumption (m^3/year)	Cows		Steers		Goats		Chicken				Others [2]		Total Water Consumption
							Broiler		Layer				
District	Number	Quantity	Number	Quantity	Number	Quantity	Number [3]	Quantity	Number	Quantity	Number	Quantity	
Hebron	1,008	20,160	440	4,400	280,500	1,402,500	6,937,875	624,409	345,000	34,500	2,592	7,776	2,093,745
Bethlehem	328	6,560	440	4,400	76,500	382,500	991,125	89,201	22,500	2,250	1,416	4,248	489,159
Jenin	1,944	38,880	1,120	11,200	153,000	765,000	6,387,250	574,853	135,000	13,500	3,328	9,984	1,413,417
Tulkarm	1,048	20,960	480	4,800	25,500	127,500	1,762,000	158,580	540,000	54,000	2,951	8,853	374,693
Nablus	3,000	60,000	880	8,800	153,000	765,000	2,092,375	188,314	90,000	9,000	2,367	7,101	1,038,215
Rammallah	336	6,720	360	3,600	127,000	637,500	3,303,750	297,338	360,000	36,000	1,117	3,351	984,509
Jericho	304	6,080	280	2,800	34,000	170,000	550,625	49,556	7,500	750	229	687	229,873
West Bank	7,968	159,360	4,000	40,000	850,000	4,250,000	22,025,000	1,982,250	1,500,00	150,000	14,000	42,000	6,623,610

[1] The number of livestock and corresponding water consumption are estimated for year 1996 based on data furnished by PWA and the Ministry of Agriculture:

Type	Number	Per animal Consumption (m^3/year)
Cows	8,000	20
Goats	850,000	5
Steers	4,000	10
Chicken:		
Broiler	22,000,000	90 per 1000
Layer	1,500,000	100 per 1000
Turkey	5,000	450 per 1000
Others	14,000	3

[2] Animals used for farming purposes, distributed according to the proportion of the cultivable lands in each district to the total cultivable land of West Bank.

[3] These figures include also turkey as equivalent broilers based on their water consumption.

. . . Livestock Water Use

A summary of livestock water consumption has been furnished by the Ministry of Agriculture, and is presented in Table 3.13 (see next sheet). The data in the table indicate that the total livestock water consumption was about 6.6 mcm during 1995. This quantity was estimated for various types of animals and livestock. Water for livestock consumption is supplied from different sources which include the municipal system, irrigation wells and springs, and cisterns. An approximate breakdown of this supply is as follows:

• Cisterns (Table 3.9)	1.5 mcm
• Municipal supply network (Table 3.11-notes)	2.4 mcm
• Irrigation wells and springs (WBWD)	2.7 mcm
Total	**6.6 mcm**

. . . Irrigated Agriculture

Estimates of water requirement for irrigated agriculture have been based on data provided by the PWA and Ministry of Agriculture. Water crop requirement quantities, which account for on-farm losses (evaporation, infiltration, evapotranspiration, leakage, etc.), have been estimated for the various crops and areas of irrigated lands in each district. A summary of these estimates is presented in Table 3.14. The table indicates that the total quantity of water provided to farms is estimated to be 70.9 mcm. In comparison, the total water supply for irrigated agriculture was estimated to be 80.6 mcm, which accounts for losses in the main supply system, prior to reaching the irrigated areas. Accordingly, the average water loss (infiltration, evaporation, leakage, and unaccounted-for water) rate in the main supply system is approximately 12 percent.

Table 3.14
Irrigated Agricultural Lands and Their Water Consumption in the West Bank

District	Total		
	Area	Water Consumption	
	(du)	(m^3/year)	(m^3/du/yr)
Hebron	3,300	1,947,000	590
Bethlehem	1,200	684,000	570
Jenin	5,800	4,060,000	700
Tulkarem	29,200	21,608,000	740
Nablus	17,400	11,832,000	680
Ramallah	900	513,000	570
Jericho	38,700	30,186,000	780
West Bank	**96,500**	**70,830,000**	**734**

Source : Modified after Ministry of Agriculture and CEP, 1995

3.1.1.6 Water Tariff in the West Bank

Water pricing policy and tariff structures are not consistent within the West Bank. Water charges vary among districts and supplying utillities. Generally, pricing is set as a mechanism for financing operation and maintenance (O&M) costs, which are not always fully recovered. Occasionally, progressive pricing structures are adopted such as in Ramallah (JWU) and Nablus Municipality. Some pricing systems account for different customers (such as domestic and industry). A summary of water tariffs in select areas is presented in Table 3.15.

Table 3.15
Summary of Water Tariffs in Select Areas of the West Bank

Institution	Customers	Consumption Rate	Water Charges[1,2] (U.S$/m^3)
Ramallah (JWU)	All	0-10 m^3/2 months (minimum)	12.66 (flat rate)
		11-20 m^3/2 months	1.00
		21-40 m^3/2 months	1.05
		over 40 m^3/2 months	1.500
	Bulk	Flat Rate	1.05
		Meter Rent (/2 months)	2.66 (flat rate)
Betunia Municipality	All	Flat Rate	1.33
Nabuls Municipality	Domestic	1-5 m^3/month	0.71
		6-10 m^3/month	1.07
		over 10 m^3/month	1.43
		Network Maintenance (month)	1.43 (flat rate)
	Industry	1-5 m^3/month	0.71
		6-10 m^3/month	0.86
		11-50 m^3/month	1.21
		over 51 m^3/month	0.86
		Network Maintenance (month)	1.26 (flat rate)
	Bulk	Flat Rat	1.30
		Network Maintenance (month)	1.26 (flat rate)
Bethlehem	Private	0-10 m^3/2months (minimum)	11.8 (flat rate)
		Over 10 m^3/2months	1.18
		Network Maintenance (2month)	2.35
	Government / Military	Flat Rate	0.6
Hebron	All	up to 10 m^3/month	0.94
		11-20 m^3/month	1.03
		over 20 m^3/month	1.18
		Network Maintenance (month)	1.03 (flat rate)

Table 3.15 (continued)

Institution	Customers	Consumption Rate	Water Charges [1,2] (U.S$/m^3)
Jericho	All	0-20 m^3/2months (minimum) over 20 m^3/2months	5.9 (flat rate) 0.3
Jenin	All	0-4 m^3/2months (minimum) 4-50 m^3/2months OVER 51 m^3/2months Network Maintenance (2months)	3.95 (flat rate) 1 1.41 2.65 (flat rate)
Tulkarm	All	0-5 m^3/month (minimum) over 5 m^3/month	2.94 (flat rate) 0.29
West Bank	Agriculture (wells)	Average Water sale price	0.17
Al Fara'a Project	Agriculture (springs)	Water Rights	Free
Jericho	Agriculture (Springs)	Use fee (flat rate for water rights) Sale of 1 hour of water right Contract (sale/lease) process fee	0.9/minute/year up to 2, 118 (flat rate) 21.2 (flat rate)

[1] WESC, 1996; World Bank, 1993c.
[2] Exchange rate : U.S$ = NIS 3.4

3.1.1.7 Existing Wastewater Facilities

. . . Sewerage Systems

The situation of the sewerage systems in the West Bank is extremely critical. Approximately 60 percent of houses in the municipal communities are connected to sewerage systems. The connection rate in the major cities has been estimated as shown in Tablle 3.16. Some cities and large towns have no system at all, and wastewater is discharged into septic tanks and/or cess pits which are emptied by vacuum trucks and disposed of either in a treatment plant or dumped into wadis. Some of the municipal wastewater collection systems like in Nablus and Hebron are combined sewers which collect both wastewater and storm water. In most cities, rainwater is allowed to run offf, where it eventually reaches wadis.

The situation in the refugee camps is even worse. Wastewater is channeled into open drains until it flows into either a sewerage network in a nearby city or is simply exported to outside the camp boundaries. No sewage networks exist in villages, and wastewater is discharged into cess pits or septic tanks.

The conditions of the sewerage systems vary, depending on the age and material of the pipes. Older pipelines, especially those of glazed clay, are badly deteriorated or are undersized to accommodate an increased wastewater flow. In some areas, the system has deteriorated due to poor connections made by local unqualified plumbers or by households themselves.

Table 3.16
Urban Wastewater Production in the West Bank

Municipality	Water Supply (m^3/d)	Estimated Physical Loss (%)	Estimated Total consumption (m^3/d)	Collection System coverage (%)	Wastewater Production Rate (m^3/d)	Type of Treatment Plant
Hebron	8,200	40	4,900	55%	2,200	Ponds (nw)
Ramallah	2,200	25	1,700	70%	900	AL
El-Bireh	4,000	25	3,000	60%	1,400	AS&TF (tbc)
Nablus	15,800	40	9,500	70%	5,300	None
Jenin	2,800	35	1,800	60%	900	AL
Tulkarm	8,000	40	4,800	65%	2,500	Ponds
Bethlehem	7,100	45	3,900	85%	2,700	None
Jerusalem	17,000	20	13,600	70%	7,600	None
Qalqilia	4,100	40	2,500	50%	1,000	None

nw: not working; AS: Activated Sludge; AL: Aerated lagoon; TF: Trickling Filter; tbc: to be constructed
It is assumed that 80 percent of the consumed water will be produced as wastewater
Quantities are rounded to the nearest 100.

. . . Present practice of Wastewater Reuse in the West Bank

Direct reuse of raw wastewater is practiced in several places in the West Bnak (Nablus, Jenin, Bethlehem, Hebron), to grow many different crops, vegetables, fodder and trees. There is presently no control of these practices such that agricultural products are not checked, and sanitary conditions for workers are poor, and soil and groundwater is likely. The farmers using the raw wastewater are aware of the poor water quality, the variation of quality during the day, its nutrient value, its possible improvement (through sedimentation), and clogging problems associated with localized irrigation systems (crops are furrow irrigated). They have tested different crops and selected the successful types. Products irrigated with raw sewage are sold in local and adjacent markets.

In the West Bank, the only existing system which is designed to treat and reuse wastewater is the treatment facility at Birzeit University. At this facility, activated sludge effluent is used for landscape irrigation using a drip system and for toilet flushing. The system is working properly. This system is a model for institutions and new communities that are willing to make a commitment to consider the reuse of treated wastewater early in the planning phase of a project.

The effluent from the new treatment plant of El-Bireh, which will be constructed in the near future, will be transported to adjacent agricultural areas at Deir Dibwan for irrigation purposes. A pilot plant for El-Bireh was carried out in 1993 by ANERA where the effluent was used to irrigate onion, artichoke and wheat. The new designs for the treatment plants in Ramallah, Nablus, Birzeit and Salfit will take into consideration the reuse possibility of the treated effluent for irrigation. There is an ongoing experiment to utilize the treated effluent of Nablus plant for irrigation where the effluent of a pilot plant is used to irrigate different crops.

3.2 The Gaza Strip Area

The Gaza Strip is a coastal area situated along the eastern Mediterranean Sea. It has a total area of 365 km^2 and consists of a system of sand dunes and sandstone hills along the sea gently sloping inland into alluvial and loessal plains. It forms a transitional zone between the semi-humid coastal areas of the north, the semi-arid plains of the northern Negev to the east, and the arid Sinai Desert to the south. The location of the Gaza Strip and its major urban centers are shown in Figure 3-1.

Area Setting

In the Gaza Strip, the elevation varies from sea level at the Mediterranean to nearly 80 m on the eastern side. The surface geology is comprised of sand and sandstone with potentially high percolation rates. The rainfall varies from more than 400 mm in the north to less than 200 mm in the south and averages about 320 mm.

Land Use

Of the total area of 365 km^2, about 170,000 du (170 km^2), or approximately 47 percent of the total land area, are cultivated (Ministry of Agriculture), and about 102,000 du are irrigated. Cities and towns, including Gaza, Rafah, Deir al Blah, Khan Younis, a few villages, seven refugee camps and public infrastructure account for about 20 percent of the area. Lands for pasture and grazing occupy about three or four percent, 18 Israeli settlements about 11 percent, and the remaining lands are mostly sand dunes and are unused. The urban area of the Israeli settlements is estimated at about 6,200 du, or 1.7 percent of the total surface area of Gaza (PALGRIC, 1995).

Population

According to the PCBS, the estimated population for mid-year 1996 was about 963,000 inhabitants. This is equivalent to about 60 percent of the population of the West Bank and residing on about seven percent of the land area of the West Bank. In addition, it is expected that about 100,000 people over and above the natural population increases will return to the area by the year 2000.

The area is very crowded. Based on the population estimates, the average density based on the built up areas is about 12,000 persons/ km^2 and about 2,600 persons/ km^2 based on total area. In the refugee camps, the average densities exceed 20,000 persons / km^2 and reach 100,000 persons/ km^2 in the Beach Camp outside of Gaza City.

Agriculture

Agriculture is an important sector in Gaza. As mentioned previously, 60 percent of the 170,000 du of cultivated lands are irrigated and 40 percent are rainfed. A summary of the crops and the areas of irrigated and rainfed cultivation are presented in Tables 3.17 and 3.18.

Table 3.17
Irrigated Lands in Gaza

Crop Type	Irrigated Area (du)
Citrus	44,000
Open Field Vegetables	32,000
Greenhouse Vegetables	10,000
Olive	6,000
Guava	4,000
Others in Mawasi	3,200
Strawberry	2,000
Flowers	800
Total	**102,000**

Table 3.18
Rainfed Lands in Gaza

Crop Type	Rainfed Area (du)
Wheat	18,000
Almond	16,000
Barley	15,000
Grape	6,000
Peas	3,000
Water Melon and Melon	3,000
Olive	2,050
Okra	2,000
Lentil	1,500
Snack Cucumber	800
Chick Peas	550
Total	**68,000**

Commerce and Industry

Development of the industrial sector has suffered over the last 30 years due to political instability and the rules applied by Israel. Over 200 industrial enterprises exist in the Gaza area distributed as shown in Table 3.19.

Table 3.19
Industry in Gaza

Type of Industry	Number of Establishments
Food	54
Textiles	70
Concrete Block	100
Total	**224**

Electric Power

The power supply is also provided by the IEC and operated by municipalities. The total supply of electricity to the Gaza Strip during 1992 was estimated at 55 MW. Nearly all of the Gaza Strip is electrified (98 percent), with the only exceptions being a few bedouin dwellings. The load factor was estimated during 1992 at 77 percent, also reflecting a high percentage of suppressed demand, and higher overloading than in the West Bank. Losses are estimated at 20 percent. The bulk price of electricity from the IEC, including value-added tax is about U.S.$0.07/k Wh.

Economy

The economy of the Gaza Strip appears to be more repressed than that of the West Bank. The real GDP of Gaza Strip between 1992 and mid-1996 rose by about 11.4 percent, from approximately U.S.$943 a million to U.S$.1,051 million. The per capita GDP, however, declined by 13.8 percent from about U.S.$1,228 to U.S$1,058, respectively. The real GNP was estimated to decline by about 18.5 percent from U.S$1.38 billion in 1992 to U.S.$1.12 billion by mid-1996. The corresponding per capita GNP fell by approximately 37 percent, from U.S$1,795 to U.S.$1,130.

Although the labor force in Gaza Strip grew by about 65 percent between the early 1990s and mid 1996 (World Bank, 1993a; 1993b; 1993c; UN, 1996), the employment rate declined by about 25 to 30 percent. This is manifested by the climbing unemployment rate, from less than 10 percent in the early 1990s to an average of 35 percent in mid 1996. Similar to the West Bank, employment in agriculture steadily decreased, from nearly 44 percent of the work force during the early 1970s to nearly 10 percent during 1996. The labor force within the industrial sector rose from about 17 percent during the early 1970s to about 25 percent during the mid-1980s, and then fell back to around 15 percent during the mid-1990s. The labor force in construction

appeared to have remained relatively stable at about 12 percent during this period, whereas the labor force in the service sector grew from about 28 to 59 percent.

The contribution of agriculture, forestry, and fisheries to the GDP fell from about 31 percent in the early 1970s to about 22 percent in late 1980s. Between 1988 and 1992, however, the contribution of agriculture increased and fluctuated between 30 and 40 percent. The contribution of industrial sector to the GDP between 1970 and 1992 remained relatively constant at an average of about 8 percent. The contribution of the construction sector climbed from 12 percent during early 1970s to 16 percent by late 1980s, after which it declined to about 13 percent.

The daily wage per employee in the Gaza Strip by mid 1996 was estimated to be lower than that in the West Bank, at about NIS 41 (U.S.$ 13.2), with public services and industry yielding higher wages. The average daily wage per employee from the Gaza Strip working in Israel is generally higher by 30 to 40 percent.

3.2.1 Existing Water Resources

3.2.1.1 Groundwater Resources

Groundwater, which accounts for almost 90 percent of the current use, is the only significant source of water in the Gaza Strip; the remaining supplies are purchased from Mekoroth. Surface water that might be available from Wadi Gaza is diverted outside of the area and rainfall either recharges the groundwater or is collected in cisterns and used immediately.

Lithology

Groundwater is drawn from the coastal aquifer which underlies the entire area. This aquifer is a southern extension of the Coastal Plain Aquifer located in Israel. It is comprised of sandstone and clay lenses of Quaternary Age. Clay lenses are generally present in the north and northwest, but they are absent in the middle and southeastern part of the Gaza Strip. The clay lenses overlay the Saqia Formation, which consists of Tertiary age clay. The aquifer generally dips westward.

Replenishment Capacity

Rainfall is the major source of groundwater replenishment in Gaza. It is estimated that almost 40 percent of the total annual rainfall infiltrates into the ground and recharges the groundwater system. The Ministry of Planning and International Cooperation (MOPIC, 1996) reported that the recharge percentage might approach 60 percent in sandy areas whereas it varies from 15 percent to 40 percent in clay areas.

Other sources of groundwater replenishment include groundwater flow from the eastern side, infiltration from surface water runoff, pipe leakage, infiltration of untreated waste

water, and return flow from irrigation. MOPIC estimates of the quantity recharged into the Gaza Aquifer from the various sources are summarized in Table 3.20.

Table 3.20
Groundwater Replenishment for the Gaza Aquifer System

Source of Return Flow	Estimated Quantity (mcm/yr)	Percent Total (%)
Rainfall	46	41
Groundwater Flow From the East	7	6.3
Surface Water Infiltration	2	1.6
Pipe Leakage	13	11.6
Untreated Wastewater	14	12.5
Irrigation	30	26.8
Total	**112**	**100**

Groundwater Flow and Discharge

Under normal hydrological conditions, water will flow from regions of high hydraulic head to regions of lower head, or in the case of the Gaza Strip from east to west toward the Mediterranean Sea. However, over-exploitation of the aquifer has lowered the head in the aquifer and developed an inverse flow pattern, represented by the phenomenon of sea water intrusion. Fresh groundwater discharge to the sea, if it exists, is minor. The aquifer is over exploited by the numerous wells which have been installed almost everywhere in, as well as immediately outside, the Gaza Strip. The total abstraction by wells (the number of wells is not certain) from Gaza is nearly 130 mcm/year (excluding abstraction by the Israeli settlements of 6 mcm /year and nearly 1 mcm/year for industry). It is reported that groundwater storage is being depleted at a rate of about 20 mcm/year (MOPIC 1996). A part of this deficit is compensated by sea water intrusion.

Groundwater Quality

The quality of groundwater in the Gaza Strip has deteriorated over the past thirty years. This deterioration is attributed to salt water intrusion caused by over-exploitation of the aquifer, contamination by untreated wastewater, and pollution from various agricultural activities in sandy areas of the Gaza Strip. Good quality water occurs only in two small pockets; one in the north, and one in the southwest. Most wells in the middle and southern parts of the Gaza Strip are brackish. Saline water upconing is mainly observed in the middle parts of the Strip.

The PWA has analyzed the water quality of all of the potable wells in the Gaza Strip. Seventy eight (78) wells were identified of which no quality data are available except for five wells, and five wells were reported to the "not working yet". The discharge from the remaining 68 wells totals about 40.4 mcm. The wells vary in depth from 40m to 126m with the median at about 80m .

According to WHO standards for health, fluoride should not exceed 1.5 mg/L and NO_3 should not exceed 50 mg/L. Only eight wells met that criteria, for the most part because the NO_3 concentrations are high. The median NO_3 concentration is about three times the standard. Based on the measured discharge rates, these eight wells can produce about 4.5 mcm. Of the eight, one-half has salinity concentrations that exceed WHO standards for taste by at least 40 percent.

Two other sources comment on the quality of water drawn from the aquifer beneath the Gaza Strip. PHG (1994) reports that the salinity in most wells in the south is greater than 2,500 ppm, and in some areas it might reach 7,000 ppm. MOPIC (1996) reported that the major pollutants in the Gaza Strip are nitrate and chloride. Accordingly, they divided the water quality in the Strip into three categories, "good quality", "deteriorated", and "poor quality". They concluded that, on the basis of nitrate and chloride concentrations, only 7 percent of the water pumped into the network is potable. About 55 percent of the water produced in the Strip lies within the poor quality category.

High concentrations of NO_3 are found in the areas around the populated areas. Chloride concentrations are highest in the middle and southeastern parts where it varies between 400 and > 1000 mg/L. The potential sources for nitrate contamination are untreated wastewater and for chlorides, untreated wastewater, sea water intrusion, and upconing of brackish water. It can be concluded that the problem of water quality in the Gaza Strip is equally as important as the problem of water supply.

3.2.1.2 Existing Water Systems

There are about 15 water departments and utilities in the Gaza Strip, and two types of administrative structure: the municipal water departments and the networks operated by UNRWA within the refugee camps. Most or all of the communities have some kind of a network system; however, these existing water supply and distribution systems are inadequate to meet the existing demand, especially in the summer months (UNDP, 1995). Of 12 communities surveyed by the UNDP, only one has a fully functional facility, 6 communities have systems that need rehabilitation and upgrading, and five communities have non-usable systems.

3.2.1.3 Estimated Present Water Supply in Gaza Strip

Water is supplied in Gaza from two sources: the groundwater of the coastal aquifer and Mekoroth. According to data obtained from the PWA and the Ministry of Agriculture (MOA), the total water supply quantity in Gaza for the year 1995 was estimated to be 134.8 mcm. This quantity was supplied from the following sources:

- Municipal wells 41.2 mcm
- Mekorot 4.9 mcm
- Agricultural wells 88.7 mcm

There are approximately 75 active municipal wells which are distributed throughout Gaza Strip (20 in the north, 28 throughout Gaza, 16 throughout Khan Yunis, and 11 throughout Rafah). As discussed previously, the water quality is not adequate as indicated by the results of recent analytical testing. These results indicate that nearly all wells were polluted, where one or more of test parameters, especially chloride, nitrate, and TDS, were detected at levels that exceeded corresponding WHO standards.

3.2.1.4 Present Water Use and Consumption Rates

As with the West Bank, the lack of a detailed database about water consumption rates has resulted in the classification of water uses to three categories:

- Urban and domestic water uses
- Irrigated agriculture
- Livestock water uses

Urban and domestic water uses encompass household, public, industrial, and commercial purposes, as the current water supply data base does not segregate these categories. Finer resolution of present water use by the various sectors is not possible. Estimates of water supply and consumption rates for these uses have been made for the end of 1995.

The available water supply and the resultant use and consumption rates in the Gaza Strip result in a very unsatisfactory situation for its inhabitants. The groundwater aquifer, which is the only current source of water is being mined to meet current use patterns and, as a result, a valuable resource is being damaged and the quality of supply is being made worse.

. . . Urban and Domestic Use and Consumption

In 1995, approximately 46.1 mcm were used in the urban and domestic sector. About 41 mcm was supplied from about 90 wells and the remainder was purchased from Mekoroth. For this analysis, all of the localities in the Gaza Strip are considered to be connected to a pipe distribution system. The total average use is estimated to be 133 L/c/d (based on the end-of-year 1995 population of 949,000).

In Gaza, the overall loss rate was estimated to be about 45 percent, of which 40 percent was estimated to constitute physical losses out of the system and 5 percent for unregistered connections and meter losses. Based on the estimated physical loss rate, the average M&I consumption rate was estimated to be about 80 L/c/d (including minor amounts for livestock). It is expected that some or most of the unregistered connections are included in the total use figure and , therefore, the actual consumption rate could be about five percent higher.

The per-capita domestic consumption rate was estimated to be approximately 70 L/c/d. The estimate was developed assuming that the public, industrial and commercial

sectors (including minor quantities for livestock) would require approximately 12 percent of the total supply.

The per-capita consumption does not present the entire picture, however, in the Gaza Strip. As mentioned in a previous section, the groundwater is of poor quality with only a small percent considered potable and the majority of the water classified as poor quality. Therefore, the adverse impacts of a low per-capita consumption are exacerbated by the poor quality water.

As indicated previously, only a total 4mcm out of the 41.2mcm supplied by municipal wells, may be considered acceptable (based on health considerations). Thus, the total acceptable water supply quantity (assuming that the quantity of 4.9 mcm supplied by Mekoroth is of acceptable quality) would be about 8.9 mcm. This 8.9 mcm corresponds to approximately 19 percent of the total supply quantity, and translates to an acceptable per capita supply rate for domestic use of only about 13 L/c/d. It should be noted this quantity may actually be less than that if the weighted average of concentrations is considered in the analysis.

Livestock Water Use

No estimates were obtained for livestock use in the Gaza Strip; however, the consensus is that the quantities are minimal and are included in the estimates of supply to urban, industrial, and agricultural uses.

Irrigated Agriculture

The total water supply quantity for irrigated agriculture was estimated, based on data obtained from the MOA, to be 88.6 mcm. This quantity accounts for crop requirements, some livestock uses, and losses (i.e., infiltration, evaporation, evapotranspiration, leakage, etc.). It should be noted that water losses in the agricultural supply system are primarily on-farm losses, as most wells are located on farms with no significant water transmission systems. This quantity was supplied to irrigate a total of about 102,000 dunums. The weighted average crop water demand rate was estimated to be about 870 m^3/dunum/year. Water use and average consumption rates for the major crops in the Gaza Strip are presented in Table 3.21.

3.2.1.5 Water Tariff in Gaza Strip

Water tariffs in the Gaza Strip are generally lower than those in the West Bank, except for agriculture which is marginally higher. A summary of the water tariff system in Gaza is presented in Table 3.22.

Table 3.21
Estimated Water Use for Irrigated Agriculture in the Gaza Strip

Crop Type	Irrigated Area (du)	Water Consumption (mcm/yr)	Consumption Rate (m3/du/yr)
Citrus	44,000	49	1,114
Open Field Vegetables	32,000	19.2	600
Green House Vegetables	10,000	10	1,000
Olive	6,000	1.2	200
Guava	4,000	4	1,000
Seasonal Crops	3,200	2	625
Strawberry	2,000	2	1,000
Flowers	800	1.2	1,500
Total	**102,000**	**88.6**	**869 (weighted)**

Table 3.22
Summary of Water Tariff in Gaza Strip

Locality	Customer	Consumption Rate	Water Charges (U.S$/m^3)
Gaza City	Domestic / Industry	1-10 m^3/month (minimum) 11-20 m^3/month 21-30 m^3/month over 30 m^3/month	1.32 (flat rate) 0.12 0.13 0.18
Nusierat, Burej, Magazi, Zaweida	All	Average	0.25
Beit Hanon, Beit lahia, Jabalya (and camp)	All	Average	0.165
Gaza Strip	Agriculture	Average	0.18

3.2.1.6 Existing Wastewater Facilities

. . . Sewerage Systems

The situation of the sewerage systems in the Gaza Strip is more critical than that of the West Bank. The municipal connection rate in the major cities is shown in Table 3.23. Some cities and large towns have no system at all, and wastewater is discharged into septic tanks and/or cess pits which are emptied by vacuum trucks and disposed of either in a treatment plant or dumped into wadis.

Table 3.23
Urban Wastewater Production in the Gaza Strip

Municipality	Water Supply (m^3/d)	Estimated Physical Losses (%)	Estimated Total Consumption (m^3/d)	Collection System Coverage (%)	Wastewater Production Rate (m^3/d)	Type of Treatment Plant
Gaza city	54,000	40	32,400	40%	10,400	AL
Rafah	13,700	40	8,200	35%	2,300	AL
Jabalia	20,100	40	12,100	70%	6,800	Al

AL; Aerated lagoon:
It is assumed that 80 percent of the consumed water will be produced as wastewater
Quantities are rounded to the nearest 100.

The situation in the refugee camps is even worse. Wastewater is channeled into open drains until it flows into either a sewage network in a nearby city or is simply exported to outside the camp boundaries. No sewage network exists in villages, and wastewater is discharged into cesspits or septic tanks.

The conditions of the sewerage systems vary, depending on the age and material of the pipes. Older pipelines, especially those of glazed clay, are badly deteriorated or are undersized to accommodate an increased wastewater flow. In some areas, the system has deteriorated due to poor connections made by local unqualified plumbers or by households themselves. There are three operating treatment plants in the Gaza Strip: Gaza City, Jabalia and Rafah. The efficiency of the existing treatment plants is low. They are old and capacities are not sufficient to handle current wastewater flows. The plants were never properly operated and maintained, and equipment were rarely maintained.

. . . Present Practice of Wastewater Reuse in Gaza Strip

Direct reuse of raw wastewater for irrigation is also practiced in the Gaza Strip but to a lesser extent than that in the West Bank. There is presently no control of these practices such that agricultural products are not checked, and sanitary conditions for workers are poor, and soil and groundwater is likely poor. The farmers using the raw wastewater are aware of the poor water quality, the variation of quality during the day, its nutrient value, its possible improvement (through sedimentation), and clogging problems associated with localized irrigation systems (crops are furrow irrigated). They have tested different crops and selected the successful types. Products irrigated with raw sewage are sold in local and adjacent markets. Reuse of wastewater has been taken into consideration when designing some of the treatment plants in Gaza Strip, but it has never been successful. Two projects for reuse of wastewater in the Gaza Strip have been attempted during the last 10 years. The first attempt was in Gaza City in 1986 where UNDP funded a project to expand and up-grade the treatment plant in Gaza. The project added two more ponds to the existing system, and an effluent reuse scheme for irrigation was constructed. The schemes consisted of a booster pump feeding a 5,000 m^3 reservoir, the treated wastewater was to be distributed to 15 farmers who were provided

with pipelines to their lands. In addition, the project furthermore reserved an area of 40 dunums for an infiltration basin for surplus treated wastewater. The project failed right from the start due to the following reasons :

- The municipality was unable to operate the system due to under staffing, lack of funds and lack of trained engineers.
- The idea of reuse was not readily accepted by the farmers who had no incentive to use treated wastewater since they could obtain fresh water from private wells at lower costs.
- Since it was surrounded by private land, the plant could not be expanded for improvement of effluent quality.
- The effluent quality did not meet the standards required for reuse (DANIDA, 1996).

A second attempt at wastewater reuse was made in Jabalia by the UNDP and the Jabalia Village Council. The project in Jabalia failed for the same reasons as above but with an additional political aspect. Farmers refused the idea out of fear that the Israeli Civil Administration would strengthen its control over the water resources and thus disallow future use of private wells once the farmers had accepted wastewater reuse.

In Khan Younis, a small-scale project to reuse the treated wastewater from the new Gaza Hospital is currently underway under the supervision of the Ministry of Agriculture (MOA) and the PWA. The treatment facilities are under construction and the hospital is expected to generate approximately 140 m^3 /day. Plans call for the use of sprinkler irrigation on 90 dunums of olive, palm trees, vegetables and other crops.

3.3 Future Water Demands in the West Bank and Gaza Strip

3.3.1 General

The total water use by the various sectors in the West Bank and Gaza Strip during 1995 was estimated to be 269 mcm. An amount of approximately 134 mcm was used in the West Bank, whereas a total of approximately 135 mcm was used in Gaza. A summary of these quantities and their distribution by sector and by location is presented in Table 3.24.

3.3.1.1 Rationale

The historic water demands in the West Bank and Gaza Strip have been artificially constrained by non-market forces. As a result, they cannot be used to forecast future demands. In fact, on the basis of various world and regional water consumption levels, the present magnitude of unsatisfied demand nearly surpasses current supplied quantities. Thus, it is necessary to plan for and develop more equitable, yet feasible, future water consumption rates and supply capabilities for needed social and economical development. Water demands projected herein represent forecast "potential" demands. That is, the forecasts for the various sectors represent

Table 3. 24
Estimated Total Present Use - By Sector [1]

District	Population [2] (10^3)	Use Quantity (mcm/year)					
		Domestic & Urban [3] [4]	Livestock [6]	Irrigated Agriculture	Subtotal [7]	Others [8]	Total
Hebron	290	6.2	2.1	0.3	8.6		8.6
Bethlehem	138	4.3	0.5	0.9	5.7		5.7
Jenin	180	3.9	1.4	4.1	9.4		9.4
Tulkarm	173	7.3	0.4	14,5	22.2		22.2
Nablus	286	8.8	1.0	24,0	33.8		33.8
Ramallah	244	6.7	1.0	1.1	8.8		8.8
Jericho	28	1.4	0.2	35.1	36.7		36.7
Jerusalem [5]	224	8.1		0,6	133,9		8.7
West Bank	**1.563**	**46.7**	**6.6**	**80.6**	**133,9**	**5.1**	**139.0**
Gaza Strip	949	46.1		88.7	134.8		134.8
Total	**2.512**	**92.8**	**6.6**	**169.3**	**268.7**	**5.1**	**273.8**

[1] Values are estimated for the end of year 1995 based on data provided by the PWA, WBWD, JWU, WSSA, and Municipalities
[2] Population estimates for the end of 1995 are based on PCBS estimates for mid year 1996 and 3% annual population growth rate.
[3] Total supply accounts for piped and un-piped communities for domestic, public, commercial & industrial purposes.
[4] Water sources for un-piped communities include private wells, springs, and/or rainwater collection cisterns. Quantities for un-piped communities have been estimated based on average per capita supply of 30L/c/d.
[5] Urban/domestic water supply has been estimated based on an average per capita supply rate of 100 L/c/d, obtained for communities in Jerusalem supplied by the JWU, WBWD or Jerusalem Municipality. No data about agricultural supply is presently available.
[6] Livestock are assumed to be supplied from the water supply network, agricultural wells, springs, and/or rainwater cisterns. Livestock in Gaza Strip & Jerusalem is assumed to be lower than that for other districts and is assumed to be included in the agricultural and municipal uses.
[7] This quantity represents the total use for Palestinian communities.
[8] This quantity accounts for the WBWD supply (and corresponding losses) to Jewish settlements in the West Bank.

unconstrained demands that would result during the planning period if present constraints on supply were relaxed. They assume that:

- There are no artificial, non market constraints on supply.
- There are no physical constraints on supply.
- Within the time frame associated with a demand forecast, economic growth will have occurred in the demand sector sufficient to create a willingness-to-pay consistent with the demand quantity and price.

The quality of water that will actually be demanded at a future point in time by a particular sector will be less than or equal to the forecast potential. It will be less than this potential to the extent that one or more of the assumptions does not hold. For example, if in a particular alternative there is insufficient source water or transmission capacity within the water resources infrastructure to meet the forecast potential demand, then the actual quantity supplied will be limited by the system capacity, and some of the forecast demand will go unsatisfied. Similarly, if the price of a unit of water exceeds the value of the water to the user. Demand will be reduced in that water sector. It is assumed that, within the range of likely prices that might be charged to water users:

- Domestic demand is price inelastic
- Industrial demand is price inelastic.
- Agricultural demand is price elastic, and can be manipulated through market mechanisms.

Implicit in these assumptions about price elasticity is a further assumption about the nature of future economic growth that is likely to occur in the West Bank and Gaza:

- The amount of irrigable land in the West Bank and Gaza is limited and declining.
- The use of land and water for agricultural production will provide only very limited employment and economic growth potential.
- Land and water will have a much higher economic value if used in industry.
- The Palestinian population will grow substantially between now and the year 2040.

It is unlikely that future development in the agricultural sector will be able to provide sufficient employment and economic opportunity to support the growing Palestinian population at an economic level which matches the aspiration and capabilities of the Palestinian people. It is assumed, therefore, that the economic future of the West Bank and Gaza will be largely based upon the development of light industry and regional commerce, and that the assumed future demand for, and value of, water will reflect these characteristics of the Palestinian economy.

3.3.1.2 Strategy

Water demand projections for the Comprehensive Planning Framwork (CPF) as proposed in the CDM/ Morganty Study are based on the following strategy:

- Demand forecast are based on target consumption rates, particularly for domestic consumption rates.
- Water demand and supply is prioritized, with the highest priority assigned to domestic uses.
- Rates are increased gradually during the early planning periods until target levels are reached, after which these rates are increased at a declining rate to reflect various constraints that are imposed on these rates.
- Various constraints are assumed at different planning periods. Initially, rates are constrained due to technical, institutional, and political limitations on available water resources and supply systems. At later planning periods, it is assumed that rates are constrained by imposed structural (i.e. water resources, and supply systems, including plumbing fixtures), and non-structural (i.e. pricing, managerial, and other conservation mechanisms) limitations, for purposes of water conservation.
- Water conservation is inherent in these rates, as it is assumed that losses will be gradually reduced from current levels. This reduction is predicated on the assumption that the water supply system will be upgraded and adequately managed by well staffed and equipped utilities along with the necessary maintenance programs.

3.3.2 Population

Future population estimates, are based on 1996 PCBS estimates of population (except for Ramallah and Al-Bireh Municipalities, which were based on Dahlem, 1996) and prescribed growth rates. Estimates of growth rates are based on past surveys of population growth rates in the West Bank and Gaza between 1967 and 1992 (PCBS, 1994). These surveys indicated that these rates generally fluctuated between 1 and 3 percent for the West Bank, and between 2 and 4 percent for Gaza Strip. This figure indicates that population has been closely linked to political events. This is clearly manifested for the periods 1967 through 1969, and 1987 through 1992. The former which was characterised by a decrease of the overall population, was attributed to the Israeli occupation of the West Bank and Gaza. The latter, which was characterized by increasing growth rates, was attributed to the combined effects of the Palestinian Intifada (which began in 1987), events in the Persian Gulf, and recent peace negotiations. Accordingly, the following declining growth rates have been adopted with the concurrence of the PWA:

- 3 percent for the period 1996 to 2000
- 2.5 percent for the period 2000 to 2020
- 2 percent for the period 2020 to 2040

These rates are intended to envelope the overall historic trends in population growth and the potential future changes in life style in the West Bank and Gaza Strip. Moreover, these rates approach the medium series estimated in PCBS (1994) without the infusion of returnees.

In this CPF study, the total number of returnees has been assumed to be 500,000, with 400,000 returning to the West Bank and 100,000 to Gaza Strip. For purposes of this master plan, these 500,000 returnees were simply added to the population figures projected for the Year 2000 based on the prescribed growth rate and 1996 population estimates. Returnees were allotted for the West Bank districts based on current proportions of population distribution.

On these bases the total population in the West Bank and Gaza was estimated to increase over 1996 figures by approximately 40 percent, more than double, and more than triple for years 2000, 2020 and 2040, respectively. Corresponding average growth population densities in the West Bank were estimated to be 390, 640, and 950 person/km^2, and 3,300, 5,400, and 8,000 person/km^2 in Gaza Strip, respectively. A summary of these projections is presented in Tables 3.25.

Table 3.25
Population Projections for the West Bank and Gaza Strip

District	Population [1,2]			
	1996 [1]	2000 [2]	2020	2040
Jenin	182,516	254,500	417,100	619,800
Tulkarm	175,698	245,000	401,500	596,600
Nablus	289,372	403,600	661,300	982,600
Ramallah	247,990	345,800	566,700	842,100
Jerusalem	227,475	317,200	519,800	772,400
Bethlehem	139,925	195,200	319,800	475,200
Hebron	294,116	410,200	672,100	998,700
Jericho	28,083	39,200	64,200	95,400
Subtotal West Bank,	**1,585,175**	**2,210,700**	**3,622,500**	**5,382,800**
Gaza	963,028	1,200,000	1,966,400	2,922,000
Total	**2,548,203**	**3,410,700**	**5,588,900**	**8,304,800**

[1] Population estimates are projected for the end of each planning year.
[2] Population growth rates as approved by the PWA are : (1) 3.0% from 1996 to 2000. (2) 2.5% from 2000 to 2020, and (3) 2.0% from 2020 to 2040.
[3] Population estimates for 1996 represent mid-year and are based on PCBS estimates (1996)
[4] A total of 500,000 returnees has been included in these figures, 400,000 to the West Bank and 100,000 to Gaza Strip. Returnees to the West Bank have been allocated for each district on the basis of current proportions of population distribution.

It should be noted that other configurations of population growth rates and assumptions of distribution of returnees may also be proposed. Naturally, any approach for forecasting demographic changes in a given area will have to be based upon many political, economical, social, and logistical considerations. One measure of the possible validity of these approaches is the corresponding population densities that they forecast, and the ability of the system to furnish the required infrastructure and services to meet developmental needs and sustain livelihood for such densities.

Currently, there are no measures or criteria to examine the adequacy of the presumed configuration of growth rates and returnee distribution assumed in this master plan. However, it is expected that other configurations that rely on a similar pattern of growth of communities and re-allocation of returnees will likely result in similar forecasts of population densities and the resulting prediction of water demands and allocation of water resources.

3.3.3 Domestic Water Demand

To bridge the gap between Palestinian domestic water supply and demand, target levels were established for this planning study. Two target rates have been set for domestic water consumption based on "Guidelines on Technologies for Water Supply Systems in Small Communities", published by the WHO, 1993. These rates are 100 L/c/d (a minimum WHO rate for house connections in small communities), and 150 L/c/d (a typical WHO average rate for house connections in small communities), which are to be met after 10 and 20 years, respectively. These target years correspond to planning years 2005 and 2015 (based on year 1995), respectively. Consequently, domestic water consumption rates for other planning years have been interpolated/extrapolated based on these targets. These target and projected rates are shown in Table 3.26.

Similarly, targets have been set for physical losses. Currently, the average overall loss rate is 40 percent. For this planning program, it is targeted to reduce the loss rate gradually from 40 percent to 25 percent over a20-year period (Table 3.26).

Targeted average consumption rates are 75, 158, and L/c/d for years 2000, 2020, and 2040, respectively. Population projections were used to calculate total domestic water demand for years 2000, 2020, and 2040. Table 3.27 shows the forecast future domestic demands proposed for the CPF. The total domestic water demand was estimated to be approximately 145, 428, and 688 mcm, for years 2000, 2020, and 2040, respectively.

Table 3.26
Target Consumption and Demand Rates

Target Year	Domestic Consumption		Public Consumption		Livestock Consumption		Industrial Consumption		Total M&I (#)	Overall	Total
	Rate (*) (L/c/d)	Ratio of M&I (%)	Rate (L/c/d)	Ratio of M&I (%)	Rate (L/c/d)	Ratio of M&I (%)	Rate (L/c/d)	Ratio of M&I (%)	Consumption Rate (L/c/d)	Loss Rate (%)	Demand Rate (L/c/d)
2000	75	0.73	7	0.07	13	0.13	7	0.07	102	40	170
2005	100	0.77	8	0.06	13	0.10	9	0.07	130	35	200
2010	126	0.78	9	0.06	13	0.08	13	0.08	161	30	230
2015	150	0.79	11	0.06	13	0.07	15	0.08	189	25	250
2020	158	0.78	12	0.06	13	0.06	20	0.10	203	25	270
2040	170	0.77	13	0.06	12	0.05	26	0.12	221	25	295

(*) Domestic consumption rates of 100 L/c/d (minimum WHO rate for house connections) and 150 L/c/d (typical WHO average rate for house connections in small communities), are targets to be met in 10 and 20 years (reference is year 1995), respectively.
(#) M&I = Total municipal and industrial (domestic, public, industrial, commercial, and livestock).

Table 3.27
Projection of Potential Annual Domestic Water Demand [1]

Year	2000		2020		2040	
District	**Population**	**Quantity (mcm)**	**Population**	**Quantity (mcm)**	**Population**	**Quantity (mcm)**
Hebron	410,000	19	672,000	52	999,000	83
Bethlehem	195,000	9	320,000	25	475,000	39
Jenin	255,000	12	417,000	32	620,000	51
Tulkarm	245,000	11	402,000	31	597,000	49
Nablus	404,000	18	661,000	51	983,000	81
Ramallah [3]	346,000	13	567,000	43	842,000	70
Jericho	39,000	2	64,000	5	95,000	8
Jerusalem	317,000	14	520,000	40	772,000	64
West Bank	**2,211,000**	**98**	**3,622,000**	**278**	**5,383,000**	**446**
Gaza Strip	1,200,000	54	1,966,000	150	2,922,000	242
Total	**3,411,000**	**152**	**5,588,000**	**428**	**8,305,000**	**688**

[1] Annual per capita domestic water demand including losses rates as approved by the PWA are:

Year	Consumption Rate (L/c/d)	Losses (%) [2]	Demand Rate (L/c/d)
2000	75	40	125
2020	158	25	210
2040	170	25	227

[2] Losses are estimated as percentages of demand rates.
[3] The current loss rate of 25% was used for Ramallah instead of the average rate of 40% for the year 2000. This loss rate along with the target consumption rate of 75 L/c/d yields a demand rate of 100 L/c/d.

The water demand quantities for Ramallah and Gaza Strip for the year 2000 were estimated based on the loss rates of 25 percent and 30 percent, respectively. The loss rate of 25 percent used for Ramallah corresponds to the currently estimated loss rate. Note that these and other demand estimates represent water demands that would be expected to occur if current physical and artificial non-market constraints on Palestinian water supply were to be removed. They also assume that economic conditions in the West Bank and Gaza Strip will be such that consumers will have the ability and willingness to pay for water services at a level consistent with the marginal costs of water supplied.

3.3.4 Public Water Demand

No detailed estimates are available for current public water consumption rates. To arrive at some representative figures, JWU and WSSA records of water consumption quantities and water consumption patterns and services in communities served by these utilities were reviewed and assessed. This review indicates public water consumption rates in these communities may constitute approximately 4 to 8 percent of the total (M&I) municipal and industrial (domestic, public, commercial, industrial, and

livestock) water consumption. In the planning study, future public water demands have been projected on a per capita basis according to a ratio of the total M&I water consumption of about 7 percent (for year 2000) and 6 percent, thereafter (Table 3.26). These estimates are based on similar loss rates to those used in developing the domestic water demands rates. A summary of projected future public water demand is presented in Table 3.28.

Table 3.28
Projection of Potential Annual Public Water Demand (1)

Year	2000		2020		2040	
District	**Population**	**Quantity (mcm)**	**Population**	**Quantity (mcm)**	**Population**	**Quantity (mcm)**
Hebron	410,000	1.8	672,000	3.9	999,000	6.2
Bethlehem	195,000	0.9	320,000	1.9	475,000	2.9
Jenin	255,000	1.1	417,000	2.4	620,000	3.8
Tulkarm	245,000	1.1	402,000	2.3	597,000	3.7
Nablus	404,000	1,8	661,000	3.9	983,000	6.1
Ramallah (4)	346,000	1.1	567,000	3.3	842,000	5.2
Jericho	39,000	0.2	64,000	0.4	95,000	0.6
Jerusalem	317,000	1.4	520,000	3.0	772,000	4.8
West Bank	**2,211,000**	**9**	**3,622,000**	**21**	**5,383,000**	**33**
Gaza Strip	1,200,000	5	1,966,000	11	2,922,000	18
Total	**3,411,000**	**14**	**5,588,000**	**32**	**8,305,000**	**51**

(1) Annual per capita domestic water demand including losses rates as approved by the PWA are:

Year	Consumption Rate (L/c/d) (2)	Losses (%) (3)	Demand Rate (L/c/d)
2000	7	40	12
2020	12	25	16
2040	13	25	17

(2) Rates are estimated as ratios of the total M&I water consumption rate at about 7% for year 2000, and 6% thereafter.
(3) Losses are estimated as percentage of demand rates.
(4) The current loss rate of 25% was used for Ramallah instead of the average rate of 40% for the year 2000. This loss rate along with the target consumption rate of 7 L/c/d yields a demand rate of 9 L/c/d.

3.3.5 Livestock Water Demand

Livestock water demand rates have been calculated on a per capita (population) basis. A per capita (weighted average) livestock water consumption rate of 13 L/c/d was assumed for all planning years, except for year 2040 where a 12 L/c/d was assumed. Corresponding per capita livestock water demand rates were developed based on loss rates similar to those used for domestic water demand rates. A summary of projections of future livestock water demand is presented in Table 3.29.

Table 3.29
Projection of Equivalent Annual Livestock Water Demand [1]

Year	2000		2020		2040	
District	**Population**	**Quantity (mcm)**	**Population**	**Quantity (mcm)**	**Population**	**Quantity (mcm)**
Hebron	410,000	3.3	672,000	4.2	999,000	5.8
Bethlehem	195,000	1.6	320,000	2.0	475,000	2.8
Jenin	255,000	2.0	417,000	2.6	620,000	3.6
Tulkarm	245,000	2.0	402,000	2.5	597,000	3.5
Nablus	404,000	3.2	661,000	4.1	983,000	5.7
Ramallah [2]	346,000	2.1	567,000	3.5	842,000	4.9
Jericho	39,000	0.3	64,000	0.4	95,000	0.6
Jerusalem	317,000	2.5	520,000	3.2	772,000	4.5
West Bank	**2,211,000**	**17**	**3,622,000**	**22**	**5,383,000**	**31**
Gaza	1,200,000	5	1,966,000	8	2,922,000	12
Total	**3,411,000**	**22**	**5,588,000**	**30**	**8,305,000**	**43**

[1] Equivalent livestock water demand is projected based on demand rates of 22, 17, and 16 L/e/d for years 2000, 2
2040.
Respectively. These rates are based on the existing livestock water demand (i.e. 1996 livestock water demand divi
by the population), and include losses at the following rates:

Year	Losses (%)
2000	40
2020	25
2040	25

[2] The current loss rate of 25% was used for Ramallah instead of the average rate of 40% for the year 2000. This loss rate yields a demand rate of 17 L/c/d for the year 2000.
[3] An equivalent livestock water demand rate of 11 L/c/d was assumed for Gaza for all planning periods.

3.3.6 Commercial and Industrial Water Demand

Due to a lack of detailed economic and industrial development plans for the Occupied Palestinian Territories, it is not possible to base estimates of future commercial and industrial demand on economic projections. As a result, projected industrial and commercial water demands have been calculated as an assumed percentage of the total M&I water demand. Present commercial and industrial water consumption rates have been estimated based on data provided by the JWU, WSSA, and other reports (ARIJ, 1995 a, b, c, and 1996; WESC, 1995; World Bank, 1993c; Planner and CEP, 1997a). The average of present commercial and industrial water consumption was estimated to be about 6 to 8 percent of the total water consumption within the West Bank and Gaza. Naturally, as for other water sectors, this consumption rate varies among districts. Future commercial and industrial water demand quantities have been estimated to be 7 percent, 10 percent, and 12 percent of the total M&I demand for years 2000, 2020, and 2040m respectively. The commercial and industrial water demand for year 2000 was maintained at the same present average level. Such a scheme, which has been

developed in concurrence with the PWA, indicates a slow industrial growth between 1996 and 2000, a rapid growth between 2000 and 2020, and a moderate but stable growth, there after. This scheme is designed to sustain and facilitate the growth of existing industries and phased development and implementation of possible industrial zones. A summary of projections of future commercial and industrial water demands is presented in Table 3.30.

Table 3.30
Projection of Potential Annual Industrial, and Commercial Water Demand [1]

Year	2000	2020	2040
District	**Quantity (mcm)**	**Quantity (mcm)**	**Quantity (mcm)**
Hebron	1.8	6.6	12.9
Bethlehem	0.9	3.2	6.1
Jenin	1.1	4.1	8.0
Tulkarm	1.1	4.0	7.7
Nablus	1.8	6.5	12.7
Ramallah	1.2	5.6	10.9
Jericho	0.2	0.6	1.2
Jerusalem	1.4	5.1	10.0
West Bank	**9**	**36**	**70**
Gaza Strip	5	19	37
Total	**14**	**55**	**107**

[1] Annual industrial water demand (consumption for year 1996) is estimated according to the following percentages of total M&I (domestic, public, industriall and livestock) demand including losses :

Year	Ratio of Total M&I Water Demand (%)	Losses (%)
1996	7	40
2000	7	40
2020	10	25
2040	12	25

3.3.7 Projected Treated Wastewater Quantities

Several factors were considered for projecting wastewater quantities. These factors, along with water demand projections were used to estimate quantities of raw and reclaimed wastewater (that may be available for reuse) in the various districts of the West Bank and Gaza Strip, as summarized in Table 3.31. The table indicates that projected quantities of wastewater which will be treated and those which will be available for reuse by year 2020 are 165 and 119 mcm, respectively. These quantities will double by year 2040 reaching 321 and 231 mcm respectively. Accordingly, approximately 22 and 30 percent of the total M&I water supply (demand) would be

available for reuse in both the West Bank and Gaza Strip by years 2020 and 2040, respectively.

Table 3.31
Projected Potential Wastewater Quantities

District	Year 2020 Wastewater Quantities		Year 2040 Wastewater Quantities	
	Collected for Treatment (mcm/year)	Available for Reuse (mcm/year)	Collected for Treatment (mcm/year)	Available for Reuse (mcm/year)
Hebron	20	14	39	28
Bethlehem	9	7	18	13
Jenin	12	9	24	17
Tulkarm	12	9	23	17
Nablus	20	14	38	27
Ramallah	17	12	33	24
Jericho	2	1	4	3
Jerusalem	15	11	30	22
West Bank	**107**	**77**	**208**	**151**
Gaza Strip	**58**	**42**	**113**	**81**
Total	**165**	**119**	**321**	**232**

Principally, the reuse options of reclaimed wastewater may include :

- irrigation
- industrial purposes
- urban dual systems (for toilet flushing, floor/street cleaning, fire fighting, loan/garden watering, etc.)
- groundwater recharge

Although, other reuse options may also be feasible, development plans in the CPF will only consider reuse for irrigation, as other reuse or recharge schemes may require more detailed and refined assessment for which much of the necessary information is not available, and are beyond the scope of the study. It should be noted, however, some localized urban reuse or groundwater recharge schemes may be considered when developing reuse schemes for agriculture. Such a case may be encountered in districts or localities where available treated wastewater quantities are in excess of the irrigation demand (either seasonally or annually).

3.4 Summary of Palestinian Water Demand Forecasts

A summary of the potential total future Palestinian water demand is presented in Table 3.32. Projected total water quantities were estimated to be approximately 372,793, and 1,194 mcm, for years 2000, 2020 and 2040, respectively. The average total per capita

M&I (domestic, public, livestock, commercial, and industrial) water demand rate was estimated to be about 170, 270, 295 L/c/d, for years, 2000, 2020, and 2040, respectively. Demands forecast for year 2000 exceed current supplies everywhere in the West Bank and Gaza, and total forecast demands for year 2000 approximate the total water allotted for Palestinian use under Article 40.

Table 3.32
Projection of Potential Total Water Demand (1)

Year	2000	2020	2040
District	**Demand (mcm)**	**Demand (mcm)**	**Demand (mcm)**
Hebron	26	81	136
Bethlehem	13	39	65
Jenin	20	54	87
Tulkarm	30	63	95
Nablus	49	112	157
Ramallah	18	69	116
Jericho	38	46	42
Jerusalem	20	63	106
West Bank	**213**	**526**	**804**
Gaza Strip	158	267	390
Total	**371**	**793**	**1,194**

(1) Total Annual demand includes domestic & public, livestock, agricultural, commercial and industrial demand.

It should be noted that projected future water demand rates represent an aggregate average for the West Bank and Gaza Strip. District-specific potential water demand patterns may be different than the average patterns assumed herein (e.g., commercial water demands for tourism in Bethlehem and Jerusalem may be higher than the assumed overall average, whereas these demands could be lower in Tulkarm). Similar situations may be encountered for industrial or agricultural water demands, where land use or climatic conditions are different than the overall assumed average. Such refined and micro-scale estimates and patterns could only be addressed in an integrated water management plan at the district level, and where adequate data are available.

3.5 Planning Framework Development

3.5.1 A Vision for Development of Palestinian Water Resources

A general set of principles for providing overall direction for development of Palestinian water resources has been assembled and used under this study to guide the preparation of the various planning alternatives, both for the short and long term. These general principles, which are collectively called the "Vision" for development of Palestinian water resources, consist of these major components :

- Economic and social development

- Public health and environmental protection
- Autonomous water resources management within a framework of regional cooperation on management of shared water resources
- Efficient and equitable water allocation

3.5.1.1 Economic and Social Development

Water is an economic good. Beyond the basic requirements for human survival, scarcity of water is an economic issue which can be addressed in terms of the value of water for a particular use versus the cost of supplying water for the use. However, Palestinian economic and social development should not be forced to proceed in a regional climate of uncertainty in the security of water supplies and inequities in water prices. As a necessary condition for development, Palestinians are entitled to sustainable, secured water supplies at dependable, affordable prices.

Except for unusual circumstances, Palestinian water resources are usufructory. That is, through appropriate licensing and permitting processes, users of water resources may obtain clear ownership of a right to use the resource, but ownership of the resource itself resides collectively with the Palestinian People. Policies of the management of Palestinian water resources are the responsibility of the Palestinian Authority.

In the long-term, it is unlikely that future development in the agricultural sector will be able to provide sufficient employment and economic opportunity to support the growing Palestinian population at an economic level which matches the present aspirations and capabilities of the Palestinian people. Therefore, the economic future of the Occupied Palestinian Territories will be based largely upon the development of light industry and regional commerce, and the projected future demand for, and value of, water will reflect these characteristics of the Palestinian economy.

Accordingly, by the year 2020, growing agricultural demands will generally be satisfied last, after the water demands of other, higher-valued uses have been addressed. The exception to this will be in the employment of lower-quality water--such as treated wastewater or use of blended brackish water--for irrigation, to the extent that such opportunities prove to be physically and economically feasible.

In the near term, there must be increased deliveries to domestic users to address the shortages in the domestic sector that have developed as the result of 30 years of non-Palestinian management of water. In the intermediate term, Palestinian water resources development must foster and support diversification and growth in the Palestinian economy, to expand industry and commerce and improve income and employment opportunities. Therefore, water supplies must be increased for commercial and industrial users.

3.5.1.2 Public Health and Environmental Protection

Palestinian water resources are scarce, and so must be protected from pollution and over-exploitation. Moreover, as greater quantities of water are made available for Palestinian domestic and industrial use, greater quantities of wastewater will be produced, thereby increasing the threat of pollution. To protect public health, to preserve scarce Palestinian water resources, and to actively and responsibly participate in the management of regionally shared water resources, an effective program of wastewater collection, treatment, reuse, and disposal must be an integral component of the development of Palestinian water resources.

3.5.1.3 Autonomous Water Resources Management

Within the tenets of international water law, and in accordance with the 1996 Declaration of Principles for Co-operation on Water-Related matters and New and Additional Water Resources, it is necessary that control over Palestinian water resources rest with the Palestinian Authority. Therefore, water resources policies, management strategies, and infrastructural designs must seek to extend control by Palestinians over Palestinian water resources. These strategies will have to be founded on regional cooperation in the management of shared water resources, they must recognize the importance of locally-compatible legal, economic, and institutional frameworks and principles, and they should include the possibility of exchange of water in the interest of minimizing costs.

3.5.1.4 Efficient and Equitable Water Allocation

It is necessary to address the regional inequities in water supply and prices that have developed in the last 30 years. It is also necessary to establish the infrastructure to provide water to all Palestinians in an equitable, efficient, and reliable manner. In the intermediate- and long-term, it is imperative that water supply systems throughout the West Bank and Gaza Strip be upgraded and extended so that all Palestinians can be given access to quantities of water required to support public health needs, develop economically, and enjoy a quality of life to which they are entitled.

3.5.1.5 Short-Term Water Supply Alternatives

In the short-term, say by year 2000, Palestinian water demands in the domestic, public, and industrial sectors are expected to be substantially greater than present supplies. Total Palestinian water demand for both the West Bank and the Gaza Strip are forecast to be approximately equivalent to the total Palestinian supply allotted under the terms of Article 40 of the Interim Oslo Accords.

If all the water identified for Palestinian use under Article 40 could be made available by the year 2000, the quantity supplied would just meet the total water demands of year 2000. The remaining demands could be met by developing new water from the Eastern

Aquifer System (Alternative 1) or from a combination of the Eastern, Western, and Northeastern Aquifer Systems (Alternative 2).

3.5.1.6 General Approach for Design of Long-Term Water Supply Scenarios

To address the uncertainty in the future availability of inexpensive, local water resources for Palestinian use, the intermediate and long-term (i.e., the year 2020 and 2040) alternate scenarios of the CPF are based upon different assumptions about the outcome of the Final Status Negotiations with respect to water. In this way, the CPF long-term scenarios will :

- Offer a description of the tradeoffs--in terms of costs, quantities, technologies, development potential, satisfaction of demand, etc.--that are implied by alternative assumptions regarding the ultimate allocation of water resources that are shared by Palestinians and Israelis.
- Span the range of possible outcomes of the Final Status Negotiations
- Provide suggested guidelines for future Palestinian water development, regardless of the results of the Final Status Negotiations
- Generate information regarding the equity of water resource distribution that might be implied by alternative Final Status Negotiations

The long-term CPF scenarios are based on different assumptions about how much water from the West Bank mountain aquifers and the Jordan River that the Palestinians will be allocated. The Base Scenario--which should be seen as a default or "do nothing" scenario--assumes that the quantity of local water which will be available for Palestinian use is that indicated by the terms of Article 40 of the Oslo Agreement. The Base Scenario would leave the Palestinians seriously short of water in the very near future, and would certainly jeopardize future Palestinian economic and social development.

3.5.1.7 Assignment of West Bank Water Resources for Long-term Scenarios

For the CPF, the West Bank renewable local water resources comprise groundwater of the mountain (Eastern, Northeastern and Western) aquifer system, and surface water of the Jordan River, flood water and wadi flows.

Since there is no accurate agreed-upon estimate of the sustainable safe yields or renewable quantities of the aquifers in the West Bank, the figures referenced in Schedule 7 of Article 40 of the September 1995, Oslo II Agreement are considered herein as the CPF reference. Although not explicitly stated, the quantity identified as "Total" for each of these aquifer systems in Article 40, is considered in the CPF to be the "total annual renewable recharge" or the "sustainable safe yield". Accordingly, the total annual renewable recharge and potentially available quantities for further development are summarized in Table 3.33.

Table 3.33
Summary of Groundwater distribution Based on Article 40

Aquifer System	Total for Palestinian Use (mcm)[1]	Total for Israeli Use (mcm)	Quantities Remaining for Development (mcm)[3]	Total Annual Recharge (mcm)
Eastern	54 (61)	40	78 (71)	172
Northeastern	42 (32)	103	- (10)	145
Western	22 (24)	340	-	362

[1] Numbers in parentheses reflect Palestinian withdrawal quantities, recorded by the West Bank Water Department (WBWD) for year 1995.

[2] Numbers in parentheses reflect estimated quantities remaining for further development by Palestinians, based on recorded withdrawal quantities for year 1995.

As can be seen from Table 3.33, estimated quantities (based on Article 40 and recorded current withdrawal rates) remaining for further development by Palestinians from West Bank aquifers are 71 and 10 mcm (vis-a-vis 78 and 0 mcm in Article 40) from the Eastern and Northeastern Aquifer Systems, respectively. The total annual renewable recharge for the Eastern, Northeastern, and Western Aquifer Systems is 172, 145, and 362 mcm, respectively. Thus, the total annual groundwater recharge in the West Bank is taken to be 679 mcm. In developing the CPF, this quantity will be considered as the total groundwater quantity available in the West Bank. It should be noted that the total renewable quantity (and quality) and the breakdown of recharge quantities in the West Bank, is uncertain and remain to be verified based upon the findings of future studies.

Likewise, there are no accurate records nor agreed assignment of the Jordan River flow and surface runoff with regard to the West Bank. Therefore, for purposes of this planning, it is arbitrarily assumed that the total of the Jordan River flow and surface runoff assigned as West Bank "local resources" is taken to be 300 mcm. This quantity is within the range of literature reported estimates (WESC, 1995 and 1996; Libiszewski, 1995; Isaac and Shuval, 1994; Assaf et.al., 1993). The assignment of local water resources among the various scenarios is summarized in Table 3.34.

. . . Base Scenario

The portion of local water resources assigned to the Base Scenario reflects the present supply in addition to the quantities conceptually remaining for further development based on Article 40. These quantities are the 71 mcm and 10 mcm from the Eastern and Northeastern Aquifer Systems, respectively (Table 3.33). The total quantity of local water resources assigned to this Base Plan is 198 mcm (approximately 20 percent of the total 979 mcm) which reflects an increment of about 8 percent beyond the present utilization. A breakdown of the ultimate assignment of local water resources conceptualized for the Base Plan and three alternate scenarios is presented in Table 3.34.

Table 3.34
Conceptual Assignment of West Bank Water Resources At Long-Term Scenarios

Case [4]	Groundwater [1] [2]								Jordan River System (300 mcm) [3]		Total Local Water (979 mcm)	
	EAS (172 mcm)		NEAS (145 mcm)		WAS (362 mcm)		Subtotal (679 mcm)					
	(mcm)	(%)	(mcm)	(%)	(mcm)	(%)	(mcm)	(%)	(mcm)	(%)	(mcm)	(%)
Present [5]	61	35	32	22	24	7	117	17	0	0	117	12
Base Scenario [6]	132	77	42	29	24	7	198	29	0	0	198	20
Scenario 1 [7]	132	77	77	53	136	38	345	51	100	33	445	45
Scenario 2 [8]	132	77	112	77	246	68	490	72	200	67	690	70
Scenario 3 [9]	172	100	145	100	362	100	679	100	300	100	979	100

[1] EAS : Eastern Aquifer System; NEAS : Northeastern Aquifer system; WAS : Western Aquifer System
[2] Numbers in parentheses represent the total recharge of each aquifer based on Article 40 - September 1995
[3] Potentially available quantity for the West Bank from the Jordan River System; arbitrary based on literature survey
[4] Percentage (%), for each case, represents the ratio of the allocated quantity over the total recharge or potential
[5] Quantities indicated are obtained from the West Bank Water Department (WBWD) for year 1995.
[6] Base Scenario reflects the remaining quantity for development in the EAS, and allocated quantity for Palestinians from other aquifers based on Article 40
[7] Scenario 1 reflects the BP quantity for the EAS, in addition to one-third the remaining quantity beyond the BP for other aquifers and the Jordan River System
[8] Scenario 2 reflects the BP quantity for the EAS, in addition to two-thirds the remaining quantity beyond the BP for other aquifers and the Jordan River System
[9] Scenario 3 reflects the total recharge quantities for the three aquifer systems and the 300 mcm for the Jordan River System

Naturally, these quantities include the 12.5 mcm (part of the Palestinian commitment in Article 40 for the West Bank) that is currently committed and funded. The quantity of 4.5 mcm referenced in Article 40 as "Israeli Commitment" for various localities in the West Bank will be included in the Base Plan. This quantity will not be considered as part of the water resources remaining for development, but rather as part of that quantity assigned in Article 40 as Israeli use, and thus will be deducted from the Israeli use quantities in Table 3.33.

Quantities that are currently purchased from Israeli utilities (Mekoroth and the Jerusalem Municipality) will be considered as part of the present supply. For cost comparison purposes, these quantities may be considered as part of the remaining deficit to be supplied by non-conventional sources (such as exchange with Israel) in years 2020 and 2040.

Scenario 1

The portion of local water resources assigned to Scenario 1 includes :

- The Base Plan quantities from the Eastern Aquifer System (i.e., 132 mcm);
- The Base Plan quantities from the Northeastern and Western Aquifer Systems in addition to one-third of the remaining quantity beyond the Base Plan from each aquifer system (i.e., 77 mcm and 136 mcm, respectively); and
- A total of 100 mcm from the Jordan River and surface flows, which reflects one-third of the remaining beyond the Base Plan.

Accordingly, the total amount of local water resources assigned to Scenario 1 is 445 mcm, or approximately 45 percent of the conceptualized total local water resources of 979 mcm. A breakdown of quantities assigned to the various local water resources is presented in Table 3.34.

Scenario 2

The portion of local water resources assigned to Scenario 2 includes :

- The Base Plan quantities from the eastern Aquifer System (i.e., 132 mcm);
- The Base Plan quantities from the Northeastern and Western Aquifer Systems in addition to two-thirds the remaining quantity beyond the Base Plan from each aquifer system (i.e., 112 mcm and 246 mcm, respectively); and
- A total of 200 mcm from the Jordan River and surface flows, which reflects two-thirds of the remaining quantity beyond the Base Plan.

Accordingly, the total amount of local water resources assigned to Scenario 2 is 690 mcm, or approximately 70 percent of the conceptualized total local resources of 979 mcm. A breakdown of quantities assigned to the various local water resources is presented in Table 3.34.

Scenario 3 (Physical Upper Limit)

The portion of local water resources assigned to Scenario 3 includes :

- The total sustainable yield of each of the Eastern, Northeastern and Western Aquifer Systems (i.e., 172 mcm, 145 mcm, and 362 mcm, respectively); and
- A total of 300 mcm from the Jordan River and surface flows, which reflects the total remaining quantity beyond the Base Plan.

Accordingly, the total amount of local water resources assigned to Scenario 3 is 979 mcm, or 100 percent of the conceptualized total local resources of 979 mcm. Therefore, this scenario reflects a notional physical upper limit. A breakdown of quantities assigned to the various local water resources is presented in Table 3.34.

3.5.1.8 Quality of Local West Bank Water Resources

Generally, it is assumed that all local water resources are of fresh water quality, except for certain brackish water springs along the Jordan Valley. Naturally, wells and/or springs where pollution may have been detected are not considered in this category.

Likewise, selected alternatives (s) for supplying water from the Jordan River will include a cost assessment regarding the pre-treatment of water. The need to consider pre-treatment of water from the Jordan River is contingent upon the point of diversion and conveyance route of the Jordan River flow to demand centers. For purposes of the CPF, it is assumed that quantities of water assigned to each scenario (i.e., 1 through 3) from the Jordan River will be supplied directly from the Israeli National Water Carrier (INWC) to respective demand centers (including Gaza) through an exchange program with Israel.

3.5.1.9 Assessment of Long-Term Replenishment of the Coastal Aquifer in the Gaza Strip

The water table aquifer in the Gaza Strip is recharged from several sources which include rainfall, groundwater flow from the east, infiltration of surface water runoff, leakage of M&I and agricultural supply systems, and irrigation return flow. Pipe leakage corresponds to physical losses from the water supply system, the wastewater collection system, and treated wastewater conveyance and reuse/disposal systems. Currently, the replenishment capacity of the coastal aquifer du to the above-mentioned sources is estimated (MOPIC, 1996; PWA, 1996) to be approximately 110 mcm/year. A breakdown of the contribution of the various sources is presented in Table 3.35. Also, the long-term replenishment capacity was estimated based on projected contribution of these resources as summarized for years 2020 and 2040 in Table 3.35. On these bases, it is estimated that the long-term safe yield of this aquifer ranges between 120 and 150 mcm / year.

Table 3.35
Long-Term Replenishment Capacity of the Coastal Aquifer in Gaza Strip

Sources (1) (2) (3) (4) (5)	Present Contribution (mcm/year)	Year 2020 Contribution (mcm/year)	Year 2040 Contribution (mcm/year)
Rainfall	46	46	46
Groundwater flow	7	7	7
Runoff infiltration	2	2	2
Leakage from M&I supply system	13	20	40
Irrigation return flow	30	4	4
Leakage from Sewage collection, and conveyance systems	14	10	20
Recharge of treated wastewater		42	81
Total	112	131	200

(1) Contributions from rainfall, groundwater flow, and runoff infiltration were assumed to remain at the present level
(2) Leakage from the M&I system was assumed to be 50% o physical losses (Section 3)
(3) Irrigation return flow was assumed to be 5% of projected irrigation demand
(4) Leakage from sewage systems was based on projections in Appendix 2
(5) It is assumed that reclaimed wastewater would be recharged to the aquifer for subsequent reuse for irrigation (Section 3)

3.5.1.10 Quality of Local Gaza Strip Water Resources

The groundwater quality of the coastal aquifer in the Gaza Strip has been substantially impacted by raw wastewater discharges, agricultural water return. flow, and salt water intrusion. Analytical results indicate that only a small portion of the aquifer water remains at potable water quality levels. This situation is handled in the CPF long-term supply scenarios by considering the varying quality of the water in the aquifer.

Groundwater for the municipal water supply system is divided into two types : fresh water and brackish water. Fresh water, which represents the smaller fraction will be extracted, disinfected, and conveyed into the municipal water supply system. Brackish water will be pretreated, desalinated, disinfected, and conveyed into the municipal water supply system.

Groundwater for the agricultural supply system may be extracted from the upper portion of the aquifer, where water is less saline, but of lower quality than that supplied to the municipal system, due to past wastewater discharges, agricultural return flows, and future recharge with treated wastewater.

3.5.1.11 Development Options

For each scenario (Base Scenario and Scenarios 1 through 3), it is envisaged that Palestinians will ultimately have control of conceptualized water sources, irrespective of the their types (i.e., local sources or others sources such as desalination).

Development options of water resources as pertain to the above scenarios may include source development or water exchange with Israel.

Any plan to remedy the current state of the water supply in the West Bank and Gaza Strip and to meet the long-term water demands, would mandate cross-boundary transfer of large quantities of water in a rather short time. Water transfer between the West Bank and the Gaza Strip could be in different directions, based upon the projected demand rates, patterns, and purposes, as well as on supply arrangements of the different scenarios. For example, the Base Scenario implies water transfer from Gaza Strip (desalination or water import) to satisfy municipal and domestic demands in the West Bank, whereas Scenario 3 implies water transfer in the opposite direction. Alternative plans may also involve the regional transfer of treated wastewater for reuse for irrigated agriculture. Such regional transfer can be accommodated partially or fully, as appropriate, through an exchange program with Israel.

A strategically planned exchange program, would serve as an auxiliary plan element to facilitate a cost-effective linkage between non-contiguous source areas and demand centers within the planning area. In such a regional transfer, water can be conceptually conveyed from Lake Tiberias to the INWC, and a like quantity can be conveyed from the INWC to a receiving Palestinian locality. For each scenario, the exchange program could conceivably, based on political, logistical, and financial settings, facilitate the phasing-in of Palestinian control over local sources while phasing-out of Israeli control. Evidently, various configurations and/or arrangements can be conceptualized. The nature and extent of the exchange program could be modified based upon the developmental stage of the infrastructure, and financial and economical considerations, as well as on the demand and supply conditions.

3.6. CDM/ Morganti Proposed Water Master Plan Element Arrangements And Costs

3.6.1 Introduction

In order to assess the affordability of a development plan in terms of an average cost per unit of water, a preliminary arrangement for each of the plan elements was developed, and a series of parametric costs were estimated.

The preliminary arrangement includes the location of an approximate source for the element and transmission facilities to demand centers within each of the districts. Source location was based on hydrologic and hydrogeologic information, map studies, The transmission facilities included pumping stations, pipelines, and terminal reservoirs, as needed. Distribution costs from the demand centers to the consumer were included as a parametric estimate based on the facility master plans developed as part of the overall Water Resources Project studies.

The demand centers were selected as the population centers in each of the districts. Each district in the West Bank and Gaza Strip was divided into different sub-districts (demand areas) and each demand area was represented by a major demand center.

3.6.2 Anticipated Long-Term Needs

The parametric costs for each of the elements were estimated over a range of capacities that reflect the near-term and long-term needs of all of the districts in the West Bank and the Gaza Strip. The estimated immediate water demand, and those for years 2020 and 2040, are presented in Table 3.36

Table 3.36
Anticipated Demand For Water In The West Bank And Gaza Strip

District	2000 Demand (mcm/yr)	2020 Demand (mcm/yr)	2040 Demand (mcm/yr)
Hebron	26	80	134
Bethlehem	13	46	74
Jenin	20	53	87
Tulkarm	30	60	90
Nablus	49	111	153
Ramallah	18	75	120
Jericho	38	41	34
Jerusalem	20	56	91
West Bank Subtotal	213	522	783
Gaza Strip Subtotal	158	269	388
Total	**372**	**791**	**1171**

The water currently available and used by the Palestinians (excluding Jerusalem) totals approximately 260 mcm/year. Beyond this quantity, additional sources have been or are currently being developed under the Interim Oslo Accords which total approximately 22 mcm/year (refer to Table 3.34). When added to present supply quantities, development of these new sources will provide Palestinians a total of 282 mcm/year. In comparison, total unconstrained water demands for the year 2000 are estimated to be approximately 372 mcm/year, leaving a total deficit for the West Bank and Gaza Strip in the year 2000 of approximately 59.4 mcm/year (50.8 mcm and 8.7 mcm, respectively).

It is anticipated that the additional supply needed for the year 2000 demand will be fulfilled from the groundwater sources that will be made available to the Palestinians consistent with the terms and conditions of the Interim Agreement.

The deficit in future years will be met from additional groundwater and surface water, demand management activities, and other non-conventional sources not now utilized in the area including wastewater reuse, desalination, and water import, The estimated additional need in the year 2020 and 2040 are presented in Table 3.37.

Table 3.37
Estimated Additional Water Needs

	2020	2040
West Bank	185	363
Gaza	98	200
Total	**283**	**563**

3.6.3 Development of Local Water Resources

Local water resources are separated into three categories; groundwater in the West Bank, surface water in the West Bank, and groundwater in Gaza.

3.6.3.1 Groundwater in the West Bank.

Depending on the water allocated to the Palestinians as a part of the final status negotiations, major quantities of groundwater will be developed from each of the three aquifers that underlie the West Bank. The total available in these aquifer is about 690 mcm/yr which is distributed, according Article 40 of the Interim Oslo Agreement, as follows:

Northeastern Aquifer System	145 mcm/yr
Eastern Aquifer System	172 mcm/yr
Western Aquifer System	362 mcm/yr

The development of additional wells in the Northeastern Aquifer will be used to supply the north part of the West Bank, i.e. Nablus and Jenin. Two well field locations are proposed, one near Dir-Sharaf close to Nablus, and one near Jenin. Regardless of the amount that will be made available to the Palestinians, the average unit water cost from the Northeastern Aquifer System, which includes the conveyance to demand centers (assumed to be Jenin, "Arraba, Tubas, and Nablus) and the distribution within these demand areas, is estimated to vary from US$ 0.65 - 0.69 per cubic meter. The water from this aquifer is of a good quality and no adverse environmental or socio-economic acts are expected from the utilization of water from this aquifer.

The development of additional wells in the Western Aquifer will be used to supply the western parts of Tulkarm, Nablus, Ramallah, and Hebron Districts. The proposed well fields to supply Tulkarm, Nablus, and Ramallah will be located near Tulkarm, Qalqilia, and Raskarkar, and another two wells fields would be located in Hebron District. The average unit water cost for the utilization of the Western Aquifer, including the conveyance to demand centers and the distribution within the demand areas, is estimated to vary from US$ 0.69/m^3 - 0.73/m^3. The water from the Western Aquifer

also is of a good quality and no environmental or socio-economic implications are expected due to the utilization of water from this aquifer.

The development of additional wells in the Eastern Aquifer System will be used to supply the central and eastern parts of the West Bank. The proposed wel fields l are located near the Ein Samiya Area, and in the Herodian and Bani Naim well fields. The average cost of water cost for the utilization of the Western aquifer, including the conveyance to demand centers and the distribution within the demand areas, is estimated to be US$ 0.65 m^3. The water quality from this aquifer varies with location. It has been reported that some 50 mcm of water from this aquifer is brackish. For this component of the aquifer yield, a desalination cost of US$ 0.58/m^3 should be added to the average unit groundwater development cost. Other than the high salinity of some of the water from the Eastern Aquifer, no adverse environmental or socio-economic implications are expected due to the utilization of water from this aquifer.

3.6.3.2 Surface Water in the West Bank

Surface water sources in the West Bank can be divided into two main components; springs and runoff from wadis, and diverted supplies from the Jordan River system.

The springs and flood water in wadis could be developed through the construction of small impoundments on the wadis. To improve the viability of these impoundments, they would likely be sized to accommodate treated wastewater.

The other major surface water source in the West Bank is the Jordan River. At present, Palestinians are not allowed to utilized any of the water out of this system unless it is delivered through Israeli facilities. There are several options for the development of this source :

- Water reallocated to the Palestinians can be transferred through the Israeli National Water Carrier to the Gaza Strip.
- Water reallocated to the Palestinians can be transferred through a conveyance line to a point near Jenin where it will be distributed to the West Bank through a Palestinian National Carrier System.
- Non-utilized flood water in the Jordan River basin can be developed creating some additional water supply for the West Bank.

Jordan River water is of good quality especially in the Northern reaches. In general, there are no significant adverse environmental or social impacts from the utilization of water from the Jordan River.

3.6.3.3 Groundwater in Gaza Strip

Groundwater is the only significant local source of water in the Gaza Strip. The only additional supply to the Gaza Strip is water purchased from Mekorot. All groundwater resources are being fully exploited and overpumping beyond the groundwater recharge also is occurring. This overdraft and the pollution from untreated wastewater is

increasing the salinity of the groundwater and is lowering the quality of water below WHO health-related standards.

Therefore, the opportunity for exploiting additional groundwater in the Gaza Strip is nil. In fact there is a need to restore the groundwater aquifer in the Gaza Strip. The future utilization of the Gaza groundwater aquifer will consist of two main components: direct utilization of the available remaining freshwater, and the utilization of the lower quality after desalination due to high salinity, and nitrification due to pollution from wastewater recharge.

3.6.4 Desalination

Desalination of both brackish water and sea water has been selected as a probable non-conventional source for additional water in both the West Bank and the Gaza Strip. Two processes for desalination were considered, reverse osmosis, and multi-effect distillation. Most of the desalination plants in the Middle East utilize the reverse osmosis process and its preference appears to be steadily growing.

Based on existing technology, a plant size of 50-100 mcm/yr is appropriate for consideration in this study. When compared to the total future deficit and considering the locations of this deficit, it is likely that more than one plant location will be required. Eight different locations for the desalination plants were investigated from different aspects. The location of any desalination plant will be governed primarily by its proximity to the area of use. The locations, plant size and service area of the eight optional sites are presented in Table 3.38.

Table 3.38
Proposed Desalination Plants

Location	Size	Service Areas
Ashkelon	50 mcm/yr	Northern Gaza Strip
Qatif	50 mcm/yr	Southern Gaza Strip
Hadera	50 mcm/yr	Northern West Bank Area
Tel Aviv	100 mcm/yr	Central to northern West Bank
Gaza	50 mcm/yr	Gaza Strip
Ashdod	100 mcm/yr	Southern West Bank
Haifa	50 mcm/yr	Northern West Bank or exchange with Israel
Egypt	any size	West Bank and Gaza

The Egypt option calls for the construction of a desalination plant on the Mediterranean Sea south of Gaza to, perhaps, serve the entire West Bank and Gaza areas. The advantages of this option are the availability and low cost of land, its environmental viability, and the lower labor costs associated with construction and operation.

If a five year construction period is assumed, the average cost of water from the reverse osmosis process is estimated to be US$ 1.32 per cubic meter for the Gaza and Israel options and US$ 1.29 per cubic meter for the Egypt option. It is important to note that with current technology, there is effectively no economy of scale advantage from large capacity plants since larger plants simply used additional basic modules.

The environmental impact of the desalination plant varies based on the desalination process, location, and energy sources. Two main adverse impacts associated with desalination are air pollution due to fuel combustion emission and water pollution from brine disposal. The desalination process, as a water supply source, can be considered as highly sustainable if technology, mechanical components, free access to international markets, and solutions to negative environmental impacts are made available.

Brackish water constitutes a major problem in the utilization of available water resources in both the West Bank and Gaza Strip. Brackish water exists through the Gaza Strip aquifer and in some parts of the Eastern Aquifer. Assuming the use of the reverse osmosis process for the desalination of brackish water, the average unit water cost is estimated to be US$ 0.58. In the Gaza Strip, a pretreatment cost varying between US$ 0.09 to 0.12 per cubic meter should be added to the average unit water cost.

3.6.5 Water Import By Sea

The Mediterranean Sea has two distinct zones of water availability. To the south and east is an area with high aridity and severe water shortage, while to the north, is an area which is humid and relatively very rich in fresh water resources. This situation suggests the possibility of moving water from the water rich-areas in the north to the areas poor in water in the south. Different sources can be considered for the importation of water to the West Bank and Gaza Strip; however, Turkey is the most feasible source at present for three main reasons:

- It is the closest water rich country to the region,
- Turkey has started the construction of a loading terminal at the mouth of the Manavgat River, and
- Turkey has shown a willingness to provide water to the Middle East.

The water import process has three main features; a loading terminal, a transport method, and an unloading terminal.

In general, the loading terminals are similar to those for oil transport. The most common type of loading terminal is the multiple buoys system which consists of several mooring buoys anchored around a berth. The problem associated with the

terminal sizes proposed here is the required large diameter floating hoses which are difficult to handle. Also the largest floating hose diameter presently available in the market is 24-inches. This hose will accommodate a maximum capacity of 100 mcm/yr. Multiple floating hoses will be needed for a terminal capacity greater than 100 mcm/yr.

For the transport method, two methods are available; by using vinyl bags and by using tankers. At present, bags are not a proven technology at the size considered appropriate for mass water movement. The idea of bags are still in the research and development stage. The largest existing bag is 30,000 cubic meters developed and tested by Nordic Water in the North Sea. At present, Nordic Water are building a 100,000 cubic meter bag. They are planning to test this bag in fall 1997 on a trip from Norway to Netherlands. Other ongoing research is being done by Medusa Bag. Inc. of Canada. According to Medusa, their bag will be made from commercially available industrial nylon fabric, coated on both sides with long durability PVC.

Estimates of cost for one 100,000 cubic meter bag were based on the available information on the cost of these bags and the assumption that a breakthrough in bag technology will take place in the near future. If the bags are to be used, then tugs to pull these bags through the sea also are needed. The cruising speed of the tug would be about 100 km/day. The estimated tug size according to Medusa Bags Incorporation is 4000Hp-5000Hp.

Tankers are also an option for delivering water from Turkey to the West Bank and Gaza. In case of tankers, two options are available.

- The use of second hand oil tankers with a capacity of 400,000 dwt and an average life time of 8 years and an estimated price of about US$ 14 million (1996 price level)
- The use of new tankers of 400,000 dwt with an estimated life time of 30 years and a price of about US$ 100 million (1996 price level)

The old tankers will need to be coated with a new lining before using it for water transport. The amiability of theses old tankers and the sustainability of this option is related to oil industry, and the terminal capacity. The average unit water cost for the different water import is shown in Table 3.39.

Table 3.39
Average Cost Of Water For Sea Import From Turkey

Terminal Capacity	Bags	Old Tankers	New Tankers
100	0.89	1.06	1.60
200	0.77	0.87	1.30
300	0.68	0.82	1.21
400	0.67	0.77	1.10

desired level. The total investment cost for the rehabilitation of the water system networks is estimated to be about US$ 42.5 million.

3.6.7 Cisterns

Cisterns are one of the most popular water harvesting techniques in the West Bank and Gaza Strip especially in rural areas. Cisterns are usually constructed from reinforced concrete. Although cisterns are expensive, households in the West Bank utilize it because it is a reliable source of water under conditions of severe water shortages experienced in many locations due to a lack of piped water systems and/or summer seasonal shortages. It is estimated that about 16 mcm/yr and 8 mcm/yr can be realized from the installation of cisterns, over and above the existing supply, in the West Bank and Gaza Strip respectively. The assumptions used for these estimates are:

- On average, there will be 6 people per household in the West Bank and 7 in the Gaza Strip.
- On average there will be 4 households per building.
- The size of each cistern is 100 cubic meters.
- The cistern will be filled twice per year.

The unit cost of water for these installations is estimated to be U.S.$ 1.88/m^3 in the West Bank and U.S.$ 1.34 m^3 in the Gaza Strip. Although the average unit water cost is high. Its value as an emergency supply makes it extremely valuable to the Palestinians.

3.6.8 Reclamation And Reuse Of Wastewater

In a water-short environment, such as the West Bank and Gaza Strip, reclaimed wastewater constitutes an integral part of the available water resources, as clearly recognized by the Policy Elements of the PWA. Therefore, it is essential that the necessary reclamation and reuse facilities be developed. The primary objectives of these facilities are to:

- Prevent the discharge of untreated or partially-treated sewage into the environment, to mitigate potential adverse impacts to human health and the environment; and
- Augment and sustain available water and environmental resources.

These objectives would be achieved by:

- Collecting and transporting sewage from all points of production to treatment facilities by methods, which are economically and technically sound;
- Controlling the discharge of raw sewage into the environment, particularly into sensitive water resources;
- Limiting the number of discharge points of treated sewage;
- Facilitating optimum reuse of treated sewage;

3.6.6 Rehabilitation of Water Supply Systems

Three rehabilitation components have been evaluated; wells, springs, and domestic water supply systems.

3.6.6.1 Rehabilitation of Wells

The rehabilitation of wells includes the cleaning, and reaming of the wells, and replacing old pumps. Based on a total of 19 domestic wells in the West Bank and Gaza Strip, and 123 agricultural wells, the rehabilitation of these wells is estimated to cost about US$ 14.2 million and a unit rate for rehabilitation of U.S.$ 100,000 / well. If agricultural wells are included, the estimated total cost would increase tenfold or more.

3.6.6.2 Rehabilitation Of Springs

The rehabilitation of springs includes the replacement of open canals with pipes, and providing each delivery system with a sedimentation basin. Springs considered for this estimate have an average annual flow of at least 2 mcm. These springs, their location and yield are as follows:

• Fawwar, and Qilt	Wadi Qilt	13.0 mcm/yr
• Duyuk, Nuweima, and Shosah	Duyuk	8.6 mcm/yr
• Auja	Auja Fouqa	9.0 mcm/yr
• Faria	Ras Faria	4.8 mcm/yr
• Tabban, Beida, Hammad, Qudeira, and Sedreh	Beithan	5.3 mcm/yr

The estimated total cost of renovation for these springs is US$ 8.1 million.

3.6.6.3 Rehabilitation of Domestic Water Supply Systems

It is estimated that average losses in the water supply system in the West Bank and Gaza Strip are about 45 percent. These overall losses are distributed as follows:

• Unregistered and illegal connections	10 %
• Inaccurate meters	10 %
• Main supply lines	5 %
• Distribution network	20 %

The rehabilitation of drinking water networks includes the reduction of the unregistered wells, the replacement of old meters, and the repair of network distribution lines within the demand areas. This rehabilitation is assumed to reduce the losses in the network to about 25 percent. The cost of rehabilitating the networks is based on the replacement of the meters, the installation of 30 pressure breaking reservoirs (one near each demand center), and replacement of old network pipes within the demand areas. It is estimated that 30 percent of the existing pipes needs to be changed to reduce the losses to the

- Applying appropriate sewage and sludge treatment technologies taking into account both quality requirements for reuse disposal and economic sustainability.

3.6.9 Pricing and Reallocation

Water pricing is not used as a tool for encouraging water conservation or transfer of water from one sector to another. Water tariff structures for most municipalities and utilities in the West Bank and Gaza Strip have been set in an arbitrary fashion, often with the intention of covering costs of municipal government, and with the intent of recovering the capital and O&M costs of water supply and wastewater systems. Water pricing and tariff structuring offer potential mechanisms to address cost recovery and water use efficiency objectives. Institutional arrangements that allow market forces to reallocate water from one sector to another will automatically increase the value of the resource, and decrease the marginal costs.

3.6.9.1 Water Tariffs for Municipal Water Supply

At present in the West Bank and Gaza Strip, the reliability of the domestic and urban water supply system is poor, willingness to pay for these services is thought to be low, and water tariffs are high (especially in relation to per capita income levels). These factors increase the likelihood that customers will seek ways to avoid paying for the water they use. Thus, insufficient revenues are generated to pay for system capital and O&M costs, and the water infrastructure deteriorates. If more water could be made available to customers and if the urban and domestic supply system could be made more dependable, customers would be more inclined to pay their water bills.

In the short-term, there is little likelihood that modifications in water pricing can be made that can be expected to improve water use efficiency in the West Bank and Gaza Strip. Data have not been collected on willingness to pay or water use as a function of price, income level, type of use, time of year, and so forth. In the long-term, water pricing should be made an integral tool of water management. Before this can happen, however, clear positions must be taken by Palestinian decision makers regarding the objectives of water pricing, and the technical analyses required for formulating and understanding the consequences of alternative water pricing schemes must be developed. Several questions must be resolved by policy makers before a water tariff can be established, including:

- To what extent should water and sewer services be subsidized? Should water prices be established only with the goal of O&M cost recovery, or should achievement of full cost recovery be the objective?
- To what extent should water tariffs be differentially assigned to different income groups in the population?
- Should the water tariff structure be used as a way to manage demand?
- Should the sewerage fee be integrated in the water use fee?

- Should the tariff structure be formulated to reflect national plans for industrial and social development?

3.6.9.2 Reallocation of Water

The most likely opportunity for reallocation of water between sectors of the Palestinian economy is from relatively low-valued uses in irrigated agriculture to high-valued for domestic and urban supply. Significant market mechanisms potentially exist for purchase or sale of water (or water rights) between economic sectors. However, given the attitude of Israeli governmental agencies toward control of Palestinian access to water, it might be very difficult in the present political climate to arrange for significant transfers of water from, say, agricultural wells in one location to industrial users in another. In the long-term, the PWA and local water managers should consider alternative licensing and permitting structures that might foster the creation and management of a water market. Attractive opportunities for market forces to be used should be given in order to move high quality fresh water from agricultural uses to municipal and industrial supply.

For purposes of the CPF, it is assumed that only partial reallocation of fresh water from the agricultural sector to the municipal and domestic sectors will take place within the planning period. This stems from the fact that a minimum quantity of fresh water is needed in the agricultural sector. In the intermediate term, this reallocation is likely to result from the improvement of irrigation systems in both areas. In the long-term, it is conceived that additional fresh water would be reallocated from the agricultural sector to other sectors due to harvesting of flood water and wadi runoff for irrigation in the West Bank, and availability of appreciable quantities of reclaimed wastewater in both the West Bank and Gaza Strip.

CHAPTER 4

WATER CONSERVATION AND PUBLIC AWARENESS

Scarcity and inefficient use of water dictate the implementation of water conservation measures. Fresh water, life itself, has never come easy especially in arid and semiarid countries. The accelerating population, expanding agriculture, industrialization, and thrive for higher living standards demand more fresh water. Drought and pollution limit its availability and mismanagement squander it. Therefore, water is becoming the most contentious commodity in many regions of the world.

Scarcity of water is only one element of the water shortage crisis, and inefficiency is another, as is the reluctance of some water-poor nations to change priorities from agriculture to less water-intensive enterprises. Water conservation is a means of enhancing water availability by managing both supply and demand of all uses. A water conservation programme requires the following steps: (a) an assessment of the potential for water resources development and water savings, (b) the application of supply and demand management methods, (c) a review of the impacts and trade-offs of various options in water conservation, (d) actions to minimize any adverse effects, and (e) implementation actions.

Water imbalance in most arid and semiarid countries portends future crises unless things change. Annual water deficits of use (not truly demand) require more water be made available and some uses need to be curtailed or changed to save water. Thus, all possible actions must be taken to increase water supply and reduce water demand although it is difficult to quantify and prove the value of conservation.

4.1 Supply Management

No single action can remedy the nation's water shortage. Many actions together are required to increase water availability. These alternative actions involve managing both supply and demand. The supply methods of managing water resources are :

(1) Capture or harvest storm and surface water flows.
(2) Reuse domestic and industrial waters and wastewaters.
(3) Conserve water by repairing leaks, suppressing evaporation, managing watersheds, removing illegal connections, pressure reduction, and installing measurement and allocation devices.
(4) Develop new sources, such as desalination of brackish waters.
(5) Protect the quality of existing supplies to preserve their uses.
(6) Pursue international water resources.

Water resources managers usually favor supply approaches, which are simpler to implement. These approaches deal more with physical facilities rather than with people. The major supply actions include getting full share of water under international agreements, developing dams for storing water, improving conveyance and distribution

structures, desalinizing brackish water, harvesting upland waters, storing groundwater, reducing leaks, and reusing wastewater.

4.2 Demand Management

Demand management (also called use reduction) is necessary to save water. Managing water demand is not easy, but it must be done. The demand methods for managing water resources are :

(1) Establish regulations and enforce conservation laws in municipal and agricultural uses.
(2) Use water-saving devices in residences, in businesses, and on farms.
(3) Change cropping patterns and industrial processes.
(4) Consider a new pricing structure that may serve as an incentive for water savings.
(5) Educate the public on water resources management issues (public awareness programmes).

The greatest potential for saving water through reduced use involves three options : municipal water conservation, expand use of water-saving equipment especially on farms, and change cropping patterns (for example, replacing bananas and citrus with crops that use less water). Most of the saving can be accomplished with small public expenditures, although they may have strong political and economic consequences. The costs of implementing the options, such as adoption of drip irrigation equipment, are borne mainly by the private sector.

The main difficulty with demand management alternatives is that they depend upon the interaction and cooperation of people. Projects that affect demand are often vulnerable to political and social pressures. For these reasons, education, lobbying, legal efforts, and various social forces often play prominent roles in programmes to manage water demand.

4.3 Water Quality Management

Water has to be of a suitable quality in order to be useful. A country's water resources, especially fresh water, are vulnerable to several threats that can diminish their value. As fresh water aquifers are drawn down or waters are reused, they tend to become more saline to the point at which they are no longer useful. Thus, water quality has to be protected in order to maintain useful water quantity. Waters also can lose their value through contamination, as agricultural, industrial, and municipal pollutants seep into groundwater aquifers and wash into surface waters. Diverse options for managing water quality include the following :

(1) Enforce regulations and standards for controlling water pollution, accompanied by more monitoring of water resources and water quality.
(2) Assist industries in managing water quality both technically and financially.

(3) Practice watershed management (land use control for example) to protect water resources.

4.4 Potential Savings

One approach to reducing the imbalance between water demand and water supply is municipal water conservation. Water scarcity and frequent rationing cause people to conserve water. Residents of many countries point out, and rightly so, that a liter of water conserved by one person will immediately be consumed by another. Thus, one cannot point to conservation as a way to increase the available total supply. However, from the standpoint of the user who would not otherwise have that liter of water, the conservation of one liter has the same value as the addition of a liter to the overall supply. The water scarcity makes most people water savers, because of both the rationed availability and the cost.

An additional conservation measure can save only a small quantity of water, but a comprehensive programme can achieve significant savings. Potential water savings in households through conservation of bath, laundry, and outside waters (e.g. yard watering and auto and walkway washing) could make more water available for others.

Municipal water is that which is used for domestic and commercial purposes, local small farm/yard irrigation, and small/light industries, and its is supplied from the municipal network. It also includes the water losses from leakage in the municipal distribution network. In some countries, the population concentrations in some areas necessitated the conveyance of water from distant sources to consumers which entails conveyance losses. The supplied quantities are those measured at the source of production and supplied to the municipal network system. However, it is difficult to project municipal water demand due to the discrepancy between the total quantity of water produced and that measured at the consumer meters. The implication of wide gaps between domestic water demand and supply, its physical manifestations, consequences, and socio-economic significance, warrant urgent measures in order to reduce its negative environmental impact. To bridge the gap between demand and supply, two basic solutions are normally proposed: increasing supply, and decreasing demand by promoting greater efficiency and conservation, all within an integrated planning and management framework. There are other ways to save water, these are :

4.4.1 Unaccounted for Water

Accounted for water (AFW) is the municipal water that is received, recorded, and billed to subscribers. Unaccounted for water (UFW) is the difference between the volume of water supplied to municipal systems, and the volume billed to the users. The term UFW is used internationally for the difference between water production at source, and the aggregated quantities measured on the meters installed at customer outlets. Logically, it must include any legitimate and intentional outlets, which may not be measured for one reason or another, and must therefore be estimated in order to

provide a complete picture of water delivered to the customer from the distribution system.

UFW is seen as a potential water resource saving due to water scarcity and because of the high relative cost of water. The potential components of UFW could be perceived as follows: (a) possible over registration of source production meters, (b) losses in the trunk transmission links, (c) losses from the service reservoirs, (d) leakage from principal and local distribution mains, and customer communication pipes up to and including the meter, (e) illegal connections, tampering with meters, etc., (f) under registration of revenue meters, (g) meter reading gaps not necessarily made up at future readings, and (h) unmeasured legitimate supplies, e.g. hydrant use to special groups.

Not all UFW is strictly "lost" water. Some is used, though unaccountable within the system. Another kind of loss is not water but lost revenues from those who draw illegally and do not pay for it. Actual savings vary with the household size, type of residential or commercial water-saving fixtures, and other factors. High percentages of UFW exist throughout the Middle East region, ranging from 30 to 70 percent.

4.4.2 Precipitation And Runoff

Precipitation, mainly as rainfall but also as snow, contributes huge quantities of water. The potential for roof capture and tank storage of the runoff is considerable in urban areas. Precipitation onto rural surfaces can be similarly captured or managed, as in recharge areas or retention basins through water harvesting projects (desert dams to capture sporadic rainfall, ephemeral wadis or streams).

4.5 Water Problems and Conservation Alternatives

The above discussion on supply and demand methods in conservation has covered various conservation methods. Some of these methods can also be applied to problems of irrigation, and municipal / industrial water as shown in tables 4.1 and 4.2 at the end of this chapter. Although conservation techniques are often overlooked in problem solving, at least one of them is a possible solution for nearly every type of water resource problem. Water conservation (especially demand management strategy of Water Conservation Methods) is a vastly undervalued alternative.

4.5.1 Impacts of Water Conservation Methods

A systematic approach to identifying particular impacts can involve the use of a matrix. Table 4.3 at the end of this chapter is an impacts-matrix that was developed for options in supply management. For convenience, these impacts are listed in several categories including economic/financial, technical/environmental, social/political, and institutional/legal. **(See Appendix V - Environmental Impact Assessment, EIA)**

A similar matrix can be developed for the demand management methods as shown in table 4.4 at the end of this chapter where potential impacts far out number the supply

possibilities. This table features the three main approaches to demand management-water pricing, regulation, and education. The analyst needs merely to scan the matrix and identify the types of impacts which are of interest. Their classification as the major types of conservation methods (e.g., pricing) makes it easy for specialists to focus their efforts. The matrices, of course, are designed to help the analysis, but are not vital to it.

4.5.2 Mitigation of Adverse Impacts of Water Conservation

Mitigation is the process of avoiding or overcoming problems. In impacts assessment, the goal is to avoid or alleviate the undesirable (negative) effects by anticipating their occurrence early in planning and implementation, and doing something about them.

Mitigation in water resources plans follows the impact identification tasks, which may involve the matrix. This step is less procedural and more creative, compared to the impact identification phase. It is an iterative process, in which several persons conduct an analysis until they agree on potential solutions to an anticipated problem. Table 4.5 at the end of this chapter is a list of adverse impacts and actions. While the actions are intended to minimize adverse impacts and make a water conservation programme effective, the list is only a guide and starting point. The analyst must still decide what is most suitable.

4.5.3 Implementation of Water Conservation

The implementation of a municipal water conservation policy requires institutional measures. Following is a list of key measures that must fit into an implementation framework.

(1) Implement an education programme to inform every body about water legislation, planning, production, and distribution; as consumers become aware of the national water situation, they will appreciate the importance of water conservation.
(2) Establish efficient training programmes in management, planning, maintenance of production and distribution systems, leakage control, water quality monitoring, billing, collection of revenues, and other activities.
(3) Establish policies and legal requirements for manufacturers and importers of bathroom and plumbing fixtures and home appliances to display water use and water-saving characteristics of the products.
(4) Use incentives such as lower duties to encourage import and manufacture of water-saving plumbing fixtures and home appliances.
(5) Amend building and plumbing codes and specifications to require installation of water-saving plumbing fixtures such as low-flow toilets, showers, faucets, and pressure reducing valves in all new buildings where line pressure is above 50 psi. Promote the retrofitting of fixtures through an education programme.
(6) Initiate and set examples to implement water-saving practices at governmental agencies, both civil and military, wherever possible.

(7) Provide incentives through lower license fees to encourage water saving practices in commercial, industrial, residential and large buildings and complexes, wherever possible.
(8) Develop financial incentives, such as a revolving loan fund for the purchase and installation of water-saving devices such as modern irrigation systems (drip, etc.) .
(9) Implement an effective leak detection and control programme, and assist in detection of household plumbing leaks.
(10) Encourage the use of the increasing block rate water pricing structure, instead of the flat fee (charging all customers the same amount regardless of the amount of water consumed) to discourage water waste.
(11) Require water conservation measures as a condition for new water services and new water rights applications.
(12) Require the agencies incharge of Public Works and Housing to use lower-quality water (wadis, brackish, recycled) for construction projects, especially highway embankments and bases, instead of the potable water from private wells or from the domestic distribution systems.
(13) Encourage the implementation of an effective programme to repair defective meters and replace old meters which are no longer accurate.

4.6. Water Policy

An overall policy statement to guide the development, management, and effective usage of the nation's water resources and to provide the principles by which all agencies and individuals involved in water would operate is an essential and foremost step. There is a general recognition that in a situation where severe water shortage is constraining economic development, coordination of water actions is imperative and operational strategies of individual agencies should be guided in an integral manner by the limits set in a national policy (see Appendix III).

The National Water Policy (NWP) should include "inter alia" statements on anticipated supply and demand (including wastewater reuse), development of a strategy and procedures for promoting increased demand management, statements on the required reliabilities of water supply, sectoral allocation of water resources, drought and flood contingency plans, measures for protecting water quality, groundwater monitoring and protection system, criteria for public investment and a public investment programme that supports implementation of the policy, and definition of the roles and responsibilities of public and private agencies.

4.6.1 Definition of a National Water Policy

Policy may be defined as "a definite course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions" (Webster's New Collegiate Dictionary, 1976). Thus, a NWP should be seen as a formal statement by a government, representing the interests of the nation, on the

course the country intends to take in developing, managing, protecting, and using its water resources effectively.

Policy thus provides an essential guide to decision-making by water agencies and water users. It sets the framework for, but should be distinguished from, the detailed strategies and actions which characterize the operating activities of implementing agencies. To the extent that the policy represents a modification or advance on current law, it may be desirable or necessary in due course to formalize the policy prescriptions within the framework of revised water legislation. If conditions change, policy must respond. Moreover, NWP can in no way prejudge international developments which in some cases critically affect prevailing conditions. Subject to these considerations, a formal policy to which all agencies can refer, can help foster coherence in decision-making and promote coordinated development and management of the resource.

4.6.2 Objectives of a National Water Policy

In most NWP's world wide, the objectives are defined according to three guiding principles:

(1) Specific recognition that fresh water is a finite and vulnerable resource, essential to sustaining life, development, and the environment,
(2) Full acknowledgment that water has an economic value in all its competing uses and should be recognized as an economic good, and,
(3) An explicit statement that efficient water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

The objectives of the NWP might possibly be to achieve, over time, the following:

(a) For Domestic Water Supply And Sanitation

More efficient and accessible delivery of potable water services and of sewage (wastewater) collection, treatment, and disposal, with the ultimate goal of providing global coverage. The Policy should recognize that in areas where water is scarce, achieving the goal of global coverage could require shifting resources between geographical zones and between users. The Policy should be responsive to consumer demand and address the possibility of providing specific services to high priority areas and communities and indicate where physical and financial resources will be found to meet those objectives. Greater involvement of the private sector and user groups may be required and their roles and responsibilities should be specified. Objectives concerning cost recovery are essential to ensure financial reliability of utilities.

(b) For Irrigation

Modernized water-efficient irrigation practices, greater attention to cost recovery, drainage and salinity control, measures to reduce pollution from agricultural activities,

improvements in operation and maintenance of existing systems, and investments in various water-harvesting methods. This calls for the development of institutions that respond to the needs of farmers for higher-quality services, including greater participation of community groups and user associations, while reinforcing management of water demand. Greater priority should be given to promoting wastewater which will be treated for use in irrigation or for other purposes. It might also address the intent, where feasible, to use brackish water for irrigation and to support this with research on salt-tolerant crops.

(c) For Industry

Introduction of water-saving and clean manufacturing technologies, extensive water conservation, and protection of surface water and groundwater resources. A stated policy to control wastewater discharges from industrial plants will encourage industry to reduce the quantity of water used per unit of industrial output.

(d) For The Environment

More rigorous attention to maintaining biodiversity, and protecting ecosystems in the design, implementation, and operation of water projects. Increased attention and incentives might be given to promoting demand management techniques and procedures throughout the water economy, so reducing the total quantity of wastewater and the volume of contaminants. Low-cost and environmentally sound methods of developing new water supplies for agriculture, urban, and rural drinking water, and industry should be pursued. The water needs of rivers (minimum flow), wetlands, and fisheries need to be considered in decisions concerning operation of water projects and the allocation of water.

4.6.3 Definition of Priorities of Water Use

The Policy should recognize that, when and where water is short, there will almost certainly be conflicts between objectives, e.g., the objective of providing universal access to potable water may not be compatible with a possible objective of expanding irrigation resources or of maintaining wetlands. It is essential therefore that the policy specifies where, in the event of increasing water shortages, or where uses conflict, priority will be given. In order to plan operations in other sectors, e.g,, agriculture or tourism, it is important that private and public personnel in these sectors are fully aware of the relative priorities given to their sectors by government suppliers of water. It is, of course, likely that considerations such as the profitability of different sectors and the users' ability to pay will be assessed in determining priorities. Defining priorities is not easy, but general guidelines need to be produced to assist other sectors, particularly private users, in decision making.

4.6.4 Scope and Content of a National Water Policy (NWP)

Much of the ground to be covered by a NWP is normally included in various existing documents of the country, for instance in past legislation and national development plans. Other aspects are implicit in traditional practices and in measures to be agreed upon in various contexts. The essential feature of the NWP is that it should be recognized as the definitive reference document on the Government's Water Management Policy and should synthesize and, where appropriate, extend various water-related statements within a "Coherent Framework" and under one easily referenced document.

It is suggested that the statements and directives of the NWP might inter alia fall under the following main headings :

(1) Ownership and Water Rights

Public ownership of water resources is the foundation on which water policy is normally based. It should be supported by a stable system of water rights to encourage entities and individuals to act in ways consistent with the objectives of national policy.

Infringement of water rights, including damage to the quantity and quality of shared waters, and mechanisms for reinstitution of rights should be addressed in the policy. Such a system of rights might cover the acknowledgment of traditional and existing rights, their appropriation, expropriation, and reallocation procedures, and policy regarding the transferability of such rights.

(2) Priorities in Water Allocation And Use

Exceptional pressures on water in most countries require unambiguous allocation policies if demands are to be satisfied in a predictable manner. Criteria should be established to guide storage and reservation of water resources for particular uses (with respect to fossil aquifers, areas of environmental sensitivity, etc.), development of new water resources, and allocation of water between uses during normal and exceptional circumstances (e.g., drought and flood). Priority would typically be given to domestic uses subject to recognition of existing rights, allowing for compensation in the event of reallocation. In the event of droughts of specified magnitudes, reallocation of water between areas and between uses, should be specified in the policy to ensure that users know what to expect under certain circumstances and can make appropriate provisions to cover risks.

(3) Water Assessment, Monitoring, and Evaluation

Deficiencies in data gathering and analysis persist in most countries, particularly with respect to real-time monitoring and measurement of water resources. Priorities might include completion of surface and groundwater studies, evaluation of quantities and qualities of brackish water, and systematic programmes of resource measurement and

monitoring. Policies with respect to monitoring, protection, and control of aquifers are of particular significance in most arid and semiarid countries. Such policies should include specific intentions of the government to meter and measure all extractions from aquifers. It is possible that government may, in its policy, wish to signal its intent to centralize water resources data.

(4) Water Resources Development and Investments

The high cost of new developments places a premium on careful planning, evaluation, and phasing of investments in water resources development. Investment proposals are set out normally in national development plans, but governments recognize that these proposals are ambitious in respect to available financial resources. Thus, in the event of constraints, investment criteria need to be spelled out in the NWP to ensure that projects are financed from the Government Budget or by Donor Agencies in accordance with an agreed upon policy.

(5) Water Management and Control

Policies regarding management of water resources must obviously be consistent with government allocation policies, yet at the same time they must recognize the increasing competition between uses and the advantages of distinguishing clearly and unambiguously between the management of the national resources and delivery of water services. With respect to the former, government must invariably remain responsible, adopting approaches to the management and regulations that recognize the unitary nature of the resource and the pervasive existence of externalities. With respect to providing water services, policies should set out the extent to which management should be decentralized and delegated to autonomous public entities, user groups and the private sector. The policy should also address the need for regulatory systems within which such delegation and decentralization should operate. With regard to the management and control of the Nation's Water Resources, the policy should distinguish, where appropriate, differences between surface water and groundwater. The impact of mismanagement of groundwater, particularly over-extraction or contamination, may be less immediately apparent than would be the case for surface water. Thus regular and effective monitoring of the quantity and quality of groundwater is essential. Methods for monitoring and managing groundwater and surface water should be spelled out in the policy.

(6) Water Conservation and Water Reuse

The NWP should state unambiguously that priority actions, investment, and procedures will be given to water conservation, including the promotion of practices that moderate end-user demand through adoption of water saving technologies, reduce water losses both directly in public systems and indirectly in user and private uses, and substitute for freshwater, in particular through programmes of wastewater reuse and exploitation of brackish water resources. Policies in support of such objectives might include direct programmes in public schemes, and incentives and regulatory constraints to encourage

action by autonomous public and private entities and individuals. The policy should recognize that water conservation is usually by far the least expensive way of gaining resources, providing additional water from other sources (particularly those which are deeper or at greater horizontal distances) should be recognized as imposing heavy strains on the country's finances.

The policy might stress the importance of utilizing all wastewater, treating it to specified levels commensurate with the nature of its reuse either to potable standards or for irrigation purposes, etc.

(7) Water Pricing and Incentives For Efficient Use

Pricing and incentive policies complement regulatory action and are critical to the efficiency of water use. The principles on which pricing policies are to be established should be clearly indicated including their relationship to : (a) cost recovery to encourage efficient delivery of water services, (b) long-run marginal costs of new supplies, and (c) externalities and opportunity costs (e.g., with respect to private exploitation of groundwater). The extent to which water can be priced at economic efficiency levels may be constrained by past policies and the impact of price increases on current users. Policies may thus have to be phased and designed to take account of weaker sections of the community (e.g. through block tariff structures). In general terms, the policy should address these issues to enable future water users (e.g. industry) to decide whether to employ water or energy intensive processing methods.

In the context of water pricing, the policy might address to what extent water should be perceived as a marketable commodity and whether water markets are to be encouraged, not just for local sales but also in terms of bulk transfer between districts or states. If such markets are envisaged, policies governing their operations need to be stated which will allow subsequent formulation of appropriate regulations.

The NWP needs to take a position regarding who should pay for the extraction and use of water resources, whether payment should be by means of taxation and budget support or direct through water charges. If it is the intention of the government to recover the costs of providing water to all or parts of the community, or to provide subsidies in some form, then that policy statement on cost recovery would indicate government intent to all stakeholders, so enabling them to make long-term investment decisions in their water.

(8) Protection of Water Bodies and Water Quality

Declining water quality threatens the sustainability of resources use. However, the cost of treatment can be very high and water quality standards need to be affordable and realistic. Essential environmental and public health concerns must therefore be balanced against the desirability of promoting the use of the lowest acceptable water quality for the purpose needed. The NWP should indicate in broad terms the degree to which water users will be held accountable for water quality degradation and whether it

is intended to recover the costs of water cleaning. Again, industries including agro-businesses need to know the intent of government water policy on which to base investment decisions.

(9) Public Education, Persuasion, and Participation

Involvement of stakeholders and the general public in water resources development and management is increasingly recognized as of a critical importance to the effectiveness of water strategies. Policies to involve stakeholders in policy discussions at the various levels of government typically may include public hearings, discussion, participation in committees and other participatory programmes. The water policy therefore my itself be a culmination of a participatory process, but it should also spell out government's intent to support water education in schools or mass media programmes, etc.

(10) Institutional and Regulatory Systems

Implementing new water management policies will have implications for the institutions dealing with water resources. A strong institutional framework is needed for dealing with the pricing monopoly, organizations, environmental protection, and other aspects of water management. Adaptation of institutional structures may be required at the national and local levels to coordinate implementation of NWP.

An important aspect of NWP is a statement on the roles and responsibilities of the many agencies involved at national and municipal levels. In countries where water utilities operate on commercial lines, or indeed have been privatized, the role of government has been strengthened in aspects of managing the gross water of the country and in regulation and monitoring. However, the provision of services and all implementation decisions have been devolved to the Water and Sewage Agencies or Authorities. Whatever institutional arrangement for water development, management, research, monitoring, servicing, and usage, is proposed for a country, those institutional responsibilities should be outlined carefully in the policy statement. Only when such statements are made, appropriate management and training programmes can be established for specific agencies.

4.6.5 Summary of Major Water Policy Action Areas

The summary below attempts to present a range of major policy action arenas in which the government must set the rules of play if the country is to achieve a reasonable balance between water supply and water demand. The following list of illustrative sub-issues are far from complete and the order of presentation of the policy action areas is random. No conclusions about priorities are implied, and no issues are proposed in the areas of international negotiations on water rights or on the assessment of available supply. Human resources development and public awareness are not mentioned prominently, because they are vital components of all policy implementation activities. The nature of the **HRD** and **Public Awareness Programmes** depends on the policies adopted :

(a) Institutional Policy : Who Manages What in The Water Sector ?

(1) Define institutional roles, boundaries, complementarities, synergies, and working relations.
(2) Personnel, regulations, salary structures, benefits, etc.
(3) Related agencies: health, education, agriculture, etc., how do they fit in, who should do what and to whom.
(4) Policy coordination and direction : how to make policy that is formulated and implemented nationally.

(b) Allocation Priority Policy : Who Gets Served First ?

(1) Domestic use-how much, for whom, at what price.
(2) Industrial use.
(3) Agriculture-does the country have an agricultural future.
(4) Hydro-power.
(5) Tourism.

(c) Pricing Policy : Who Pays How Much For What Service ?

(1) Service orientation of the countries water entities.
(2) Pricing to cover operation and maintenance, recover capital costs or pay off loans, reserve for future investment.
(3) Subsidies : for whom, for how long, at what level.
(4) Nothing is free. Someone always has to pay. What do subsidies and incentive pricing mean to the nation in the short and long run ?
(5) Pricing methods and their implications-economic, financial, technical, social, environmental, etc.

(d) Participation Policy : Whose Voice is Heard ?

(1) Stakeholder analysis-the groups, their interests, the impact on them of the policies and implementation measures.
(2) NGO role in policy formulation and implementation.
(3) Water users-irrigators, urban users, sectoral groups, industrial associations, transporters, etc.
(4) Water for the poor, water for the rich.
(5) Distinguishing between national interest and individual/firm interest in water policy formulation and implementation.
(6) Monitoring water production and use : how much is enough ? Who should do what and report to whom ? Cost/Benefit analysis.
(7) Units of measurement : geological, administrative, community-based?

(f) Standards, Policies, And Guidelines : Who Needs What Kind of Water?

(1) Wastewater reuses and guidelines.
(2) Drinking water standards.
(3) Irrigation approaches-restricted and unrestricted, irrigation methods.
(4) Environmental standards.

(g) Incentive And Enforcement Policy : What And Who Makes Whom Toe The Line?

(1) Marketing freedom : countries regulations and defacto monopolies and oligopolies.
(2) Monitoring and control of groundwater use.
(3) Using import duty to promote technology use and development.
(4) Demand reduction-positive and negative incentives and sanctions.
(5) Credit policy
(6) Conveyance losses-real losses and illicit water use for productive or domestic purposes.

(h) Devolution And Privatization Policy Issues : Where is The Line Between Public And Private Sectors, And Between Central Government And Local Authorities.

(1) What services can the private sector supply more effectively than the public sector.
(2) What services can governorate or municipal services supply better than the central government.
(3) What are the financial implications of such new arrangements.
(4) National versus local priorities and interests.
(5) National versus local resources control.

(i) Investment Policy : What Sectors Get Subsidized ?

(1) Innovative technology for water saving-dual delivery systems, etc.
(2) Brackish water desalinization.
(3) Big engineering works (large dams, large irrigation schemes/canals).
(4) Small technology : micro-storage, improved irrigation, etc.
(5) High technology or low technology
(6) Construction versus operation and maintenance and rehabilitation.
(7) Research priorities and funding.

(j) Economic And Social Policy Issues

(1) Economic and Social - Cost / Benefit analysis.
(2) Indirect effects of policy decisions.

(3) Income effects of policy decisions-revenues, fines/sanctions, investment decisions, saving decisions.

(4) Water rights : who owns what water at what point? When does the state give up control? Transfers and trades/sales of water rights.

(5) The country cannot afford to pay for the water investments it will have to make to keep ahead of population growth. Any water policy must be based on a set of economic policies which promote rapid, substantial, and sustainable economic growth for the country.

4.7 Improving Communication in the Water Sector

Many people in Palestine determine the fate of a plan on water quality and conservation. They are people in ministries, government units, parastatals, private sector, and the general public. Some make, or influence, public policy and regulations, others operate the Palestinian system to provide water for municipalities, industries, and agriculture. Customers, especially families through everyday living, have strong influence on others. It will be a hard job to reach and affect many of these people. The task is challenging. It will involve changes in behavior by people who provide the water and those who use it. All will need information--and motivation--to make individual changes. It is also important to broaden participation in the processes to implement water policies.

There are at least fur five main target audiences for change in water behavior. Each audience has its own roles to play and its own actions to take. Some should be involved as participants in determining policies and rules. Others are mainly users. Different approaches will be needed for different target groups. Groups include: (I) government policy-makers, Parliament, the Office of the President of the Palestinian Authority, and ministers; (ii) government administrators, (iii) managers of water-using agencies, private sector businesses, and non-governmental organizations; (iv) attentive public and influential persons outside of government; and (v) the public at large.

4.7.1 A Setting for Involvement and Participation

The Palestinian Authority has recently stressed the need to decentralize many of its activities. Such steps tend to foster a setting in which communication, education, and participation flourish. Such a setting can serve to strengthen a number of aspects of a comprehensive water plan. At the same time, communication, education, and participation help build the setting for involvement. Both processes need to move along together.

Many of the people know Palestine has a water problem, but the subject doesn't rank high on the public agenda. Few people talk about it, still fewer put their concern into action. More involvement of many affected by water, both inside the government and outside, should lead to more effective policies and actions, greater concern , and perhaps more actions to conserve and protect the resource. There fore, it is essential to

initiate a continuing national information campaign on water use and conservation, and begin steps for long-term education.

4.7.2. Methods for Involvement and the Resources Required

Some involvement and information efforts-especially with other agencies and decision-makers-will need face-to-face contacts, supported by well-developed data, presented in ways to get discussions of choices. Because people differ and their needs vary, a combination of methods will be required.

One type of involvement calls for job-related education and training to upgrade skills of people who work within the water system. The following section (4.8) on training and communication show how this component would be developed.

Some of the audiences are simply too large to reach in personalized, face-to-face ways. Mass media offer the only feasible channel to reach thousands and hundreds of thousands with information on water. The public at large must be part of the plan in the short term and the long term. A national campaign is needed initially to make most people aware of the water problems. It can set out the threat to future development, the health and economic hazards of declining water quality, waste in present practices, and threats to family well-being.

A long-term effort means education, starting with the young. Some is now being done, but it lacks the resources to make it as pervasive as needed. Public involvement and awareness efforts of this kind call for many more and different resources than now available in Palestine's water-related agencies. This approach would involve a major training and communication project, with external donor support. The Palestinian Authority has to build a strong communication capability in the Palestinian Water Authority to develop and carry out this level of awareness and involvement.

4.7.3 Consequences of Lack of Involvement and Awareness

The need for involvement and awareness has been put forward here as a positive force to support a comprehensive plan. Without involvement and awareness, each benefit stated here becomes neutral, or even a negative factor in some cases. Without the awareness sought here, there are many unfortunate possible consequences. Here are some:

- Policy-makers and administrative leaders work with partial knowledge of the water sector, and their actions bring fewer benefits.
- Management - people work from less knowledge of how their acts affect other users and the operation of the water system.
- Private - sector entrepreneurs make business decisions that fail because of poor understanding of the water problem.
- The attentive public may offer ill-guided influence due to limited knowledge of the significance of water policy.

- The public at large may unknowingly waste one of their country's most limited resources-or spoil its quality and availability.

4.8 Training and Communication

Communication will play a key part in the acceptance of any water quality and conservation plan. Communication is important also in operation of Palestine's water system. One aspect deals with the political and popular acceptance: that's a communication task. The second aspect is partly communication (moving information between units that operate the system) and partly training (developing individual skills that make the system work better).

4.8.1 Training

(1) Training in Water Management Information

Information helps determine how effectively and how efficiently Palestine's system delivers water to users. Some of that information moves as data between parts of the system. Some information is packaged in the skills that water-system workers use in doing their jobs.

In this latter area, we're dealing with the skills that determine how well the whole system functions. These are skills of people who sample and analyze water for quality; those who handle the valves that direct and deliver water; others who find and repair leaks in water lines; those who clean and maintain canals; and many others performing others tasks. There are also people who manage the system, many of whom need to become better managers.

The quality of human performance rests on skills. Managers and services workers develop skills through education, specific pre-service training, and upgrading through frequent in-service training.

The PWA has training programs but without training units. A training unit needs to be strongly funded, housed in good and well equipped facilities, and supplied with effective training material and trainers.

Donor support should be sought to form such a unit and strengthen its capabilities. Donor support could provide needed training of managers of the training unit and trainers; equipment and supplies; and advisory assistance.

The training unit would have a place in the strategic planning process proposed for the PWA. One early output would be a master training plan for the staff of the PWA, outlining in-service training at all levels for managerial, administrative support, technical, and field personnel. The plan should cover training to be done by the PWA training unit as well as training conducted by outside units, or abroad.

(2) Irrigation and Water Management Information

Irrigation uses about twice as much of Palestine's water as all other uses combined. Thus, it is a prime target for saving through efficient delivery, use, and conservation. Good communication is needed among the main players in agriculture: farmers, extension workers of the MOA and the private sector. The better the system works, the better limited irrigation waters will be used in order to increase the irrigated area. The same is needed for domestic, municipal, and industrial uses of water.

The general communication model here is a two-way flow: Give training on the best information available to the many groups that work with farmers (farmer associations, extension workers, private-sector firms, and marketing agencies, for example). They can then integrate that information into the services they provide to farmers, including advice on choice of crops, fertilizers, pest control, post-harvest handling, marketing, and more.

This requires a strong capacity in technical information services--a staff able to keep up with irrigation technologies. Some technologies will come from national and regional research. Others will come from international sources. To gather these technologies, the system will need linkages with such sources as the International Irrigation Management Institute (in Sri Lanka) and international databases. It will also need to transfer these technologies through training and communications media. People with technical background and communication skills are needed to provide this kind of service.

(a) Resources for Training Programs

. . Funds to build training facilities with adequate classrooms (with heat and air conditioning), hostel, video and publication studies.
. . Funds for training and presentation equipment
. . Technical assistance in organization and management of a training unit, also on methods, equipment, and production.
. . Funds for additional training personnel: trainers and production staff for print and audiovisual media.
. . Funds for staff development training, including travel and some overseas education

(b) Resources for Information:

. . Technical assistance to develop and train staff to operate water information system and a management information system.
. . Funds for staff to operate the information systems

4.8.2 Communication for Public Awareness and Involvement

Acceptance of a national water quality and conservation plan calls for programs to get information to public or audiences that make decisions about policies and individual

actions. That is a communication task. It is intended that Palestinians take part as planners and choice-makers in the plan. That calls for a strategy to create awareness and involvement. Such a strategy begins with a careful discipline of identifying the key participants and their stakes in the plan. That comes before designing or delivering messages. **(See Appendix VI - Phases of Conducting Public Awareness Campaign for Water Conservation).**

This national water quality and conservation plan needs a base of much more than acceptance in the mind. It can benefit Palestine only when it's put to use. Adoption will entail a long list of changed behaviors by organizations and individuals. The awareness and communication strategy thus needs to be based on a behavioral paradigm. (Endnote 1 in this section works through an example of this approach applied to one set of behaviors in delivery and use of water.).

To communicate awareness, a wide range of tasks need to be covered. Some messages will be focused on one or just a few targeted individuals. Others will target audiences of much larger size, where special and mass media may offer the only feasible channels of communication.

A system-oriented plan: a national water quality and conservation plan integrates many within a larger system. Policy in wastewater treatment, for example, affects other parts of the system. Among other parts affected, for example, would be standards (and costs) for industries, quality and availability of water for irrigation, charges to consumers at large, and many more. This idea of system has to be reflected in planning for public awareness. Groups and organizations that have a stake in the system should have their chance to know about provisions that would affect them.

Communicators begin the process by identifying the interested publics. Next they set goals for their awareness effort. Then nature of that information and the number and location of the target publics suggest the feasible methods for giving information.

The major publics are set out here, along with specific goals of awareness, the information required, and some of the means of communicating with the publics. **Five main publics get attention:**

4.8.2.1 Public No. 1: Government Policy Makers

Targets:

.. Parliament / Council of People
.. PWA
.. Ministry of Municipal, Rural Affairs and Local Government (Environment Department; Governorates and Municipalities Liaisons; Testing Services; Public Relations)
.. Ministry of Trade and Industries (MTI) (Directorates of Industries and Specifications and Measurements)

.. Ministry of Agriculture (Irrigation, Public Relations, Publications)
.. Ministry of Interior (Governorates, Public Safety Committees)
.. Ministry of Health (Water Quality, Basic Protection of Public Health)
.. Ministry of Education (Elementary and Secondary)
.. Ministry of Information (Radio, Television, Cinema)
.. Chambers of Industry
.. Police Forces (Public Relations) and Security Department (Public Relations)and Civil Defense Department (Public R elations)

Specific Goals of Awareness:

- That policy-makers give water resources a high-priority among all public-policy initiatives.

- That the Palestinian Authority personnel understand the public awareness plan, recognize how water-use sectors are interrelated, and seek equity among the competing interests.

- That information from government units (as public relations, education, and public information output) reinforce attitudes and actions that guard the water resources and use it efficiently.

- That government units encourage and set examples for water protection and conservation measures.

Information Required: Policy-Makers and Administrators

The following information would be presented in conferences with policy-makers who influence laws and regulations on water. Besides an overall concern, each group would have its own dominant interest in one category: (for example, MOA and farmers organizations might be most interested in irrigation; the PWA interest might be municipal water and sewerage; MTI's concern might be industrial situation). The most detailed information for each group, however, would relate specifically to that group's interest.

The Common Background

- The present situation of water supply and water demand, allocations to the three main uses, and efficiencies of use.
- Projected supply and demand for future periods with projected population and consumption rates
- The water-shortage gaps projected for the population under expected trends in the three main uses: municipal, industrial, and irrigation.
- Different approaches to reduce the deficit, with associated effects:
  Change allocations among uses
  Change efficiencies in use for each category

Apply practical conservation measures
Increase water supply-ways and the costs associated

This information would be developed in a brief paper (about 20 pages with simplified charts and graphics). The same paper would serve all the several groups, irrespective of each group's main interest in water.

The Special-Interest Material

- A close-up look at alternatives for each group's main interest in water (for example : irrigation for MOA, municipal and domestic for PWA; industrial for MTI and Chambers of Industry)
- Trends in supply and demand in use within the group's main interest
- Projections under different scenarios of growth or decline
- Alternatives for dealing with the water resources, with effects on other use categories

Each main-use group would get a brief paper setting out the information above (about 20 pages with simplified charts and graphics). A set of graphics would show alternatives and consequences. This material would serve other groups who share that main-use interest.

4.8.2.2 Public No. 2. Government Administrative Units

Targets :

- The Palestinian Authority personnel who deal with water (Governorates, Municipalities, Water Authorities, etc.)
- Management (Including Those Who Set Specifications For Water Fixtures) Technical Staff and Service Staff

Goals of Awareness

- That people administering public laws and regulations on water understand the situation so their actions will protect the resource and improve efficiency of its use.
- That facilities be kept constantly at optimum working efficiency through regular monitoring, preventive maintenance, and prompt repair.
- That training programs be developed to give technical and service staffs abilities needed to do their jobs better.
- That specifications for plumbing fixtures and water-using appliances reflect a national need to conserve water.

Information Required

Managers of Palestinian facilities and services should have information material on the national water situation, along with information on supply and demand and alternatives and consequences for the area in which they serve. These managers could be given (i) personal notification by their supervisors and (ii) the documents that relate to their stake in the overall situation.

Technical and service personnel could be informed in two main ways:
(i) short, attractive brochures on the overall water situation (the same material as used in mass media efforts); and (ii) training sessions put on by their agency to give them the knowledge and technology needed to improve their individual performance.

4.8.2.3 Public No. 3. Private Sector

Targets :

- People in businesses and industries that use water in production (tannery, mining, etc.)
- Importers of plumbing fixtures and water-using appliances
- Businesses that sell products or perform services that affect efficiency of water use (pumps, water appliances, plumbing fixtures)
- Farmers' Union
- Society for the Control of Environmental Pollution
- Society for the Conservation of Nature

Goals of Awareness

- That owners/managing directors of water-related industries and Importers and merchants of plumbing fixtures and water appliances understand the country's water situation so their corporate actions protect the resource and improve efficiency of its use
- That corporate processes and operations are carried out with optimum protection and efficient use of the water resource while making a profit for the firm
- That supervisory, technical, and service personnel be trained to have and use skills to meet this objective

Information Required

Owners and managing directors of such firms need to understand the background situation regarding water. They will have special interest in how the plan may affect their profit picture and their operations.

Technical and service personnel require different information. As members of the public, they would be exposed to the mass media efforts. Many work with certain

elements of the water system. They should get training (planned in consultation with the private sector- and possibly carried out by the private sector) to help them improve performance.

4.8.2.4 Public No. 4. Attentive Public

Targets :

- Intellectual leaders (universities; social, cultural, and religious communities; mass media)

Goals of Awareness

That persons who express their public-policy interests interpersonally and in organization know and understand Palestine water situation and its importance to the present and future well-being of the citizens

Information Required

The most powerful communicating method with many of this public is by interpersonal means. One technique would be to hold a series of briefings for invited persons, under sponsorship of a high-ranking government official, or perhaps under patronage of the head of the PWA. The program presentation would use content from the agency briefings, with a special report released to the mass media at a press conference held in conjunction with the briefings.

4.8.2.5 Public No. 5. The Public at Large

Targets :

Urban householders -- adults and children
Rural householders -- adults and children
Nomadic householders -- adults and children

Goals of Awareness

- That adult family members, as individuals and as role models, know the country's water situation and accept responsibility for their own and the family's actions
- That individuals adopt water-using practices that take less water and protect the quality of the water they use
- That the public become aware that water supply and sewage services are expensive and heavily subsidized (revenue collected from users do not cover expenses of operation and maintenance)
- That children be educated about water as a national resource and on individual behaviors that serve both their own well-being and the greater good of their families and others

Information Required for the Short Term

Information needed here is that which encourages people to change their behavior --for such reasons as to save money, to do things better, or to be responsible within the family, to be patriotic. Communicators need to know current behaviors (how much water people waste in everyday actions, and how much could be saved by better practices). They need also to know people's attitudes behind their present actions (what people think about water and water conservation).

Only mass-media offer cost-effective ways to get information to these mass publics. Mass media perform best in bringing subjects before the public, making people aware of subjects. The result often is that people begin to talk about them. Other people may be the strongest influence in causing individuals to change their opinions and actions.

A social-research organization would need to be engaged to conduct market research upon which to base the mass-media program. Also, top-flight producers would be needed to conduct a powerful mass-media effort.

The first rounds of the mass-media campaign should kick off with the press conference and briefings for the attentive public (above). This would mean (i) collaborating with Radio Palestine and Palestine Television, (ii) producing a first wave of radio and television slogans for concurrent release, (iii) working with newspaper and magazine editors for feature coverage of the plan, (iv) displaying the first series of posters for schools and for adults.

Mass-media materials would be used over the full life of the project. Frequency would likely slow with time. Well-conceived slogans would be used throughout. While the early months and years would tend to be straight-on persuasion, a subtle shift in emphasis might occur as successes came out. Stories of success would be adaptable to print, radio, and television. In addition to keeping up public interest in the topic, many such reports would serve as "agents" in the transfer of water-saving technologies.

Children comprise the most fruitful target for long-term behavioral influence. They are not yet set in their actions regarding water; also, behaviors adopted early in life simply have longer to have effects. Schools are society's main effort to mold socially desirable behaviors. Thus, the schools are the most promising target for this longer-term effort.

Targets

Children through the elementary and secondary school years
Teachers of elementary and secondary schools
Curriculum developers--for elementary and secondary schools

Goals of Awareness

- That children be guided in forming water-using behaviors (habits) that conserve Palestine's scarce water resources, that they develop attitudes that will sustain these behaviors throughout their lives.
- That teachers accept the validity of water conservation as an appropriate subject for elementary and secondary school pupils and use the concepts in such ways as to instruct pupils and reinforce their learning.
- That curriculum developers for elementary and secondary schools see water conservation as a topic around which to produce many and varied educational experiences.

Information Required for the Long Term

Children need to be exposed to water-conservation learning in many and varied ways. Some would be through direct teaching, such as in health and hygiene; and some through secondary channels, such as in computing water usage as an excavation language arts, reading and writing on water conservation. Both the direct and the subtle treatment of the topic require curricula, and teachers to use the curricula.

Curricula development could be triggered by investment of resources for that purpose. The project should begin with talks in the Ministry of Education, fitting the project to the Ministry's interests and existing processes. The project could initiate a development team, funding it for a several-month period. This might include three persons: educational curriculum development specialist, subject matter source, and a media producer. The results would include reference materials (print and audio-visual), lesson plans, and teacher training.

4.8.3 Resources for Communications

Communication specialties are needed in two areas to carry out the program envisaged here. One specialty is in strategic planning: identifying audiences and goals of awareness, determining appeals, formulating messages, and choosing media. The second specialty is in production of the communication materials.

(a) Communication Planning

Communication represents a large part of a project that can be developed from this plan. Many persons, institutions, and firms will contribute. In addition to strategic planning, there will be need for effective management of personnel and financial resources. The consultant did not find an existing unit with the management expertise required. One non-government organization, the Society for the Control of Environmental Pollution, seems to have a base from which to manage such a program. It would need to recruit personnel for management and, with technical assistance, to develop both the systems and human resources to carry out the assignment. Sources of social research expertise have to be found also to participate in the program.

(b) Communication Production

There are writers-editors at a professional level in Palestine. These persons could be viewed as potential contributors through secondment, or program managers might be able to bring them into collaborative relations with the program. Designers and artists are mainly working in the private sector.

Quality printing can also be done in Palestine, especially in the private sector. Printing should be no problem, provided the program has adequate funding. In summary, the following external resources that would be required to mount the communication program set out above:

Funding of a private-sector firm to mange the communication program, funding for production and other services, funding for local professional staff as needed, funding for technical assistance required at several points. The personnel and tasks follow:

Program leader (for the life of the project)
Technical assistance personnel (most external):

- Strategic planning and production for mass media
- Presentation materials (desktop publishing, graphics, and print)
- Information science (management information systems and database operations)

Endnote 1.

An Example of Strategic Planning for Public Awareness

Let us assume that more efficient use of irrigation water in Palestine will call for more precision in the amount and timing of water delivered for specific crops. Assume further that the extension service of the MOA is a logical organization to provide farmers with the technical know-how on practices plus continuing advice to achieve that improved precision.

Without knowing just what that assignment would mean to a field extension worker, we can assume that he would need (a) some new or added technical knowledge that he doesn't now have and (b) some reason for wanting (1) to get the knowledge, (2) to keep the knowledge up-to-date, and (3) to use that knowledge. That's something other than business-as-usual: he has to change some of his own behavior. And that means wanting to change, at least seeing sound reasons to change. Let's look for some reasons.

Reasons extension worker would have for changing :

<u>Good things he might get by changing:</u>

- Please his supervisor, get praise (maybe improve his chance for promotion)

- Help a client - farmer (and get praise from the client)
- Feel good as professional (for doing his job better)
- Expand his own knowledge and influence

Bad things he might avoid by changing:

- Criticism by his supervisor
- Poor image the client (farmer) has of him
- Poor professional self-image

Reasons extension worker would have for NOT changing :

- Doesn't have the knowledge and information needed
- Must learn new information to advise others--learning isn't easy
- Chance of failure or poor showing as extension worker--if you try nothing new you can't fail or look worse than you do already
- Clients may not want to change practices--change will mean they'll have to learn new methods and probably do more work
- Client will need convincing proof; may ask hard questions
- Not sure the research results are practical and profitable for the farmer.

With these brainstormed ideas or items at hand, the next step is to rate them for importance (to the extension worker in this case), also for our own ability to deal with them: can we meet the person's need?

The persuader can then look for two classes of information to use with the extension worker. One is the substance of the argument (the content that answers a need); the other is the way (including the order) the arguments are put (direct and personal, written, etc.). In this case, we may first have to convince extension managers and supervisors that they should "buy into" this program. To do that we may, for example, have to:

(1) Promise to provide solid research-based data,
(2) Involve extension in formulating the methods and practice (also in planning the strategy and materials needed to introduce the technology).
(3) bear some of the cost of training up the extension workers,
(4) develop backup video, audio-visual, and print material, and
(5) furnish expert staff (and funding) to do Multimedia campaigns.

In setting out this example of a single audience, we also see several related audiences-each having individual wants and needs that differ from our extension-worker target. Extension managers and supervisors want some satisfactions that are a little different than the field worker may seek. And, of course, the farmer clients bring an entirely different set of wants-wants that have to be analyzed by extension workers as they get programs for farmers.

Maybe this example shows the point that public awareness programming involves much more than a basketful of creative ideas. It means hard and disciplined thinking about substance, strategy, and tactics.

Figure 1 that follows provides a flow sheet to help a planner move through this process.

Planning for Persuasion

The target audience : _____

_____

The action desired : _____

_____

From this point answer questions from the viewpoint of the target audience--not yourself!

Reasons for Taking the Action

Good things he'd get by taking that action	Bad things he'd avoid by taking that action
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Reasons for Not Taking the Action

_____

_____

_____

_____

_____

Rank the various reasons by importance: the high-ranking reasons for the action are the positive points to stress; the high-ranking reasons for not taking action are the ones that must be neutralized or overcome.

Table 4.1. Municipal/Industrial Water Problems and Alternatives

Municipal/Industrial Problems	Alternatives
Supply Shortage	- Improve distribution system - User awareness enhancement - User conservation measures - Reuse/recycle - Improve treatment level - Take water from other sectors - Import water - Groundwater over-drafting - Additional surface water development - Improve use efficiencies - Desalinization of brackish water
Water losses	- Redesign systems - O & M (e.g., leak repairs) - Public awareness - Monitoring increase
Low Water/Wastewater Prices & Tariffs	- Raise costs to encourage conservation - Awareness of user incomes - Enforce/implement tariffs - Improve water measurement
High Water Demanding Industrial processe	- Sectoral transfer of supply - Regulatory incentive - Replace/improve processes - Reuse/recycle
Low Water Pressure/Heavy Withdrawals	- Redesign distribution systems - Modify operation schemes - Raise water prices - Additional water supply - Public education
Water Hammers & Pipe Ruptures	- Change operation schemes - Modify system design (e.g., flow retrictions) - Increase water supply & delivery

Table 4.1. continued

Municipal/Industrial Problems	Alternatives
Inadequate Metering /Monitoring	- Install/Protect meters - Monitor meters - Employee training - Public education - Expand meters repair facilities
Undetained/Retained Runoff	- Detention basins for erosion and sedimenation controls - Increased storage facilities - Increased infiltration areas (e.g., groundwater recharge)
Absence of M& 1 Water-Saving Devices	- Raise water costs - Public awareness - Financial incentives for installation - Penalties for non-compliance - Availability of devices - Codes and ordinances
Unawareness of Conservation Needs and M	- Public awareness - Cost structure change - Employee training - Other demand management techniques
Ineffective Regulations	- Enforce existing regulations & administrative controls - New regulations
O & M Shortcomings	- Cost recovery - Employee Training - Design system to minimize O&M
Inefficient Management &/or Administrati	- Government reorganization - Private sector O&M.

Table 4.2. Irrigation Water Problems and Alternatives

Irrigation Problems	Alternatives
Supply Shortage	- Improve irrigation efficiency - Select crops with lower water requirements, &/or different seasons - Cut back on irrigated areas - Import water - Use of wastewater effluent - Detain/retain precipitation - Desalinate brackish water
Water losses	**A. Canals** - Line canals & maintain in good condition - Use enclosed pipes - Control structures - Automate/improve operation - Water measurement **B. Farms** - Improved irrigation methods (Drip, etc.) - Irrigation schedules - Farmer training & incentives - Water-saving devices (e.g., plastic houses) - Line & maintain farm canals
Inadequate Delivery System	- Improve/expand/replace existing systems - 24 hour irrigation - Use crops with lower water requirements
Low Water Costs	- Increase cost of water - Measure water - Public education programme - Equitable price structure - Illegal water diversions removed
Low-Value &/or High Water Demanding C	- Marketing help and support - Set product standards - Farmer training - Develop new crops and storage/transport

Table 4.2. continued

Irrigation Problems	Alternatives
Inadequate Regulations &/or Ineffective Enforcement	- Employee incentives/penalties - Enforce regulations - Employee training - Public awareness/education
O&M Lacking	- Training of employees - Cost recovery of private funds - Design system with O&M priority
Insufficient Monitoring	- Maintenance improvement - Read meters - O&M - Staff & Support services - Install measuring devices - User education
Deficient Management &/or Administratio	- Remove concept of food self-sufficiency - Administrative reorganization - Private sector O&M
Poor Water Quality	- Blend types of water - Crop selection - On-farm/canal treatment

Table 4.3. Impacts of Supply Management Methods in Water Conservation

EFFECTS	METHOD			
	Leak Repairs	Metering	Watershed Management	Evaporation Suppression
Economic-Financial Effects				
More Revenues	0	0		
Increased Profits	0	0		
High Implementation Costs	0	0	0	0
Variable Costs Decrease	0	0	0	0
Higher Costs Temporary and Operating Deficit	0	0	0	0
Higher Water Rate for Revenues	0	0	0	0
Subsidy/Grant Availability	0	0	0	0
More Personnel Needed	0	0	0	0
Technical-Environmental Effects				
New Supply Sources Decreased, Delayed	0	0	0	0
Improved System Deficiency	0	0	0	0
Decreased Energy Use	0	0	0	0
Institutional-Legal Effects				
Local Government Conflict	0	0	0	0
Company Opposition			0	

Source: Adapted from New England River Basins Commission, 1980

Table 4.4. Impacts of Demand Management Methods in Water Conservation

Impacts	Pricing	Regulations	Education
Economic-Financial Effects			
Decrease variable costs-water supply	0	0	0
Decrease variable costs-wastewater treatment	0	0	0
Decrease user's water and sewerage bills	0	0	0
Postpone/reduce/stop new source investment	0	0	0
Postpone/reduce/stop wastewater investment	0	0	0
Maintain fire protection, public health	0	0	0
Increase revenues with new connections	0	0	0
Users buy water-saving fixtures and reuse-recycle systems	0	0	0
Revenue increase	0		
Users increased water bills	0		
Increased revenues re-invested, and better services	0		
Increased revenues diverted to general budget, allowing a tax cut	0		
Big users develop own sources, with loss of revenues	0		
Increase prices, reduce production, layoff employees & increase product prices	0	0	
Conduct rate study	0		
Decrease water bill, at least temporarily		0	0
Lost revenue causes rate increase, and government subsidy	0	0	0
Other community programmes cut to pay for lost water revenues	0	0	0
Cutback in O&M to pay for lost revenues	0	0	0
Government pays for enforcement		0	
Government pays for educational programme			0
Conservation discourages new industries	0	0	
Environmental-Technical Effects			
Postpone/reduce/stop new source investment	0	0	0
Make additional connections	0	0	0
Reduce O&M	0	0	0
Reduce wastewater volume	0	0	0
Reduce O&M at wastewater treatment	0	0	0
Increase life of wastewater systems	0	0	0
Reduce energy consumption	0	0	0
Maintain water supply flow or level	0	0	0
Vary stream flows	0	0	0
Increase wastewater pollutant concentrations	0	0	0
Decrease wastewater transport efficiency	0	0	0
Over watering damages vegetation	0	0	0

Table 4.4. Continued

Impacts	Pricing	Regulations	Education
Improve system by revenue reinvestment	0		
Revenue loss to degrade system	0	0	0
Social-Political Effects			
Maintain community life style	0	0	0
Put water-based recreation in jeopardy	0	0	0
Revenue losses stimulate other groups to fund opposition to government		0	0
Revenue gains pay for community programes		0	0
Revenue gains increase community programes		0	0
Users & special interests oppose conservation	0	0	
Politicians oppose programme	0	0	
Consider programme equity, fairness	0	0	
Affects politics of community development	0	0	
Increase understanding by users			0
Difficult enforcement implementation		0	
Difficult cooperation with schools			0
Received well by users and government			0
Institutional-Legal Effects			
Maintain bonds and loans	0	0	0
Law limit conservation options for users	0	0	0
Conflicting surface & groundwater laws inhibit comprehensive conservation	0	0	0
Poor cooperation among agencies complicates implementation	0	0	0
Local/national laws limit conservation	0	0	0
Necessary coordination with media & schools			0
Improve coordination of participating government bodies			0
Difficult coordination of independent water supply and wastewater operations	0	0	0

Source: Adapted from New England River Basins Commissions. 1980.

Table 4.5. Actions to Mitigate Adverse Impacts From Supply and Demand Management Methods in Water Conservation

Impacts	Actions
Supply Management	
Costs of programme may result in temporary operating deficit	Short-term loans; temporary subsidy from local government; use emergency funds; borrow from another budget
Costs of programme can not be covered by existing revenues	Implement new water rate; seek subsidy from government
Lack of cooperation from local government may complicate implementation.	Develop education programme to explain need for programme, increase cooperation.
Community opposition	Develop education programme to inform community of need for programme.
Demand Management	
Revenue decrease	Raise water rate Obtain government subsidy Increase taxes to subsidize utility
Additional expenditures needed to pay for programme	Minimize cost of programme Raise water rate Obtain government subsidy Increase taxes to subsidize utility
Regulatory board limits	Lobby for change in policy
User expenditures required for water-saving devices	Provide devices free or at low cost; Establish customer assistance.
User water bill increase	Provide users with information on how to reduce use.
Large volume users may develop own source relocate, lay off employees; new industry not attracted	Modify price structure or regulations to minimize effects on these users, to maintain community economic livelihood.
Reduced sewer transportation efficiency	Replace sewer at greater slope; exempt area from conservation.

Table 4.5. Continued

Impacts	Actions
Damage to landscape	Inform users how to irrigate most efficiently; Design program so that irrigation limited, but still allowed; Reuse grey or treated wastewater for irrigation.
Public and political opposition	Implement education programme to improve users' understanding of need for programmes.
Community water related recreation may be jeopardized	Design programme to limit use, but still allow use; Exempt community use from programme.
Equity of programme	Design program very carefully to assure equity among users.
Lack of cooperation of community departments may complicate implementation.	Implement education program to improve their understanding of need for cooperation.
Limits of regulatory board	Lobby for policy change.
Limits of local, state or federal laws.	Lobby for change; Obtain exemption.
Voter preference limits use of revenues	Implement education program to inform voters of need for funds.

Source: Modified of New England River Basins Commission, 1980.

CHAPTER 5

PALESTINIAN BEST PRACTICES OF WATER CONSERVATION

5.1. Introduction

The Interim Agreement signed between the Palestine Liberation Organization (PLO) and the Government of the State of Israel on September 28, 1995, restates parts of the agreement on the Gaza Strip and Jericho Area signed in May 1994, and of the Agreement on Preparatory Transfer of Powers and Responsibilities (Cairo Agreement), signed in August 1994, and in so doing, supersedes the latter two agreements. Under the Interim Agreement, increasing responsibility has been granted to the Palestinian Council for public services in WBG (West Bank and Gaza Strip) including the power to operate, manage, and develop water and sewerage systems and resources. However, the existing systems supplying water to the Israeli settlements and the Military Installation Areas, and the water system and resources inside them continue to be operated and managed by the Israeli Mckoroth Water Company (Mckoroth).

The situation of the water sector is critical in both the West Bank and in Gaza Strip. However, the extreme water resources limitations facing Gaza Strip, possibly one of the most serious in the world today, demand a much better level of water resources management and greatly improved standard of service delivery to be achieved, and quickly. Groundwater, the only significant available source of water, is seriously over-utilized and badly contaminated.

The World Bank report (which was based on the findings of pre-appraisal and appraisal missions which visited the West Bank and Gaza in October 1995 and January 1996) stressed the urgent need to complete the rehabilitation programme which has started under the Emergency Rehabilitation Project (ERP) and other bilateral donor's initiatives. The Executive Authority of the Palestinian Council (EAPC) places a high priority on the improvement of water and wastewater services in Gaza Strip and the West Bank.

A number of donor - supported investment and technical assistance projects are already underway in the OPT in order to (a) extend the provision of water, (b) improve sewage collection and disposal facilities, (c) provide a healthy and clean environment for the inhabitants, (d) attract the business which is essential to economic development, and (e) continue and reinforce these efforts.

5.2. Palestinian Water / Wastewater Sector

5.2. 1. Issues and Constraints

The key sector challenges are : (a) improving water resources management and environmental health conditions, particularly management of the aquifers, (b) improving water supply delivery systems, (c) improving the sewerage collection, treatment, and disposal system, (d) improving wastewater resource management, and (e) strengthening the institutional, financial and regulatory framework for the management of water and wastewater.

Limited renewable water resources is the main constraint for economic development in Gaza Strip and misappropriation of the mountain water in the West Bank hinders availability for use. Thus, water availability; aquifer overdraft and allocation among various uses is one of the main issues and constraints to socio-economic development. Also, neither the volume of water produced nor used is recorded with any accuracy. Although most wells in Gaza Strip and the West Bank and a good number of consumers do have meters, many do not function, so that water pumped and used can only be estimated. However, overall estimates indicate that about 50 percent of water in municipal distribution networks is lost through leakages, illegal connections and inaccurate, or lack of, metering. Furthermore, not only these water resources are finite and will eventually be exhausted, but the excessive withdrawls are causing sea water intrusion and /or up-coning of deeper brackish water. Agricultural drainage water and leachate from sanitation facilities are the cause of high nitrate contents in aquifers.

Service coverage for sewerage is only about 25% in Gaza Strip and 30% in the West Bank. The rest of the population uses septic tanks, pit latrines, and other on-site excreta and wastewater disposal systems. The operational treatment plants are inefficient and dispose of their insufficiently treated effluent either into the sea without sea outfall as in Gaza Strip or open fields, causing aquifer pollution, in Gaza strip and the West Bank.

Data related to cost recovery is limited. In addition to inaccurate metering, there is no accounting separation between different operational departments in municipalities and village councils. While it is possible to discern the revenues from water and wastewater services, the costs incurred by these services cannot be clearly identified, as many functions are shared between different departments. Maintenance expenditures are far below a level necessary to maintain infrastructure adequately, and no provision is made for depreciation or capital cost recovery. Most tariffs are flat or regressive and do not encourage conservation.

5.2.2. Investment Programme

Little investment took place during the period of Israeli military occupation although the UNDP and UNRWA made important contributions and facilitated other donor funding for priority projects. The Emergency Assistance Program (EAP) prepared by the World Bank in December 1993 defined a strategy for the sector with initial

investment priority given to : rehabilitation and selective extension of municipal and village water networks; construction of new wells in selected municipalities and villages where resource, institutional and political conditions permit; urgently needed tools and equipment to support improved O&M; the development of the Jerusalem Water Undertaking (JWU) as a model regional utility; and rehabilitation and extension of existing sewerage networks and treatment plants. These priorities have been supported during the first two years by ERP through PECDAR and by other bilateral donor-funded projects, mainly through UNDP, UNRWA or directly with municipalities and village councils.

The Ministry of Planning and International Cooperation (MOPIC) was established in 1994 and has moved swiftly to assess sector needs. Detailed planning within the water sector is needed to define a sectoral investment program. This was not possible prior to the establishment of the PWA. It has been agreed that a Gaza Strip and West Bank Water and Sanitation Planning study will be implemented by the PWA with funding provided by the Technical Assistance Trust Fund (TATF), as an immediate priority to define a 5- to 10- year investment framework. Pending more detailed sectoral planning, the World Bank / IDA has assisted the EAPC to define a Core Investment Programme, including the proposed Water and Sanitation Services Project in Gaza Strip and a Municipal Infrastructure Development Project which will include water sector investments in the West Bank. The Core Investment Program was presented to a Donors' Meeting in Paris in January 1996. A number of bilaterally supported projects are addressing some of the larger infrastructure improvement needs (see Appendix IV)

5.2.3. Sector Outlook

A future situation is envisaged in which management of the separate municipal and village council water and wastewater departments in Gaza would be consolidated into a single, efficient Water and Wastewater Company for Gaza (WWCG), administratively and financially independent of the local governments that it serves, but accountable to its customers to provide adequate supplies of water to meet their drinking and other water needs, and to collect wastewater for treatment and reuse. The same concept and situation is planned for the West Bank.

The immediate objective, however, is to improve to an acceptable level the quality of water supplied and wastewater treated, the quantity of water available, and the management of water and wastewater services. To do so, an internationally experienced water and wastewater ***operator*** would assist in implementing a service improvement program. The existing municipal and village council water and wastewater departments would be strengthened, operation and maintenance of services improved, and the management and financial accounting of water and wastewater services separated from other services. This is expected to lead to the establishment of WWCG, capturing economics of scale, and facilitating a more efficient, sustainable and equitable sharing of the limited available water resources. Upon completion of the operator's contract, the fully functional unified WWCG is expected to continue to operate autonomously under the direction of a Board of Directors. If the EAPC so chooses, private sector

management could be continued in the form of a management contract, affermage, or a concession granted to the private sector to provide water and wastewater services for an extended period of time.

The management contract of service improvement program for water and wastewater systems in the Gaza Strip was signed with an international ***operator*** on May 28, 1996. Appendix VII shows "Description of Services of the Management Contract for Gaza".

5.2.4 Sector Restructuring

5.2.4.1 Sector Objectives

The short-term strategy for the water and wastewater sector in the West Bank and Gaza Strip is to : (a) improve the quantity of water and strengthen regulatory controls over the Gaza aquifer, institute effective conservation practices to reduce losses and manage demand, improve the quality and management of water, (b) involve the private sector in the provision and management of services, (c) continue to implement a program of priority water network rehabilitation and expand piped water coverage to selected municipalities and villages, implement a programme of priority sewerage network and treatment plant rehabilitation, and develop new wells, (d) lay the basis for long-term institutional reform, (e) create regional water and wastewater companies by rationalizing and consolidating individual municipal utility departments and village councils, (f) establish effective data collection and cost recovery policies and systems, and (g) establish an effective regulatory framework.

The medium - and long - term strategy is to : (a) develop and implement coherent water resources management policies for the West Bank and for Gaza, including particularly a wastewater re-use policy for Gaza, (b) develop regional water resources management policy with Jordan and Israel, (c) extend and consolidate a program of priority network rehabilitation, expand piped water coverage to all villages, (d) develop additional new wells in the context of an overall water resources management strategy, (e) consider desalination subject to economic feasibility, (f) develop and implement a long-term WBG-wide program of improvement to sewerage networks and treatment plants, and reclaimed water reuse, and (g) increase private sector participation in the provision of services.

5.2.4.2 Palestinian Council's Water Policy

The PWA has a number of agreements relating to water resources contained in the Interim Agreement. These include management to prevent harm to the water resources, continued supply of water to settlements and the Military Installation Areas, and payment of the real cost of water purchased from Mekoroth. Law 18 of January 18, 1997 empowering the PWA to exercise its functions provides the overall direction of sectoral policy (see Appendix III).

A key factor of the EAPC's water policy is the separation between regulatory functions and service delivery. The PWA will be incharge of regulation, comprising tariff review, water law and legislation, water extraction licensing and monitoring, overall sector planning and coordination, and establishing standards for drinking water and wastewater quality, as well as other technical standards.
The legislation also establishes a Water Council to make decisions on sectoral policy, water management, tariffs, and key organizational arrangements. The Water Council comprises representatives of relevant ministries and research institutions.
The role, mandate, scope of work and powers of the PWA and its commissioner (Head) are defined in the legislation.

The PWA will carry out a Water Resources Planning / Institutional Study for the WBG, financed by the TATF and managed by IDA. The objectives of this study would be to formulate a vision for the water sector, contribute to sector policy development and water resources strategy, develop plans for optimal use of water allocations in accordance with the provision of Article 40 (Water and Sewage) of the Interim Agreement, determine priority investments and estimate costs for a five - to ten-year investment programme, and assist to define a more appropriate institutional framework for service delivery.

As indicated above, it is expected that in the future, water and sewerage responsibilities in WBG will be merged into a small number of regional utility companies along similar lines to the JWU in the Ramallah District. In Gaza, a single company (WWCG) is envisaged as described earlier. However, in the short term, service provision in Gaza will remain the responsibility of municipalities and village councils and a Management Contract Operator **(Operator)** will implement a Service Improvement Program. This policy has been agreed to by all municipalities and village councils in Gaza Strip and the PWA and translated into a Memorandum of Understanding (MOU) signed by all parties. It states that the municipalities and village councils support the proposed Service Improvement Programme and are willing to cooperate and facilitate the assistance to be provided by an **Operator**. The municipalities and village councils will also maintain, as a minimum, present operating levels and financing of water supply and sanitation in their respective areas including staff, power, and consumables. Moreover, they support in principle the proposed WWCG, the form of which has yet to be determined and agreed, and they will collaborate and cooperate fully with the **Operator** to facilitate necessary preparatory activities that will be required in order to make a decision to proceed with the establishment of WWCG.

The implementation of the Management Contract would be facilitated by a Steering Committee (SC) which was recently established and could subsequently become the Board of the WWCG. It comprises representatives of the municipalities and village councils, consumers, the PWA, and appropriate ministries of the EAPC. The SC would oversee and guide the activities of the **Operator** and provide advice to the PWA. The assistance provided by the **Operator** would be coordinated by a Technical Counterpart Team (TCT) of responsible water engineers from municipalities and village councils.

The TCT would work hand in hand with the **operator**, and facilitate access to and cooperation with the concerned municipalities and village councils.

It is envisaged that a similar Contract Management programme will be implemented in the West Bank and it is expected to start in 1998.

5.3. Water Conservation Practices / Programs

Preface

Most conservation measures and practices can be carried out only by a capable institution with a mandate for action, a capable staff, and adequate resources. Water conservation takes many forms. However, it is helpful to differentiate between conservation measures and practices. Measures may be direct, such as regulatory controls or economic incentives related to water use, or indirect such as through persuasion of the public awareness campaigns carried out in the mass media. Measures are largely the direct responsibility of a central water authority such as the PWA. Management practices, on the other hand, are typically carried out by the water user often because of measures introduced by the PWA. Practices typically require the use of technologies to reduce losses from leaks, reduce evapotranspiration, reduce demand for fresh water by substituting water of less quality and increase of water recharge, and may other practices. A number of water conservation programs in the Palestinian territories were / are being funded and implemented by various international donors and agencies such as the U.S.A/U.S.AID, Germany / KFW and GTZ, Norway /NORAD and NVE, France, Austria, Canada / CIDA, Japan / JICA, Finland / FINIDA, Denmark, Sweden, the World Bank / IDA, UNDP, UNRWA, SCF, Catholic Relief Services (CRS), and many other foreign NGO's.

These programs are :

- **Program No. 1 :** Water and Sanitation Services Project in Gaza Strip/ Management Contract.
- **Program No. 2 :** Rehabilitation of Water Distribution Networks in the West Bank
- **Program No. 3 :** Rainwater Harvesting in the West Bank
- **Program No. 4 :** Development of Springs in the West Bank
- **Program No. 5 :** Municipal Infrastructure Development Project for the West Bank and Gaza Strip
- **Program No. 6 :** Service Improvement for Water and Wastewater in 16 Municipalities of the Gaza Strip (SIP)
- **Program No. 7 :** Public Awareness Campaign for Water / Wastewater in the West Bank and Gaza Strip
- **Program No. 8 :** Water Tariff Study in the Palestinian Territories
- **Program No. 9 :** Action Plan for Water Master Planning Support of the PWA.

Each of the above listed programs is explained in a separate section of this chapter 5 of the report. The name, goal, objectives, description and background, activities, and the environmental impact of each program are detailed. Other requirements such as context, gender impact, and records of success of each program are not available due to the very recent implementation of these programs, therefor, were not reported. The relevance and applicability of these programs to the Middle East Region has to be assessed in the presence of representatives of other countries /sites in the region.

Program No. 1

Water and Sanitation Services Project in Gaza Strip / Management Contract

Implementing Agency : Palestinian Water Authority (PWA)
Beneficiaries : 16 Municipalities and Village Councils in Gaza Strip and the Palestinian Water Authority

Objectives : To address urgent priorities aiming at improving the quality, quantity, and management of water and sanitation services in Gaza Strip through a private sector Management Contract for water and wastewater operations, strengthening and restructuring the institutional framework for both service delivery and for sector governance functions, and creating the operational, institutional and managerial conditions for priority rehabilitation, upgrading and extension projects to be financed by donors.

Problems of Municipal and Industrial Water in Gaza Strip

- Abstraction from the aquifer exceeds recharge, therefore water balance deficits occur
- Pollution of groundwater caused by high chloride and nitrate concentrations and by improper wastewater collection and disposal without treatment
- Loss of treated wastewater as a source for irrigation
- Loss of rain storm water as a source of fresh water due to lack of drainage and collection systems
- Unaccounted for water (50%). Many public services do not pay such as mosques, fire fighting , and UNRWA. These services account for almost 13% out of the 50%.
- Illegal connections (theft)
- Almost 80% of household meters are either malfunctioning or not functioning, and municipal well meters are not functioning
- Improper design of the water distribution networks which either causes losses or maldistribution among different areas i.e. some areas receive plenty and others receive very little.
- Different zones of the town / city / village receive different qualities of piped water due to mismanagement and irregular disinfiction or lack of proper operation of the chlorination system
- Contamination of household water supply caused by intermittent supply and/or low hydraulic pressure of the distribution system which permits suction of pollutants through fractures in the pipes such as industrial effluent or sewage
- Water supply pipes are located within the vicinity of the sewage network
- Corroded and rusted pipes of the old network which cause rust and sand being suspended in the water received by the consumers and therefor leads to their dis-satisfaction and complaints of water quality

- Improper locations of a few public water supply wells
- Uncontrolled cess pits lead to seepage of sewage into the groundwater aquifer
- Use of municipal supply by the industry instead of having a separate network
- Dumping of raw industrial waste in the sewage network
- Inefficient use of water in the following industries in particular : tile, soft drinks, Garment, and concrete
- Car wash which poses a threat of pollution by lead, hydrocarbons, and other compounds.

Description : The project consists of : (a) the provision of an International Operator under a four-year Management Contract to implement a Service Improvement Program, (b) the provision of operating investment funds for the Operator, built into the Management Contract, essential to fund goods, equipment, works, and services required for improving services and for attainment of performance targets, and (c) the provision of technical assistance to (i) strengthen the newly created PWA, (ii) support implementation and monitoring of the project, and (iii) provide independent auditors to monitor the Operator's technical and financial performance.

The project is designed within the framework of a program addressing the priority needs for WBG as originally defined in the water and wastewater component of the three-year Emergency Assistance Program (EAP). It includes equipment procurement, upgrading and extension of municipal water supply networks, rehabilitation, extension and construction of municipal storm water and sewerage networks, improvement of village water distribution and related programs and the drilling of new wells. For Gaza, the program includes : (a) the provision of an International Operator to implement a Service Improvement Programme together with the provision of operating capital for the operator, (b) finance for investment in rehabilitation projects and provision of additional water and wastewater facilities in areas where they are most urgently required (through bilateral funding), and (c) technical assistance (TA) and Institutional Capacity Development.

Environmental Aspects : The project has been placed in environmental screening category "B" consistent with the provision of World Bank Operational Directive 4.01 "Environmental Assessment". The Environmental Planning Directorate of the MOPIC has not issued environmental assessment guidelines for use in the WBG. However, once these procedures are issued they would be applicable to the proposed project and to the parallel investment programme. All investment projects in the WBG which would be financed in parallel by donors (outside the scope of the project)are subject to field-based review against a set of criteria which include an assessment of environmental impacts. All selected projects will be submitted for review and approved by the Palestinian Environmental Authorities and by IDA environmental specialist. Currently there are no project proposals whose implementation would require land acquisition or result in involuntary resettlement. No known archaeological or historical sites would be affected by rehabilitation works nor does the operating investment component of the project raise any international water issues. The project will not

support major expansion or rehabilitation of existing wastewater treatment facilities, for which bilateral funding would be used, but will ensure that any expansion of wastewater collection facilities does not result in unacceptable over loading of treatment facilities. The project would give particular attention to the findings and recommendations of the report on Wastewater Treatment and Re-use Strategy for Gaza and the West Bank Commissioned by PECDAR in 1994. Implementation of the project would result in significant improvement in the management of water and wastewater services in Gaza and in the regulation of abstractions from the seriously overdrawn and contaminated Gaza aquifer. Staffing requirements of the Operator require a sewerage engineer with experience in regulation of industrial wastewater, wastewater treatment and reclaimed water re-use. Table 5.1 shows a list of proposed water conservation Projects for Gaza Strip. For each project, the name, problems to be solved, objectives, scope of work and potential participants are shown in a separate sheet.

Table 5.1

PROPOSED WATER CONSERVATION PROJECTS For GAZA STRIP

Project No. 1	**Project Name :** **Well Inventory & Quota Revision**

Problems :

1- Uncontrolled abstraction (most meters do not work).
2- Inadequate quota for various crops.
3- Lack of continuos checking for quota updating.
4- Absence of water tariff & charges.

Objectives :

1- Efficient use of water through control.
2- Facilitate monitoring.
3- To save the basic information for each well.

Scope of Work :

1- Comprehensive well survey.
2- Design of tariff system.
3- Development of adequate licensing.
4- Review of quota and relevant subjects.

Potential Participants :

1- PWA.
2- Ministry of Agriculture
3- Ministry of Planning.

Table 5.1 Continued

Project No. 2	**Project Name :** **Network for treated wastewater for irrigation**

Problems :

1- Limited water resources.
2-Increasing of salinity in irrigation water in Gaza Goveornorate.
3- Spread of environmental and public health hazards.
4-Absence of proper water supply network to convey the treated wastewater to the farms.
5- Improper disposal of wastewater.

Objectives :

1- Minimize the health & environmental impacts.
2- Utilize renewable sources of water
3- Increase the irrigated area.

Scope of Work :

1- Identify suitable areas and crops which will be irrigated.
2- Assessment of agricultural demands.
3- Design of the distribution networks .
4- Public Awareness.

Potential participants :

1- PWA
2- Ministry of Agriculture.
3- Gaza Municipality.

Table 5.1 Continued

Project No. 3	Project Name : Drilling New Wells

Problems :

1- Insufficient water supply quantity
2- Bad quality of existing water supply

Objectives :

1- Improve water supply quality
2- Increase quantity to fulfill demand (extra 40, 000 m^3/day)

Scope of Work:

1- Drilling of 20 new wells (15 in the north (100 m^3/hr) & 5 in the south (80 m^3/hr)
2- Construction of necessary network and other auxiliaries
3- Public awareness

Potential participants :

1- Municipality of Gaza and, Jabalia
2- Ministry of Planning & International Cooperation
3- PWA

Table 5.1 Continued

Project No. 4	**Project Name :** **Feasibility of/and using Agricultural wells for municipal supply**

Problems :

1- Insufficient water supply quantity
2- Bad water quality of existing water supply

Objectives :

1- Improve supplied water quality (resource quality)
2- Increase quantity to fulfill demand (extra 40,000 m^3/day)

Scope of Work :

1- Survey and screening of potential agricultural wells
2- Screening of 48 agricultural wells, each of them is working for 12 hours at a rate 70 m^3/hr
3- Construction of necessary network and other auxiliaries
4- Public awareness
5- Develop tariff policy
6- Installation of water meters for municipal supply

Potential Participants :

1- Municipality of Gaza, Jabalia, Beit Hanon, and Beit Lahia
2- Ministry of Agriculture
3- PWA

Table 5.1 Continued

Project No. 5	Project Name : Rehabilitation of Existing Municipal Wells

Problems :

1- Bad quality of pumped water
2- Corroded fitting
3- Pollution of wells (oil & contaminants)
4- Sand particles at existing pumped water
5- Misalignment of connecting rods and transmission links
6- Poor safety measures in well site (well hole, civil works)
7- No access for conducting required measurements e.g. pressure gauge and flow meter
8- Chlorination system does not function properly
9- Declining well capacity discharge

Objectives :

1- Improve water quality
2- Increase efficiency
3- Ensure safety
4- Facilitate monitoring

Scope of Work :

1- Assessment and evaluation of existing municipal wells (19)
2- Develop rehabilitation plan
3- Installation of required equipment
4- Develop maintenance programme
5- Develop safety regulations
6- Public awareness

Potential Participants :

1- Municipality of Gaza, and Jabalia
2- Ministry of Agriculture
3- PWA

Table 5.1 Continued

Project No. 6	**Project Name :** **Well Site Protection**

Problems :

1- Groundwater pollution around the wells

Objectives :

1- Minimize pollution risk
2- On-site protection of the resource around the well

Scope of Work :

1- Improve and reconstruct well housing
2- Develop guidelines to restrict land use at the well site
3- Restrict chemical handling at the well site
4- Setting of monitoring system around the well (3 piezometers per well)

Potential Participants :

1- Municipalities of Gaza and Jabalia
2- Ministry of Planning & International Cooperation (MOPIC)
3- PWA

Table 5.1 Continued

Project No. 7	**Project Name :** **Water meters Replacement & Rehabilitation**

Problems :

1- Majority of water meters do not work.
2- Unsuitable water meter type.
3- Improper water meter installation.
4- Social problems due to group water meters.

Objectives :

1- Reduce the un-accounted - for water.
2- Proper billing.
3- Water conservation and efficient use.

Scope of Work :

1- Survey of household connections
2- Development of specifications for the Gaza water supply system.
3- Identify the proper meter for the Gaza water supply system.
4- Installation of meters for zones & household.
5- Setup the policy to ensure meter inspection & maintenance.
6- Public awareness.

Potential Participants :

Gaza Municipality - PWA - Ministry of Housing.

Table 5.1 Continued

Project No. 8	**Project Name :** **Replacement & Rehabilitation of water supply networks**

Problems :

1- Irregular supply.
2- High percentage of unaccounted- for -water due to leakage and/or illegal connections.
3- Improper pipe material as asbestos or P.V.C.
4- Under designed piping.
5- Contamination due to old network.

Objectives :

1- Minimize the water losses
2- Improve the level of the system performance in quality and quantity.
3- Regular supply.
4- Reduce contamination.

Scope of Work :

1- Survey and data preparation for the network modeling.
2- Identification of the proper pipes material and size to fulfill the future demand
3- Leak detection
4- Replacement and rehabilitation of the specified parts of the network.
5- Public awareness.

Potential Participants :

Gaza Municipality
Jabalia Village Council
PWA

Table 5.1 Continued

Project No. 9	**Project Name :** **Development of Appropriate tariff (water & sewage)**

Problems :

1- No strategy for cost recovery.
2- Water & sewage tariffs do not reflect economic costs
3- Inadequate water quantity & quality

Objectives :

1- Sustainability in water and waste water services
2- Secure investments through water & sewage revenue in order to develop water and sewage services.
3- Efficient use of water.

Scope of Work :

1- Identify all costs associated with provision of water supply and sewage.
2- Establish tariff structure for water & sewage.
3- Assess the application of alternative tariff structures.

Potential Participants :

PNA
PWA
Universities
Gaza Municipality

Table 5.1 Continued

Project No. 10	**Project Name :** **Construction of Storage & Blending Reservoirs**

Problems :

1- Insufficient storage capacity
2- Improper distribution system
3- Bad water quality.
4- Inadequate water supply quality

Objectives :

1- Meet the peak hour demands & emergency cases
2- Improve the water quality in some areas.
3- Achieve equity through water blending
4- Better management & control of water distribution.

Scope of Work :

1- Identification of type of reservoirs, pumps and locations
2- Design of reservoirs, pumps and necessary connections.
3- Implementation.
4- Public awareness.

Potential Participants :

Gaza Municipality
PWA
MOPIC
Consultants

Table 5.1 Continued

Project No. 11	**Project Name :** **Construction of carrier segment (phase 1) Gaza City**

Problems :

1- Absence of regional management policy
2- Good quality water is restricted to the North and south of Gaza City.
3- Areas in the middle of Gaza Govornorate are served by bad water quality.
4- Better control and mobilization of fresh water resources from wells outside Gaza Governorate
5- Connection of secured access of fresh water in the north to Gaza City.

Objectives :

1- Better control and mobilization of fresh water resources from wells outside Gaza Govornorate
2- Connection of secured access of fresh water in the north to Gaza City.

Scope of Work :

1- Survey site specifications and selected locations and collection of data.
2- Design of piping system (25 000 m long and about 40" diameter).
3- Implementation.
4- Public awareness.

Potential Participants :

Municipalities & Village Councils
PWA
MOPIC
Consultants

Table 5.1 Continued

Project No. 12	**Project Name :** **Construction of transfer main trunk**

Problems :

1- Existing network cannot cope with the extra supply of 5 x 10^6 m^3 / yr. according to Article (40) of Oslo (2) Agreement between the Palestinians and the Israelis.

Objectives :

1- Accommodate the additional water supply to Gaza Governorate which will be supplied from Israel.

Scope of Work :

1- Design of 5000 - 7000 m long carrier.
2- Implementation.
3- Public awareness.

Potential Participants :

Municipalities & Village Councils
PWA
MOPIC
Consultants

Table 5.1 Continued

Project No. 13	**Project Name :** **Storm Water Collection**

Problems :

1- Flooding of streets & low level areas.
2- Health hazards.
3- Overloading the sewerage system.
4- Land and roads erosion.
5- Hindering of traffic & pedestrians.
6- Waste of potential water resources.

Objectives :

1- Proper collection and use of storm water as a resources (6 x 10^6 m^3/yr.).
2- Reduce health hazards.

Scope of Work :

1- Assessment of potential.
2- Survey and system layout identification .
3- Design.
4- Implementation
5- Public awareness

Potential Participants :

1- Municipality of Gaza
2- PWA
3- MOPIC

Table 5.1 Continued

Project No. 14	**Project Name :** **Rehabilitation of Existing Network and Sewering the Non-Connected Areas**

Problems :

1- 25% of Gaza City is not sewered.
2- Health risks due to flooding of wastewater.
3- Environmental degradation.
4- Clogging of network.
5- Old pipes need replacement.
6- Lack of awareness among community.

Objectives :

1- Minimize health hazards.
2- Provide efficient collection and disposal of wastewater.
3- Water resources conservation.

Scope of Work :

1- Survey and assessment of existing sewerage network.
2- Identification of needs for non-sewered areas.
3- Design.
4- Implementation
5- Public awareness

Potential Participants :

1- Municipality of Gaza
2- PWA
3- MOPIC

Table 5.1 Continued

Project No. 15	**Project Name :** **Storage of Treated Wastewater for Irrigation**

Problems :

1- Potential resources are being disposed to the sea.
2- Mining of fresh water for agricultural use.

Objectives :

1- Meet agricultural water demand.
2- Development of fresh water resources.

Scope of Work :

1- Assessment of effluent quality and quantity
2- Surveying of possible storage sites.
3- Environmental impact assessment.
4- Design of storage reservoirs treated water.

Potential Participants :

1- Gaza Municipality
2- PWA
3- MOPIC.

Table 5.1 Continued

Project No. 16	**Project Name :** **Construction of New Treatment Plant**

Problems :

1- Insufficient capacity of the existing treatment plants.
2- Improper location of the existing treatment plants.
3- Improper design and operation problems of the existing treatment plants.
4- Escalation of health and environmental hazards.

Objectives :

1- Increase the treatment capacity to cope with the future needs.
2- Minimize health hazards and environmental degradation.

Scope of Work :

1- Assessment and evaluation of proposed locations of wastewater treatment plants.
2- Conduct environmental impact assessment.
3- Identification of needs (capacity) and design criteria.
4- Develop effluent standards.
5- Design.
6- Implementation.
7- Public awareness

Potential Participants :

1- Municipality of Gaza
2- PWA
3- MOPIC
4- Ministry of local government
5- UNRWA

Program 2
Rehabilitation of Water Distribution Networks in the West Bank

- Goals and Objectives :

- Reducing the water losses
- Raising the per capita consumption
- Controlling the Pressure in the system and obtaining the required pressure for the Customer.
- Saving in the energy cost /m^3 of water consumed (if pumped from the source)
- Conservation in water resources.
- Better supplied water quality (by stopping the pollution from the sewerage system).
- Better control in the distribution of water in case of shortage in the water supply.
- Reducing the high maintenance costs.
- Achieving cost recovery.
- Sustainability in the water supply

- Implementor :

- Hebron Mun. , Halhul, Yatta, Dhahiriya (Hebron district), Nablus Mun, Tulkarm Mun., Qalqilia Mun., Habla (Qalqilia), Beit Imrin, Beit Iba, Jericho Mun.

- Context :

- Urban and rural

- Description of Activities :

- The old water distribution system was constructed 30 years ago, mostly not well designed, mainly the pipelines were laid overground, with high percentage of water losses and high running cost of maintenance, and shortage of water supply,
- A new design for the distribution network according to the following criteria:
  1. The network should meet the expansion of the city.
  2. The design shall meet future demand of the population up to the year 2020.
  3. All the pipelines were buried underground to the required level.
  4. All pipelines (6", 4", 3") were chosen to be lined from inside and coated from outside with P.E. layers to resist the corrosion.
  5. 2" pipelines were chosen to be galvanized and coated with P.E. layer from outside.
  6. Pipelines of diameters 6", 4" and 3" were installed by welding.
  7. Pipelines of 2" diameter were installed by couplings.
  8. All pipelines were buried in two stages :

a. Soft bakfilling by using sand surrounding 15 cm from each side of the pipe
b. Final backfill for the rest of the trench by using suitable backfill material

9. All welded joints were warped by suitable P.E. tapes.
10. New customer outlets were installed and the customers were shifted to the newlines.
11. Suitable valves were installed at the beginning of each branch and at the required place for better maintenance and operation.
12. All of the distribution water network was subjected to the required test pressure
13. All valves were installed inside valve chamber.

- Record of success on solving problem :

- The project is recently completed and records of success are not available.

- Relevance to the region :

- Wherever, the network is old, such a project is relevant

- Explanation of How Environmentally Friendly :

- It achieves its goal and objectives without any negative impact.

- List of Contacts

- Halhul Municipality
- West Bank Water Department (WBWD)
- PECDAR

- Photographs of Program :

- Not Available

Program 3
Rainwater Harvesting in the West Bank

- Goals and objectives

- Optimize the capture and use of rain water at the domestic, catchment and municipal levels for water supply and artificial recharge.

- Implementor :

- Individual people with the help of some NGO's such as CRS (Catholic Relief Services) especially in the southern Part of the West Bank.

- Context :

- Mainly in rural areas, some in urban areas.

- Description of Activities :

- People dig or construct cisterns in their households by the help of some NGO's. The owner is responsible for the construction, while the NGO will supply the Cement & the needed concrete reinforcement steel bars.
- People will collect rainwater falling on roofs of their buildings or rock catchment and store it in the cisterns to meet part of their household water needs.
- Volume of each cistern varies between 50 - 100 m^3 or in some cases of larger volume.
- Volume of stored water is enough to supply the demand of 6-member family for at least one year.

- Gender Impact

It reliefs the woman from hauling the water from a long distance

- Record of success on solving problem

Not available

- Relevance to the region

Low cost practice and easy to construct especially in the rural areas.

- Explanation of How Environmentally Friendly

The risk of pollution is high and the collected water needs chlorination.

- List of Contacts

Thousands of cisterns are constructed in the West Bank

- Photographs of Program

Not available

Program 4
Development of Springs in the West Bank

- Goal and objectives

- Reach the sources of the springs
- Increase the yields of the springs
- Decrease the losses between the source and the storage tank
- Better quality of water.
- Control the distribution of water
- Better storage system
- Improve the environment of the spring by providing proper protection of the spring location.

- Implementor

- PHG. together with the governorate, and village councils in Ramallah District.

- Context

- Rural (Ein Arils, Bitunia, Durar Al Qaria' .... etc)

- Description of Activities

- Explore the source of the spring
- Excavation works and collecting all the streams
- Construction of storage tanks directly at the source
- Installing the required inlet, outlet, washout, and overflow pipes and other piping works.
- Clean the site.

- Gender Impact

- Not reported

- Record of success of solving problem

- Not reported

- Relevance to region

- Wherever there is aspring, the project is relevant

- Explanation of How Environmentally Friendly

- No negative impacts are reported except minor habitats living along the water course.

- List of contacts

- PHG

- Photograhs of program

- Not available

Programme No. 5
Municipal Infrastructure Development Project for the West Bank and Gaza Strip

Implementor :

PWA + Municipalities and villages including 5 selected pilot municipalities, the Ministries of Local Government, Transport, Public Works, Planning and Finance, and PECDAR.

Objectives :

(i) Help remove critical infrastructural bottlenecks, improve essential services and facilities, preserve existing infrastructural assets, and create productive employment.

Background :

Almost all the urban population and perhaps 70% of the rural population is served with piped drinking water, primarily from wells, supplemented in some cases by supplies from MEKOROTH, (the Israeli Water Company). Service quality is poor, and while water quality generally meets drinking water standards, the quantity available (about 60 liters /cap/day) is inadequate to meet the basic needs of population. Water is expensive to pump from deep aquifers and to purchase from the Israeli system. Efficiency is low (unaccounted for water exceeds 50% of supply) and cost recovery is poor (30-40% of bills unpaid) - both indicative of weak management and inadequate maintenance. Also, many villages lack a piped water supply, few municipalities in the West Bank have adequate sources of water, and overdrawal of the Gaza aquifer threatens the resource and has contributed to severe water quality problems. Furthermore, fragmentation is great : water and wastewater services are currently provided by numerous separate local governments (municipalities and village councils) and by two regional utilities. With respect to wastewater, less than half the urban area is sewered, and untreated or inadequately treated wastewater presents serious health and environmental risks. A few municipalities have wastewater collection systems but only about 60% of houses are connected. Moreover, the few treatment plants that exist have generally failed to operate as designed. In most cases, sewerage is discharged untreated into wadis, irrigation reuse schemes remain unutilized, septic tanks and cesspools are infrequently dislodged and septage disposal is haphazard. The extreme water resources limitations facing Palestinian authorities, among the most serious in the world today, demand a much better level of water resources management. The shared nature of the three groundwater aquifers underlying the West Bank necessitates agreement with the Israeli authorities on the management of the resources - the subject of future negotiations and the sources of considerable uncertainty. At the heart of the problem of resource management has been a fragmented institutional structure which did not provide an adequate framework or incentives. However, the recent establishment of the PWA and the anticipated passage of legislation empowering the PWA has provided the basis for developing a sound policy and regulatory framework for the sector. It should also help

rationalize the sector and contribute to improving the service delivery. A very recent PWA - sponsored development is the proposal to consolidate the technical management of the individual water utilities in Gaza under the aegis of management consultants on the proposed World Bank - supported Water and Sanitation Services Project in Gaza. It is hoped that this initiative will lead overtime to the full consolidation of the individual municipal water utilities.

Description :

Improving water resources management - particularly management of the highly sensitive Gaza Strip groundwater aquifer, improving water supply delivery systems, improving coverage and service quality and reliability to municipalities and villages, preserving scarce resources by reducing the incidence of leakage in existing networks, improving environmental sewerage collection, treatment and disposal system, improving wastewater resource management through increased recycling, improving the overall efficiency of the utilities-currently fragmented among many individual municipalities through consolidation, commercialization and privatization, protecting Palestinian water rights, and strengthening the policy making and regulatory capacity of the newly established Palestinian Water Authority (PWA).

The **short-term strategy** is to : (a) improve water quality and availability; collection, treatment, reuse and overall system efficiency; protect public health; (b) finalize negotiations with Israeli authorities on sources, uses and rights in order to secure sustainable long-term supplies; (c) focus on investments to rehabilitate deteriorated systems and to extend these systems where necessary and feasible, particularly to villages; (d) utilize foreign technical assistance to begin restructuring the Gaza utilities and help improve system efficiency; (e) consolidate the individual Gaza utilities over time into a single regional utility operating on a viable commercial basis; and (f) to strengthen the PWA's ability to plan, manage, regulate and make policy for the sector. The **medium /long-term strategy** is to : (a) enter into broader regional agreements to preserve resources and supplies; (b) extend safe and reliable services to all villages; (c) consolidate the individual West Bank utilities into about 3 regional utilities operating on a commercial basis; and (d) further strengthen PWA.

Environmental Issues and Actions :

The Project has been placed in environmental screening category "B" consistent with the provisions of IDA Operational Directive 4.01. All sub-projects would be subject to screening for potential environmental impacts, resettlement issues and the protection of cultural heritage, consistent with local regulatory requirements and those of IDA. They would also be supervised during implementation by environmental specialists and representatives of the Environmental Planning Directorate (EPD) for the Ministry of Planning and International Cooperation and the Palestinian Department of Archaeology (PDA) of the Ministry of Tourism andAntiquities. Formal clearances would be obtained from the EPD and PDA for all sub-projects proposed for funding under the Project, consistent with current Palestinian environmental and cultural heritage procedures. No

resettlement is anticipated and no known archaeological or historical sites are anticipated to be affected by activities to be supported under the proposed project. However, given the high density of archaeological and historical sites in the West Bank and Gaza, provisions will be made in construction contracts for the use of "chance find" procedures should archaeological or historical materials be discovered in the course of project implementation. In order to support effective implementation of the proposed project, a series of three-day training courses on the application of the Bank's procedures for environmental assessment, resettlement and cultural heritage would be conducted in cooperation with EPD, PDA and the implementing agencies.

Activities to be supported under the proposed project would be focused on the rehabilitation and completion or expansion of existing water and wastewater facilities. The project would not provide for the construction of new wastewater treatment plants or sludge disposal facilities prior to a detailed examination of interventions in this area, including their potential beneficial and adverse environmental impacts. Where possible, the project would draw on the expertise of previously established environmental monitoring systems to routinely monitor the quality of water and wastewater at the level of the water and wastewater utility.

Water Interventions : The proposed program of interventions in the water and wastewater sector would have significant benefits to environmental health and environmental quality and would support the conservation of limited water resources. Improvements to water supply, including the rehabilitation of wells and disinfection systems, would result in more reliable access to safer water and reduce contamination at source. Rehabilitation of distribution systems would allow for conservation of water resources which are presently lost due to leaks. Expansion of piped water coverage to selected villages would provide access to safer water and would improve health and overall living standards. Asbestos cement pipes have been widely used in the West Bank and Gaza due to their low cost and durability. Under the project they would only be replaced and/or repaired in locations where structural damage has occurred or is anticipated due to physical conditions. Improved pressure and reliability of water supplies would reduce infiltration of wastewater into water pipes during periods of negative pressure. Establishment of a routine maintenance program should enhance the reliability of the distributed water.

Wastewater Collection Interventions : Rehabilitation and expansion of the wastewater collection networks would reduce present direct discharges to the groundwater table from vaults, abandoned cesspits and leakage from poorly maintained collection systems. This intervention would reduce the periodic flooding of streets with untreated wastewater and lower public health risks resulting from contact with these materials. Establishment of facilities for wastewater testing would allow for the more accurate characterization of wastewater which would be especially important in the long-term given their potential for reuse.

Wastewater Treatment and Reuse Studies : The proposed support program would also include review of existing and proposed investments in new and/or expanded

wastewater treatment facilities. For this purpose specialized consultants would be retained to review existing and proposed wastewater treatment facilities, concerning their design standards, reliability of operation under local conditions and possibilities for reuse of treated wastewater for groundwater recharge, irrigated agriculture and other beneficial uses. They would be responsible for the preparation of modified or new process designs which would include provisions for sludge treatment and monitoring of wastewater from the plants and within reuse schemes. These interventions would be implemented as priority steps to address control of pollution now resulting from the discharge of partially treated and/or untreated wastewater to surface discharge points such as seasonally wet river beds ("wadis"). These studies would include : reviewing the adequacy of provisions under existing legislation with respect to relevant current and future industrial pollution issues and proposing improvements where necessary; and evaluating measures required for the current and future control of industrial discharges in order to assure that the municipal wastewater flows could be safely used for restricted reuse.

Environmental Review of Proposed Wastewater Treatment and Reuse Activities : Provisions have been made in the terms of reference for the consultants to include the preparation of environmental reviews, as required by IDA Operational Directive, 4.01, "Environmental Assessment." The reviews would address environmental concerns in an integrated manner as a key element of treatment technology evaluation, site selection, plant design, system operation and monitoring. Environmental reviews would be prepared with reference to the guidance provided in the IDA Environmental Assessment Sourcebook, Volume II, "Wastewater Collection, Treatment, Reuse and Disposal Systems, " pages 231-244. Special attention would be given to analysis of potential risks to effective wastewater reuse presented by the current and/or potential discharge of industrial wastewaters with or without pre-treatment into municipal collection and treatment systems. Contractors would be briefed concerning measures to be taken should they have "chance find" of archaeological or historical materials.

Programme No. 6
Service Improvement for Water and Wastewater in 16 Municipalities of the Gaza Strip (SIP)

Emplementor :

PWA, and DEGREMONT / France, and the joint venture of lyonnaise des Eaux and Khatib & Alami Consulting Engineering Companies. **(Operator)**

Objectives :

(i) Leak detection of water supply systems in Gaza Strip.
(ii) Training of teams to operate the Van (Mobile shop) which contained a caustic correlator DF 5000 with radio transmitters, 2 ground microphone detectors (DF Junior), and 2 pipe locators (electromagnetic and magnetic). Workshops on leak detection techniques and leakage control procedure were conducted.
(iii) This leakage survey is part of the indicators selected by PWA to assess the Operator's performance.

Description :

A leak detection campaign has been performed for 6 months under the supervision of the **Operator** using leak detection equipment. About 468 km of lines were surveyed, 373 leaks detected, 139 major illegal connections located, and unknown lines feeding one municipality from another and illegal connections were revealed. The leak detection techniques used in the project included (a) physical inspection, (b) audible detection by ground microphone, and (c) acoustic correlator.

Under metering (or no metering) and illegal connections are the two main factors deteriorating the overall efficiency of water systems in Gaza Strip.

The main elements of metering policy for the SIP was set out. The policy addresses the technical, procedural and administrative issues related to metering. Affordability and equability are covered under the tariff review. Elements of metering relevant to Gaza Strip have a significant effect on technical aspects of metering. In particular, the very low flows encountered due to intermittent availability of water and roof tanks storage and the frequent blocking of meters due to silting in the pipe network.

Global Performance Finding :

A rough assessment of the leakage revealed that the detectable physical losses are only 1 to 3%. Commercial losses (under metering, illegal connections, free connections) are the most important part of the losses. The assessment showed the amount of losses was between 20 and 30%. Small leakage (non-detectable) e.g. badly corroded pipes, bad quality house connections, etc. are an important part of the physical lost. It remains very small as long as the pressure in the system is low, and any increase of the pressure

would increase losses very significantly and some times can lead to collapse of the system. Renewing and rehabilitation of the distribution network (service lines and house connections) is one of the priorities.

Terms of Reference

Note : The PWA and /or the municipalities / village councils in the Gaza Strip retain the exclusive right to set tariffs, fees and any other customer charge paid for the water and wastewater services provided.

The PWA is seeking professional services of an **Operator** for the management of a Service Improvement Program for the water and wastewater systems currently operating in the Gaza Strip. This section provides additional information describing the specific professional services to be provided by the Operator and to be addressed in the proposal documents. This scope of services applies to all water and wastewater facilities and systems under the auspices of the PWA in the Gaza Strip.

The Operator shall provide all personnel and associated wages, salaries, and benefits; administrative facilities and services and other services necessary to oversee the management and direct the operations of the various water and wastewater systems including source withdrawal, treatment, pumping, and distribution systems, wastewater collection, pumping, treatment and disposal in order to complete the following tasks :

1. To improve the efficiency of the water supply distribution system, the Operator will:

    a. Develop, direct and supervise a leak detection program including repair of leaks and replacement of pipe.

    b. Develop, direct and supervise a meter calibration, repair and replacement program starting with the master meters at the wellheads and including all distribution meters.

    c. Map the water and wastewater network; develop and test a hydraulic model and train the PWA and municipality / village council staffs in its use. Provide the hardware and software to the PWA.

    d. By using the hydraulic model, identify and implement a program of system strengthening to reduce hydraulic losses.

2. To improve efficiency of the operating equipment of the water system and wastewater system, the Operator will :

    a. Identify the immediate needs for equipment repair, obtain parts and tools, direct and supervise the repairs and maintenance including, but not limited to all wells,

pumps, generators, controls, water and wastewater treatment equipment, and auxiliary equipment included in the water and wastewater systems.

3. To improve the disinfection of water supplies, the Operator will :

   a. Identify the problems of existing chlorination equipment, obtain repair parts, direct and supervise the repairs; direct subsequent maintenance.
   b. Supply sufficient chlorine to ensure chlorine residuals throughout the distribution system.

4. To protect the integrity of the wells, the Operator will :

   a. Examine each of the wells and identify and carry out the work and obtain parts, supervise and direct the required wellhead protection measures.

5. To improve the quality of the wastewater effluent, the Operator will :

   a. Identify the problems of existing wastewater treatment equipment, obtain repair parts, direct and supervise the repairs, direct subsequent maintenance.

6. To improve the efficiency of revenue collections, the Operator will :

   a. Develop, supervise and direct a program to identify illegal connections and with the assistance of the EAPC and the PWA convert these connections to legal service connections.

   b. Develop, supervise and direct a program to update the database of connections and to classify the use in accordance with current tariff definitions.

   c. Develop, supervise and direct the institution of computerized administrative systems to enforce collection of overdue accounts. Provide hardware and software and train the employees in its use.

   d. Analyze the tariffs and the recommend a tariff structure and tariff levels that will promote water conservation.

   e. Develop a unified billing and collection system.

   f. Create separate financial accounts for water and wastewater services based upon utility Code of Accounts.

7. To improve the operations of water and wastewater systems, the Operator will :

   a. Identify the need for support facilities and equipment and administrative support; e.g., transportation, including specialized vehicles; communications system, including telephones, two-way radios; facilities including office space,

warehouse space, repair space and repair tools and equipment, meter testing and repair space and equipment

b. Develop and establish a preventative maintenance program and train the operators.

c. Develop and establish a computerized materials and maintenance management systems, obtain the hardware and software, and train the employees.

d. Identify a listing of critical and necessary spare parts, materials and equipment, obtain the parts, materials and equipment and establish an inventory system for storage and replacement (as a part of the materials management system).

8. To improve the efficiency of the customer service and public relation, the Operator will:

a. Develop and establish a customer service system and train the employees involved in responding to customer complaints, inquiries and any other interface with the customer.

b. Develop and establish a public information program to educte the public as to :

- the importance of water supply and wastewater collection and treatment to the population, public health, and the economy.
- the problems existing in the sector including overdrawing of the aquifer(s), contamination of the sources, illegal connections, excessive leakage.
- the programs underway to improve service
- the costs of operating the systems and the methods of recovering the costs including the provisions of needed amounts for domestic use at minimum cost and the concept of everyone paying their "fair share".

9. To improve the effectiveness of the management of the water and wastewater systems, the Operator will :

a. Develop and implement a management training program consisting at a minimum of the elements of management, personnel management, financial management, budgeting, planning, controlling.

b. Develop and implement a training program to provide technical operations and maintenance training to all water system operators and maintenance workers.

c. Develop and establish computerized administrative systems, obtain the hardware and software, and train the employees.

d. Develop and establish a comprehensive occupational safety program, and provide safety training.

e. Develop and establish an emergency operations plan, train the water/wastewater system employees and conduct mock drills as training for the implementation of the emergency actions.

f. Develop and establish a region wide association of water works and wastewater works technical, administrative and management personnel in order to foster a cooperative transfer of knowledge; schedule and conduct seminars on all aspects of water works and wastewater works management and operations.

10. To improve the long range performance of the water and wastewater systems, the Operator will :

    a. Identify major problem areas.

    b. Develop a prioritized capital improvement and rehabilitation plan.

11. To assist in impementing the Investment Component which will be carried out in parallel and financed by other donors, the Operator will :

    a. Identify rehabilitation and extension sub-projects.

    b. Assist in preparing bid documents for sub-projects by local consultants .

    c. Supervise the construction of sub-projects

12. To provide for administrative control, the Operator will :

    a. Compile and maintain comprehensive monthly records and report to the appropriate authorities for facilities and systems operations, regulatory matters, laboratory analyses, maintenance plans and activities, related financial matters, permit and compliance results, equipment status, and other relevant information in accordance with applicable laws, regulations, permits, and guidelines.

    b. At least monthly, or as necessary, meet with the PWA designated representative to review operations, reports, ongoing cost information, and key upcoming projects and / or operations which may impact service delivery to the public. Conduct annual comprehensive plant and system inspections with the PWA designated representative to evaluate and document conditions, safety, or other concerns.

13. In managing the operations, the Operator will be guided by the various standards, requirements, and guidance documents including, but not limited to, the following:

    a. Industry best practices as identified by recognized international standards;

b. World Health Orgainzation guidelines;

c. Design criteria and performance specifications for the various components and equipment throughout the utility as identified by manufactureres information;

d. Assess maintenance performance standards as identified by manufacturers information.

14. Modifications to the Terms of Reference :

The following modifications shall apply under the Scope of Work :

a) The "Operator" of the project "Service Improvement Program for Water and Wastewater Systems in the Gaza Strip" shall provide the Consultant with all necessary data and information to carry out the required analyses for the tariff model. This will include water and sewage, but exclude irrigation and reuse of waste water. The Operator will carry out the work on the basis of the Terms of Reference for the national study, i.e. the present TOR. The two parties shall beforehand discuss and agree on formats and specification of all information to be provided and agree on a timetable for the work.

b) A study shall be made and evaluations carried out on intersectorial pricing of water for regular water supply and irrigation, to ensure optimal social and economic benefit of use of the limited water resource available. This may lead to a shift in price between the tariffs for drinking water and irrigation from those developed on basis of the other criteria mentioned. The study will i.a. include the economic benefit of irrigation vs social and economic benefits of the drinking water supply. The Consultant will include his recommendations with respect to the shift in price setting due to "intersectorial considerations".

Program No. 7
Public Awareness Campaign for Water/Wastewater in the West Bank and Gaza Strip

Goal :

Conserve and protect water resources through community participation and enhanced action through public awareness

Implementor : PWA + Consultants

Objectives :

(i) Achieve public participation in the development and implementation of national policies for water conservation, protection and ensure accountability.
(ii) Achieve sustainable and equitable water resources development through active public participation in the design and implementation of national policies for water conservation, protection and accountable service delivery.
(iii) Educate, train, and prepare extension materials, using different kinds of radio messages, tv spots, leaflets, posters and all channels of media
(iv) Change behavior and attitudes regarding water use and abuse and enhance self initiatives and promote common responsibility
(v) Rapid assessment of the present water consumption patterns and perceptions and consultation to assess awareness among key constituencies. Continuous consultation with these constituencies through meetings, workshops, on all issues related to water shortage public awareness.
(vi) Establish a network of all interested bodies to update data, information and relevant experience concerning water issues and to select contractor for utilizing various media tools

Description : The main problems in the water / wastewater sector are :

- Lack of public awareness of the scarcity and vulnerability of water resources .
- Need for community support and participation in water conservation and protection
- Resource abuse through over exploitation and pollution
- Indifference, helplessness and lack of empowerement within the community regarding water issues.
- Absence of mechanisms for accountability of water institutions to the community

The scope of work included the following :

- Generate, test and disseminate material
- Design and implement national water awareness campaign
- Consult with community activists and organizations to identify opportunities for community action

- Conduct general public awareness targeted at the general public, concerned groups and specific audience
- Carry out workshops with focus groups to identify issues, approaches and partners
- Establish a network of government, non-government, and other interested partners to implement the public awareness campaign
- Implement and evaluate a national awareness campaign and targeted mini-campaign

The expected outputs of the campaigns are as follows :

- Local and national campaigns successfully conducted
- Educational, training and extension material for all channels of media
- Policy and practice guidelines on participation
- Public information material on initiatives, policies, and guidelines for community action.
- Build and develop the community capacity to assure the accountability of the water institutions.
- Build a system for designing, developing and disseminating public information

The project was executed in five stages :

Stage 1 :

(i) Identification of water problems, target groups and areas. A group of creative individuals (focus group) such as artists, thinkers, writers, educators, communication specialists, water and wastewater experts, and representatives of grass roots organizations were selected.
(ii) Finalization of a report on public awareness campaign proposal including the design and an action plan for the campaign.

Stage 2 :

(i) Launching mini-campaigns targeting farmers, industrial and domestic / municipal water consumers using various media tools i.e. radio messages, TV spots, news papers, posters, etc.
(ii) Production of educational material and leaflets and conduct training courses on different subjects related to water conservation and public awareness
(iii) Conduction of workshops in the West Bank and Gaza Strip for brain storming on issues related to the water problem (scarcity, deterioration of quality) and suggested actions. The participants represented the government, NGO's, education, health, agriculture, and women groups.

Stage 3 :

(i) Launching mini-campaigns targeting farmers, and industrial and domestic consumers using various forms of communications accompanied by practical measures and supported by local institutions which should be responsible for long-

term implementation of the suggested water conservation measures. Since water resources management is of a multi-sectorial nature (water, economic development including agriculture and industry, health and hygiene, information system, and community and urban development), all relevant institutions must be identified by regions in Palestine and their performance capacity analyzed.

(ii) Cooperation between existing institutions and local water authorities was encouraged by donor agencies in order to disseminate information effectively. Information regarding water resources and their proper utilization and discharge into the environment should be presented to the public in understandable language and an appealing manner in order to emphasize priorities in water conservation and utilization.

(iii) The most commonly utilized forms of communication for awareness building are the provision of information by means of mass media and talks with local groups accompanied by the use of audiovisual aids. The news media (Radio and TV) and the most effective with public service advertisements and newspapers and magazines articles. Direct mail contact can also be achieved through bill inserts promoting domestic water conservation, as well as simple pamphlets and leaflets, water utility newsletters, household maintenance handbooks, and message buttons and bumper stickers for cars. Colorful posters can also be effective when displayed in public buildings and commercial centers.

Stage 4 :

(i) Based on information and data collected by this stage and the assumption that the public awareness and involvement in addressing water issues have been raised to a certain extent, the target group at this stage would be the decision makers. The aim is to ensure that water issues are receiving the appropriate attention and decisions are taken accordingly.
(ii) Expanding a network to include the international community, and forming pressure groups locally and internationally especially in raising the water rights issue.
(iii) Documenting the campaign proceedings and holding seminars and meetings to present the water problems and the most applicable water conservation measures and practices.
(iv) Develop evaluation techniques and criteria to evaluate the degree of success in achieving the objectives of the public awareness campaign.

Stage 5 :

(i) Develop the project design and action plan for the national campaign based on the results of the above mentioned four stages

Completed Activities :

1. Research and Reports

- Finalized two reports about water cost in the Middle Area of Gaza Strip (Maghazi, Buraij, Nusairat Refugees Camp and Deir Al-Balah City) and Rafah City
- Drafted a report on Integrated Water Resources Management in the Middle Area
- Reviewed the Emergency Resource Protection Plan and recommended further activities
- Developed a questionnaire to be filled in by the project team and municipalities with information on on-going projects in water / wastewater sector in Gaza Strip
- Organized and followed up the formation of the technical committee to support the negotiating team in Gaza

2. Public Awareness

- Women Compassion Workshop on Women Contribution to the best practical means for water conservation, held on the International Day of Environment - June 5, 1996.
- Children Summer Camps to raise awareness of water / wastewater problems among children
- Training and support of other organizations

3. Hydrological Data Monitoring and Analysis and Data Bank Activities

4. Technical Consultation and Advice on Water / Wastewater Projects

5. Cooperation With Other PWA Projects and Activities

6. Proposed potential environmental Awareness campaigns for the West Bank and Gaza Strip, are shown in table 5.2. Each campaign specifies the water/wastewater problem(s), the target group and the messages which need to be delivered by various media channels.

Table 5.2
Potential Environmental Awareness Campaigns

No.	Problem	Target Group	Message
1.	**Quantity Problems: 50% of water is unaccounted for**	Mayor / Municipality Councils Water dept. Tech. dept. Main. dept.	Depletion & pollution of water resources Promote household inspection of meters, iIntroduce taxes to cover meter fixing & maintenance Increase fine for illegal connection Replace the old existing network Upgrade the services of maintenance and establish emergency dept. to deal with complaints
		Public	Instill sense of responsibility towards water resources & environment "It's your own water you are polluting / stealing" Promote & enhance people to pay their bills-> they get better service Mobilize people to report leaks & aware them of the implications
2.	**Improper Design of the Network**	Mayor / Mun. council., Technical dept. MOPIC, MOH Donors	Mobilize municipality to write & submit proposals for donors. Take into consideration future demands in the design of the network. Ensure regular supply for the public Coordinate with municipalities when developing/implementing new projects Support / fund the replacement of the old network
3.	**Overpumping Rate of the Wells (Pumping of Saline Water, upconing)**	Technical dept., Water dept.,	Explain to them : * the consequences of overpuming; a) water quality b) aquifer depletion * To dig more wells to meet water demand "special distribution of wells"

Table 5.2 Continued

No.	Problem	Target Group	Message
4.	<u>Quality Problems</u>		
	Inequalities in quality		Blend water from different reservoirs
		Water dept.	Build elevated reservoirs
			Re-allocate different water qualities for different uses. i.e. poor quality for cooling
			Close poor water quality wells and dig new ones with better quality
		Min. of Agriculture & farmers	With cooperation / coordination of Ministry of Agriculture, make use of agricultural wells.
5.	**Irregular Disinfection of Water Supply**	Mayor/Municipal Councils.	Comply with the specific requirements in pipe installation of water/wastewater network, i.e. enough space between the two networks.
		Tech. dept.	Replace old network (look problem. #2)
		water dept. , sewage dept.	Installation of non-return valves, in industry, and monitor them to control pollution.
		Industrialists / Min. of Industry	On-site recycling of industrial waste before dumping into the sewage network
		EPD/EN.H. MOH	Reuse of this recycled wastewater if applicable ex. Tile Industry
6.	**Uncontrolled Cess Pits**	Technical dept. Sewage dept.	Promote construction of septic tanks in nonsewered areas.
		EPD / MOPIC	Aware the public of the consequences of cess pits' depth.
		Public	Find alternatives for cess pits.
		Mayor / Municipal Councils.	

Table 5.2 Continued

No.	Problem	Target Group	Message
7.	**Usage of Municipal Supply for Industry.**	PWA Municipalities MOI/ industrialists PWA, 'Municipalities., 'Environmental. & preventive health dept.	Aware policy makers of the overall water problem. Promote industries that demand low water quality & quantity. Design separate water supply network & source for industry. For short term, installation of non-return valves
8.	**Dumping of Industrial Waste Into the Sewage Network and Open Areas.**	policy makers in industries & MoI EPD	On-site recycling Promote re-use of recycled waste water Promote understanding of consequences on public health and environment.
9.	**Misuse of Water**	Industrialists Min. of Industry. (MoI) Petrol stations staff Car wash staff	Promote understanding of the overal water problems Promote efficient use of water When relevant, promote on-site recycling & use of recycled waste water (if appropriate).
10.	**Trans - boundary pollution**	Politicians / negotiating team	Monitoring of waste water from Erez & wadi Gaza Control pollution

Table 5.2 Continued

No.	Problem	Target Group	Message
11.	**Storm Water Wasted**	PWA Ministry of Agriculture (MoA) Municipalities & Village Councils NGO's	Upgrade & rehabilitate the Sheikh Radwan Pool. Identify projects to collect & store storm water (greehouses' storm water drainage network) Wadi Gaza Storm water collection It's a good source for recharge of the aquifer.
12.	**Inefficient Use of Water, Use of Flood Irrigation**	Farmers (citrus), Water Dept. Field Service Dept. Donors	Introduction of moreefficient irrigation system. drip irrigation for example. Promote and the above messages
13	**Increased Salinity**	Farmers Policy makers	Minimise abstraction of ground water. Promote understanding of economic implications of salinity on farmers. Change of crop patterns
14	**Absence of Agricultural Policy**	Policy makers Ministry of Agriculture (MoA)	Change of crop pattern. Land use planning Implication on water resources regarding quantity and quality.
15	**Tariff Policy & Quota**	Water Authority. Ministry of Agriculture. (MoA)	Tariff structure is distorted. Cost recovery.

Table 5.2 Continued

No.	Problem	Target Group	Message
			Development of new tariff system Social equity. Revision of the quota system to make it corresponds to the actual consumption.
16.	**Uncontrolled Abstractions**	Farmers Policy makers Ministry of Agriculture PWA Donors	Install new water meters Enforcement of appropriate legislation Formation of agricultural inspection teams. Promote and support irrigation systems.
17.	**Pollution of Ground-water**	Farmers Ministry of Agriculture (MoA) Min. of Health/ Env. Health dept. Preventive health Dept.	Protection of well head. Control, restrict & prevent (when necessary) pesticides and fertilizers use. Promote awareness of health implications. Promote use of compost and biological control. Promote use of treated waste water.
18.	**Inadequate Chemical Analysis of Agr. Well water**	MoA /water dept. Donors	Detection of hydrocarbons (oil, grease) & pesticides in water. Fund equipment for laboratories.

Programme No. 8
Water Tariff Study in the Palestinian Territories

Implementor : PWA + Consulting Engineering Firms

Goal :

Promote the overall water tariff policy and the general development goals of the new nation by obtaining a generally applicable tool to determine concrete tariffs at various locations of Palestine to cover water supply cost for domestic use, industry, agriculture, wastewater disposal and re-use of treated wastewater.

Objectives :

(i) The operator will analyze the existing tariffs and recommend a tariff structure and tariff levels that will promote water conservation in order to develop macro and micro tariff policy guidelines and recommendations for suppliers of water and discharge of wastewater which will : (a) achieve financial self sufficiency in the sector, and among individual suppliers, (b) ensure appropriate signals for water conservation and pollution control, (c) ensure economic efficiency in the use of scarce water, and (d) ensure access by the poor through appropriate tariff structures.

(ii) Study of connecting the water supply networks of all the municipalities in Gaza Strip and that a single entity would have to run the whole water supply system in the coastal region i.e. Coastal Water Utility, and a similar entity for the West Bank i.e. West Bank Water Utility.

(iii) Ascertain the fixed and variable costs, water consumption for various uses, leakage and other unaccounted for water, performance of revenue collection, and social and economic conditions to be taken into account.

(iv) The overall water and wastewater service shall be economically sustainable. Consequently, the average tariff must be sufficient for operation on commercial basis, with revenue collection to cover both operational and investment costs / depreciation of assets.

(v) The sewerage fee shall be integrated in the water use fee (with the exclusion of connection fee).

(vi) The tariff structure shall encourage water conservation.

(vii) Supply of the "basic water need" may be done at a cost level below the actual level (commercial) cost in order to provide affordable water to the poorest segment of the population. The total subsidy at any water utility shall be recovered by other consumers at the high end of the tariff structure (those who can afford)

(viii) The tariff system shall be practicable for implementation and enforcement

(ix) Pollution charge shall be added on for industrial pollution according to the strength of the effluent if found practical for implementation and enforcement

Project Description :

The problems of water tariffs in the West Bank and Gaza strip could be summarized as follows : (i) water tariffs do not reflect economic costs, (ii) poor cost recovery performance by water suppliers, (iii) very wide range of water tariffs, (iv) price distortions produce mix-allocation, waste, and pollution, and (v) water tariffs subsidize other services and lead to deterioration of infrastructure and provided service.

The work was carried out in two phases ; phase 1 for data collection and phase 2 for the study by which the actual tariffs are developed. The report from phase 1 was reviewed by PWA and served as an input for phase 2.

The **scope of work** included the following : (i) identify all costs associated with the provision of water supply, (ii) establish tariff levels on the basis of long run marginal costs, (iii)assess the application of alternative tariff structures, (iv) assess the ability and willingness to pay by consumer groups and by regions, (v) develop and recommend practical tariff strategy on a national, regional and individual supplier level, (vi) recommend procedures for subsequent tariff adjustments, and (vii) establish current levels of government subsidies to the sector.

The **out puts** of the study will be : (i) a national tariff survey, a seminar on the results and a report, which will include recommendations on the appropriate national and regional tariff policy and tariff structures, and (ii) 16 municipalities in Gaza Strip and a utility case study assessing tariff formulation practices, and (iii) PWA will develop its capacity building by (a) enhancing its capacity to design and administer tariff studies, (b) training a core task force / group of field researchers in the skills and methods of data collection, survey, design, enumeration and evaluation, and (c) ability of municipal and utility suppliers to assess economic cost and determine value of water.

Potable water demand for 16 municipalities in Gaza Strip (the year 1996 population of 910852 people and the projected population of 1836000 people in the year 2015) will be assessed. The existing annual water supply produced from municipal wells (86.7%), purchased through Mekoroth (11.3%), and purchased from other private sources (2%) which adds up to about 46 mcm is causing an increase in water salinity due to over-pumping of the wells and these wells have to be progressively abandoned, and substituted. The cost afforded by each municipality will be appraised based on personnel list and payroll, technical assessment of the energy consumption, chlorination cost for aquality standard pursuant to WHO recommendations, maintenance cost based on the assets value, and provision for renewal based on replacement value of the assets.

The project was executed in two phases 1 and 2, the details of which are as follows :

Phase 1- Data Collection

The Consultant will review literature and reports on water supply, wastewater disposal, re-use of wastewater and irrigation providing overall information for the whole

territory, as well as information for individual utilities, programmes and projects. Such basic information will be supplied by PWA at the outset of the study.

Subsequently, the Consultant will collect information directly from the concerned authorities and utilities for a selection of utilities and projects so that tariffs for a range of representative water supply systems may be covered. Coordination of data collection with other on-going and /or planned activities is important, in particular the World Bank activities in Gaza Strip and the West Bank.

For drinking water supply and sewerage the following utilities shall be studied :

		Population served (approx.).
In Gaza :	Caza City	280,000
	Rafah	140,000
	Beit Lahia	25,000
In West Bank :	West Bank Water Dept.	1,000,000 (mainly bulk supply)
	Jerusalem Water Undertaking (JWU)	200,000
	Hebron	150,000
	Nablus	100,000
	Bethlehem	54,000

Refugee camps being served on individual basis or buying water in bulk from the utilities will be included in the study.

For the re-use of waste water, projects at the following utilities shall be studied :

		Population	% wastewater collected
In Gaza :	Gaza City	280,000	60
	Beit Lahia	25,000	50
In West Bank :	Nablus	125,000	60
	Hebron	150,000	55
	Al-Bireh	40,000	65

For irrigation, the studies shall be based on cooperatives and private well operators in Gaza and the West Bank (2-3 systems at each place).

On basis of accounts, records or estimates (if needed) the following shall be determined for each case :

a) Fixed costs.
b) Costs varying with water consumption.

c) "One of" costs, e.g. cost of providing a house connection, and costs of "technical services".
d) Water consumption : total and per capita consumption (gross figures), net water use for different categories of customers. This will include private consumers of varying housing standard / income level, commercial and industrial uses.
e) Percentage of unaccounted for water.
f) Data on technical and administrative performance, including revenue collection.

For irrigation water and re-use of wastewater, the following shall be determined in addition to relevant points above (existing and planned systems) :

g) Total water consumption and area irrigated, identification of crops and area for each; estimate of total value of crops.
h) Type of irrigation system / technology and accompanying water consumption per unit area for different crops over the year.
i) Cost components of each crop (with present cost of water), gross value and estimated net profit for each crop.
j) Limitations due to water quality (salinity of regular irrigation water or contamination of wastewater to be re-used).

An inception report will be prepared at the point where the specific data collection is well underway and the Consultant has a good appreciation of the tasks ahead. The inception report will present initial findings and an updated workplan for the study.

Upon completion of Phase 1 a report shall be presented where all information collected is processed and presented. Comments will be made when data are based on estimates or assumptions. Comments shall also be made in cases where poor practices are uncovered that clearly influence tariffs or revenue collection. Particular points to be taken into account when developing the structure of the tariffs and the actual tariff levels shall be noted.

Phase 2 - Studies

In developing the tariff structure a price elasticity evaluation will be a central part, where the aim will be to arrive at a progressive tariff structure that will provide affordable water to the various users, but at the same time be a driving force in making efficient use of the available water and reducing the total water consumption. Equally important will be to determine the "minimum basic need" and the price that can be afforded by the poorest segment of the population. Two areas shall be selected to conduct a specific study on the consumers ability and willingness to pay. Social and economic evaluations will therefore play an important role in the overall studies.

The tariff structure should be arranged so that subsidized cost for "basic need" is balanced out by consumption in the progressive range of the tariff structure. Various tariff systems will be evaluated against each other. Systems to be evaluated are the increasing block rate system, minimum charge plus increasing rate according to usage

etc. How to charge for "one of" costs and technical services should also be dealt with. The Consultant will estimate short-term effects of planned and ongoing measures to improve efficiency (e.g. leakage reduction and improved revenue collection) that should be taken into account when calculating the tariffs. The Consultant will prepare a working document to PWA where he will present his recommendation to PWA regarding :-

- Tariff system to choose
- Planned efficiency measures to take into account

and receive instructions for further work.

An incentive to improve efficiency and reduce extraction for irrigation (particularly in Gaza) by imposing a levy on all irrigation water and a penalty fee for overabstraction, shall be proposed by the Consultant. With a major purpose being to promote switching to more efficient irrigation techniques and high value crops, the economic and social consequences of various magnitudes of levies shall be carefully evaluated.

Tariff structures for drinking water supply (combined with sewerage), irrigation and re-use of treated wastewater shall be prepared for representative (small and large) systems in Gaza Strip and the West Bank. The structures shall be arranged as simple formulas where cost figures may be applied to work out the actual tariffs.

The tariffs derived for the utilities and systems listed under phase1 will be applied to demonstrate that collected revenue will balance with the total costs to be taken into account. The Consultant will, on basis of insight achieved during the course of the work, present his recommendations regarding efficiency improvements in order to reduce the price of water to the customers, and reduction of the overall water consumption. The Consultant shall prepare a unified cost accounting system (including coding and classification system) to help water institutions use the same approach in calculating the tariffs. A proposal shall be made on procedures for changing tariffs (when, how much, and why).

Water tariffs and fees connected to water licenses are two key options to finance a sustainable Palestinian Water Authority. The Consultant shall propose a mechanism / mode (not level) for how the water tariff system could contribute to the financing of PWA's operation. The analyses, calculations and recommendations of the Consultant will be presented in a draft report which will be discussed with PWA. Following a hearing process, where the Consultant shall be available as needed to answer questions and clarify, PWA will present comments to be taken into account in the preparation of the final report. The final report will present phases 1 and 2.

Programme No. 9

Action Plan for Water Master Planning Support of the PWA

Goal :

Promoting capacity building of the PWA for managing water master planning at national and local levels in the West Bank and Gaza Strip and develop a strategy for water master plan.

Implementor : PWA + NORAD under the Norwegian Institutional Co-operation Programme

Objectives :

(I) Discuss with PWA the approach and priorities to be applied in water master planning including the roles of the various parties (PWA, PECDAR, MOPIC, Ministry of Local Government, and other ministries, donors, municipalities, and utilities)
(ii) Review of and comment on Terms of Reference of various water and wastewater projects .
(iii) Review the various reports produced, and discuss and advice on corrective actions / modifications.
(iv) At suitable stages, review the overall situation with PWA (assess the focus, approach, actions needed, new water sources to be investigated, etc.)
(v) Discuss with PWA and advise on follow-up studies and detailed design / construction of facilities resulting from master planning activities

Description :

There is a need by the PWA for a dynamic and flexible management approach to be developed gradually to capture the rapidly changing political, demographic and economic situation in the West Bank and Gaza Strip. It is important to focus on a long-term vision beyond the current intense situation, and as soon as possible establish the core organizational structure so that management of PWA can be released from daily routine operations in order to dedicate themselves to the long-term development of the Palestinian Water Sector. Such an approach will need properly designed and operated information systems for management and decision making purposes covering relevant project information as well as water resources information. In order to achieve the intended long-term continuity and sustainability of the water master planning support, it is important for PWA to consolidate the internal institutional structure and pursue the employment of the managers and key staff to their respective units. The following tasks are the main activities of the programme :

(1) Support concerning on-going programmes : review and advise upon the latest development, coming events, supervision responsibilities and approval procedures for key projects where PWA is the counterpart, with special emphasis on : (a) the World Bank Water Sector Strategic Planning Study, (b) the U.S.AID funded Municipal Services Project (especially the master plans and groundwater modeling components), (c) the French funded Water and Sanitation Project in Hebron - Bethlehem, (d) the regional master planning activities in Hebron, and (e) Ramallah District Sewage Management Master Plan supported by FINIDA .

(2) Economic sustainability of PWA : Assess issues and opportunities related to PWA's financial sustainability such as budgetary requirements, potential sources of income, etc.

(3) Water Licensing Policy : Advise PWA in the on-going development of a Water Licensing Policy and Guidelines.

(4) Water Reuse Strategy : Identify issues, opportunities, constraints and realistic schedules for a water reuse and reallocation. Discuss and outline a water reuse strategy for the Palestinian Territory.

(5) Water Rights Issues : Advise PWA in defining approach and expertise in preparing the future negotiations regarding water rights issues.

(6) Project Data Base : In response to the need of a dynamic and manageable inventory of on-going and proposed projects, review the progress of the project data base that should provide relevant and easily accessible project information for PWA's management. This is an invaluable tool for maintaining a practical water master planning activity.

(7) Awareness Campaign : Assist in its upcoming water awareness campaign, including information to the ministries and other stakeholders about the implications of the upcoming water tariff structure, water rules, and standards that are being prepared by the PWA.

(8) Provide assistance (if required) to the mini-meeting in the National Water Council to explain the water supply-demand situation and provide information about the implications of the Interim Agreement and the PWA's role and planned long-term actions.

(9) Priority Investments : Assess the short-term priority investments and prepare indicative funding needs and a phased plan for water and sanitation project investments and institutional support, in a 20 year perspective. Coordinate this activity with the on-going World Bank assisted Water Sector Strategic Plan and Priority Investment (Investment Ranking)

APPENDIX I

CONSULTANT'S DETAILED TERMS OF REFERENCE

A. Terms of Reference

1. Produce a Background Report for the Palestinian Territories, including literature search and local context supported by statistical data

2. Identify a list of Best Practices (as defined herebelow) around household water conservation and efficiency, and obtain local approval

3. Describe each Best Practice in the format listed here below

4. Summarize each of the best practices briefly

5. The Consultant will work closely with the GreenCOM Middle East Coordinator, and on a more limited basis with several GreenCOM core staff advisors, to identify several Best Practices for each site/country.

6. Each approved practice will be summarized in a similar format by the Consultant, referred to here as a "Case Study" format, but should not be described in a highly nationalistic fashion. The consultant will present a draft of his report to the delegate of the Water Working Group in the country where the data is collected. He will incorporate the changes suggested by the delegate.

7. The period of analysis would cover the last 20 years. The consultant will first determine which institutions have implemented household water efficiency/water conservation programs in that period of time. These may be institutions at the national, regional or local level. Donor views of sectoral programs in water conservation in general may be helpful in initiating the search. (S) he will review documentation about those programs and elaborate research questions that must be answered. Then a mini-research plan to answer those questions would be prepared. The research plan will include what programs to visit, what issues to address during those visits, who to interview about those interventions, what questions to ask those interviewed and even what observations need to take place to supplement the information. The plan should be prepared taking into account the time limitations of the contract to perform this task. Multiple sources of evidence will be desirable. This will help cross-validate the information gathered. When planning the interviews, the consultant will consider interviewing policy makers/implementers, service delivery personnel and beneficiaries. The persons interviewed may represent different points of view : in favor, against or middle of road. Service delivery representatives may not be eager to talk to researchers, but may have perspectives that are important. Because vivid examples of what has been implemented will be important, the consultant may use pictures and audio visuals to supplement his report. Information sources must be included / footnoted.

8. The Consultant will produce a "Final Report" for the site / country including a literature review detailing the local context. Findings should be supported by secondary data and statistics. The Final Report will consist of a "Background Report" and a "Summary Report of Best Practices", as described herebelow under section "E. Reporting".

B. Definition of Best Practices

Best Practices are defined as "Existing programs or initiatives promoting domestic water conservation and efficiency that : have a track record of success; are being implemented by public or private organizations; and that local authorities at each site / country agree they would like to share with other countries in the Middle East region to help foster regional cooperation around water issues". These practices could include those that have an impact on efficient water use and that could be implemented by such different actors as institutions (private and public) and individuals at the household level. Practices may affect water at different points in the delivery system, before it reaches the municipality to after it leaves the municipality. Practices could also include policies, policy implementation actions, technologies and/or physical actions performed that have an impact on the efficient use of water at the household level. They could be practices implemented in rural as well as in urban areas.

Best Practices may include a wide range of programs implemented by public and private entities, including but not limited to :

... Participatory efforts with residents prior to installing water and sanitation systems
... Municipal planning initiatives that impact consumption and reuse of water
... NGO and Government educational efforts in the schools
... Programs with households (women) to change behavior
... Technological improvements (e.g. improved water meters)
... National policies that impact domestic water consumption
... National Community water conservation program
... Treatment and recycling of gray water
... Efficient agricultural / irrigation practices (e.g. irrigation at night). This is the subject of another study
... National desalinization program. This is the subject of another study
... National hotline. This is the subject of another study

In many cases, the Best Practices may be donor supported. This has implications for replicability.

C. Criteria for Selection of Best Practices

... Already in existence with a track record of success (due to adoption rates or impact on water use)

... Relevant to the Middle East region
... Environmentally friendly
... Meets approval of designated local authorities

D. Questions to be Answered for Chosen Practices

... What is the practice and what is its purpose? What problem is being solved? Who identified the problem? the solution?
... What technical justifications were provided when selecting the practice for implementation? Was there community involvement in the definition of the solution to the problem which the program / practice addresses?
... Were is the practice being implemented and by whom?
... Who is the intended audience ?
... Are there differential benefits of the practice by gender ? What impact have selected practices had on the division of labor between men and women ?
... Is there a proven track record of success for the practice ? Are there any evaluations done of this practice ? If so, what are the major findings of that evaluation work? Has the practice been adopted without problem ? Are there dropouts? If so, why did beneficiaries either abandon the practice or not adopted it? What impact has the practice had on water conservation or on the efficient use of water?
... How is the practice relevant to the Middle Eastern region as a whole ?
... What contextual circumstances explain the success of its practices and to what extent those circumstances may affect (help or hinder) its replicability in other countries ?

E. Reporting

The consultant shall produce a "Final Report" which consists of :

A) Background Report : which includes a literature review detailing the local context. Findings should be supported by secondary data and statistics.

B) Summary Report : Best Practices approved for consideration at the Intercessional Experts Workshop will be described in a case study format by the consultant and compiled into a final summary report written in English. The report should be mainly descriptive and include the following sections :

I. Background
II. Methodology
III. Case Studies of Best Practices / Programs
A. Program 1
Goals and Objectives
Implementor
Context (Urban / Rural)
Target Audience (Socio-Demographics)

Description of Activities
Gender Impact
Record of Success on Solving Problem
Relevance to the Region
Explanation of How Environmentally Friendly
List of Contacts
Photographs of Program

B. Program 2 (Repeat above format)

IV Discussion

V Conclusions and Recommendations

APPENDIX II

LIST OF PERSONNEL MET AND AGENCIES, ORGANIZATIONS, OR INSTITUTES CONTACTED DURING THE MISSION

1. Nils Saelthum / Resident Coordinator - Norwegian Institutional Cooperation Programme, Palestinian Water Authority - Jerusalem, P.O. Box 51618 / Palestine

2. Fadia Daibes / Programme Coordinator - Norwegian Institutional Cooperation Programme - Palestinian Water Authority (PWA)

3. Zuhdi R. Al-Mansour / General Director - Jenin Municipality - Palestine

4. Walid Abu - Muwais / Mayor - Jenin Municipality

5. Jawdat Yaghmour / Chief Engineer - Associated Consulting Engineers (ACE), U.S.AID - Water Resources Program in Association with Camp Dresser and Mckee Int. / Morganti Group of the U.S.A - El-Bireh, P.O. Box 799, Palestine.

6. Musa Abu - Garbieh / Director General - Palestinian Water Authority, P.O. Box 891, Ramallah - Palestine

7. Fadhel Kawash / Deputy Head - Palestinian Water Authority, P.O. Box 891, Ramallah - Palestine

8. Dr. Samih Al-Abed / Assistant Deputy Minister - Ministry of Planning and International Cooperation (MOPIC) - Ramallah, Palestine

9. Khalil I. Nijem / Assistant Project Director - Physical Planning and Institutional Building Project - Ministry of Planning and International Cooperation (MOPIC), Ramallah, Palestine.

10. Dr. Samir Abu- Aisheh / Engineering Faculty - National Najah University, Nablus, Palestine

11. Mazen El-Nouri / Projects Monitoring Office - Palestinian Economic Council for Development and Reconstruction (PECDAR), P.O. Box 54910, Jerusalem, Palestine

12. Farouq Kittani / Projects Monitoring Office - Palestinian Economic Council for Development and Reconstruction (PECDAR), P.O. Box 54910, Jerusalem, Palestine

13. Abdallah S. Abdallah / Director - Palestinian Geographic Center (PALGRIC), Ministry of Transportation, P.O. Box 868, Jerusalem, Palestine

14. Dr. Khairi Al-Jamal / Team Leader - Palestinian Water Authority, Gaza, Palestine

15.Reem Abu - Mudain / Public Awareness Officer - Palestinian Water Authority - Gaza, Palestine

16.UIF Tellefsen / Project Manager - Physical Planning and Institutional Building Project - Norwegian Cooperation Program, PWA, Ramallah, Palestine.

17.Dr. Rashed M. Y. Al-Saed / Expert - Sanitary and Environmental Engineering - Palestinian Water Authority, P.O. Box 891, Ramallah, Palestine.

18.Hazim Khalid Kittani / U.S.AID Water Resources Program - Camp Dresser and Mckee - Ramallah, Palestine

19.Dr. Hafez Shaheen / Hydraulics Consultant - Universal Group for Engineering and Consulting, P.O. Box 51492, Nablus, Palestine .

20.Mohammad Al-Turshan / Agronomist - Palestinian Water Authority, P.O. Box 891 - Ramallah, Palestine

21.Oddvar Lindholm / Professor at NCH - Project Manager - Norwegian Pollution Control Authority - Oslo

22.Lana Abu - Hijleh / Programme Management Officer - UNDP, P.O. Box 51359, Jerusalem - Palestine

23.Musbah A. Tahboob / Head - Health Department - Hebron Municipality , P.O. Box 6, Hebron, Palestine

24.Terje Gimming / Chief Engineer - Office of International Cooperation, NVE, Norwegian Water Resources and Energy Administration, Oslo, Norway

25.Ramadan Safi / Public Relations Officer - Palestine Engineers Association, Jerusalem Center, Jerusalem, Palestine

26.Torbjorn Damhaug / Norwegian Institute for Water Research, Oslo, Norway

27.Mohammad Jaas / Water Supply Engineer - West Bank Water Department, Ramallah, Palestine

28.Abdul-Kareem Asaad / Engineer - Ramallah Water Utility, Ramallah, Palestine

29.Dr. Abdul Rahman Tamimi / Palestinian Hydrological Group (PHG)

30.Dr. Sufian Sultan / Head - Palestinian Environmental Authority, Hebron, Palestine

31.CARE International, Jenin, Palestine

32. Mohammad Al-Muqaied, Water Resources Protection Department, the Dutch Project, MOPIC, Directorate General for Environmental Planning, Gaza.

33. Dr. Hani A. Daraghma / General Director - Biodiversity Specialist, Palestinian Institute for Arid Land and Environmental Studies (PIALES), Hebron, Palestine

34. Hiba M. Tahboub / Projects Officer - the World Bank - Resident Mission West Bank and Gaza, P.O. Box 54842, Jerusalem, Palestine

35. Rebhi Al-Sheikh / Projects Monitoring Office, PWA, Gaza, Palestine

36. Henry Wattlet / Director - SOGEA - France, Hebron Municipality Palestine.

APPENDIX III

THE FORMATION OF THE PALESTINIAN NATIONAL WATER AUTHORITY (PWA)

After so many years of lacking control over all aspects of life, the Palestinian people are re-establishing national sovereignty and reinstating control over national land and resources. The international community recognized the Palestinian right to control and manage national water resources in the Multilateral Talks on Water in the Middle East which were held in Muscat, Oman in April 1994. The Palestinian Authority announced in the Oman Talks its intention to establish the Palestinian National Water Authority (PWA).

The PWA was established by presidential decree 90/1995 on 26 April 1995, and the Palestinian Authority announced officially the establishment of the PWA. The powers and responsibilities defined in Bylaws (Law No. 18/1996) enacted on January 18, 1996. Upon its establishment, the PWA recognized the need for a legal framework to organize the nation's water sector and manage its waters. In due course, a law entitled "National Water Council and National Water Authority Act" was produced and later on signed by the president on June 5, 1997. The PWA has policy-making and regulatory responsibilities for both Gaza Strip and the West Bank. Its authority in the West Bank is limited under the Interim Agreement pending final negotiations of the Israeli - Palestinian peace Agreement.

A. PRE-PALESTINIAN AUTHORITY WATER MANAGEMENT

Until the beginning of May 1994, all water resources in the Gaza Strip and West Bank were controlled by the Civil Administration, the administrative arm of the Israeli occupation. The Civil Administration managed water in the West Bank and the Gaza Strip through the West Bank Water Department and Gaza Department of Agriculture. Although both departments were staffed primarily by Palestinians, the West Bank Water Department and the Gaza Department of Agriculture were run by Israeli military officers, who carefully watched to ensure that military rules and regulations were being applied in their respective areas.

Under the Israeli occupation, the water management systems applied in the occupied Palestinian territories of the Gaza Strip and the West Bank were like mirror image reflections of the system applied in Israeli: water is managed by agricultural institutions and essentially for the interest of Israel and Israelis, whether living in Israel or in settlements on the occupied lands. The discriminatory water management policy applied in the occupied territories resulted basically in:

(a) Unjust allocation of rights as well as unjust allocation of social and economic benefits of water use and services;
(b) Economically inefficient and environmentally unsustainable utilization of the limited resources of available water;
(c) Political complexities that will continue to overshadow the Israeli-Palestinian negotiations;
(d) Inapt infrastructure and legal framework;

(e) Weakening of Palestinian institutional and professional capacity in the field of water management.

B. WATER MANAGEMENT UNDER THE PALESTINIAN AUTHORITY

As of 4 May 1994, the Civil Administration lost control over most of the Gaza Strip and the Jericho area as a result of the implementation of the self-rule arrangements agreed upon between the Palestinian Liberation Organization and the State of Israel in Cairo. As of that date, the Palestinian Authority took charge of Civil Affairs, including the responsibility for water resources management, in the self-rule areas.

Under the new arrangements, the Water Division of the Department of Agriculture in Gaza became a division within the Agriculture Ministry of the Palestinian Authority. Later on, the name was changed into the Directorate General of Water, Hydrology and Geology. In the Jericho area, the Palestinian Authority supported by the UNDP Water Resources Action Programme (WRAP) and a number of non-governmental organizations (NGOs), established the Jericho Water Office in June 1994 in order to undertake the essential task of hydrological monitoring in the area. On 28 February 1995, the Palestinian Authority established the Hydrology Bureau (HB) as a unit within the Water Planing Directorate of the Ministry of Planing and International Cooperation (MPIC). The HB has the very precise mandate of: (a) undertaking hydrological monitoring; (b) development and maintenance of hydrological archives, databases and information systems; and (c) designing, carrying out and supervising hydrological studies (including assessment of water resources).

All of the above-mentioned intermediate institutional and organizational arrangements were essential at the time when they were established by the Palestinian Authority. However, the target of the Palestinian Authority has been to capitalize on existing resources and "building blocks" and, ultimately, the development of a comprehensive legal and institutional framework to manage water in Palestine in a manner that guarantees social equity, economic efficiency and environmental sustainability. Accordingly, the Palestinian Authority established the PWA to achieve this goal.

Fortunately, the PWA did not have to start from scratch. Expertise and initiative to enhance water management capacity in Palestine existed in governmental units, universities, NGOs, and national programms. One very important component that the PWA has available to it is the Water Resources Action Programme. WRAP is a joint initiative of the Palestinian leadership and the international community and was

launched at the beginning of 1993. WRAP is financially and technically supported by the United Nations Development Programme (UNDP), the Canadian International Development Agency (CIDA), and the British Overseas Development Administration (ODA).

The basic objective of WRAP is to develop Palestinian water management capacity. An interdisciplinary team of national professionals, the WRAP Task Force, constitutes the technical executive arm of the programme. As the programme was designed to support the establishment of the PWA, work on the programme has been executed in such a manner as to this end. The first activity of WRAP Tasks was to identify priority issues related to water resources management that needed prompt action, and then mobilize resources to address these issues. WRAP has undertaken a number of activities ranging from supporting institutional development to undertaking technical hydrological investigations and launching a public awareness campaign. During the first month of operation, WRAP supported a workshop on the appropriate institutional framework for water within the Palestinian Authority. In addition, the work organized by WRAP on the legislative dimensions related to water management proved to be very helpful to the PWA in preparing the draft act on the "National Water Council and National Water Authority", which (as noted above) was presented to the attention of the President by the PWA upon its establishment.

Recently, the work of WRAP was taken over by the PWA, and all the programme's resources are now at the disposal of the PWA. The PWA is now focusing on the development of a comprehensive analytical framework for planing water resources management capacity and at the activation of the PWA. A number of other activities involving other parties are also on the PWA agenda.

C. MAIN FEATURES OF THE PALESTINIAN WATER ACT

Maximum involvement of stakeholders; observing social equity and environmental sustainability while maximizing economic benefits; modern high-tech, and capitalizing on all available and existing resources; largely interdisciplinary, but highly specialized; and de-fragmented, but decentralized: this is how water management in Palestine is envisaged by the Palestinian leadership and the PWA. This is easily sensed when reading through the National Water Council and National Water Authority Act;

According to the proposed law, the highest water authority is in the hands of the National Water Council (NWC). The NWC is headed by the President and includes ministers of agriculture, planning and international cooperation, justice, local government and industry and a representative from national universities. In addition, membership in the Council is open to any party whenever deemed necessary by the Council. The proposed act defines water in Palestine as; all the water in the country; whether surface or subsurface, and including wastewater and brackish water. As for management, the proposed act defines it as: the control of water resources development by means of policy guidelines, studies and dissemination of information, development of comprehensive water use plans, and licensing.

While deciding on strategic options, including general policy, pricing, involvement in regional cooperation, water resources protection and pollution control regulations, investment priorities are the responsibility of the NWC. The PWA represents the executive arm of the NWC. The PWA has been conceived as a public institution attached to the presidency. The head of the PWA is assigned directly by the President.

The proposed National Water Council and the National Water Authority Act set the objectives of the PWA as follows:

(a) To ensure the most rational management of the water resources available in Palestine, in order to achieve a balance between available water, in terms of both quantity and quality, and the needs of the Palestinian people at present, as well as in the future;

(b) To promote introduction of those laws and regulations that are necessary to prevent abuse and pollution of water resources;

(c) To ensure the endorsement of the NWC for all water projects, and to oversee the implementation of those projects through national and local government departments or individual contractors;

(d) To achieve the highest level of cooperation between local administrative bodies for the purpose of enhancing their water management capacity, and rational assessment of future needs;

(e) To achieve the highest level of cooperation between the PWA and all parties that have common interests.

Law No. (2) for 1996

Establishment of the Palestinian Water Authority

The Chairman of the Executive Committee of the Palestinian Liberation Organization. The chairman of the Palestinian National Authority After reviewing the Law No (5) for 1995, regarding transfer of authorities and functions, the existing Law No. (2) for 1938 for monitoring water resources which is valid in Gaza and the West Bank, and the Decision No. (90) for 1995 which was issued on 26/4/1995 to establish a Palestinian Water Authority and appoint a commissioner; and upon the requirements of public's benefit,
We issued the following law :

Article (1) : The following words and phrases mentioned in this law have the underneath mentioned meanings unless otherwise stated :

The Authority	:	The Palestinian Water Authority
The Council	:	The National Water Council .
Water Resources	:	The water located within the boundaries of Palestine whether surface of ground water and the regional water including brackish and waste water
Water Policy	:	The policy approved by the Palestinian National Authority, to protect natural and political rights in water resources, its utilization and projects in Palestine.
Water Monitoring	:	Monitoring of development of water resources, through guidance, data, studies and comprehensive plans foe water utilization, and issuing of permits and licenses to use water.

Chapter -1-

Establishment & Objectives of the Palestinian Water Authority

Article (2) :The Palestinian Water Authority establishes and enjoys a considerable independent character, has its own budget and follows the President of The National Palestinian Authority and has a commissioner appointed by the President of the National Palestinian Authority.

Article (3) : The Palestinian Water Authority aims to achieve the following :

1. Guarantees the most efficient management of available water resources in Palestine, to achieve the balance between available water quantities and qualities, and the needs of the Palestinian people in the present and the future.

2. Applies the water policy approved by the National Palestinian Authority Council.

3. Establishes water projects and fully supervises their implementation through governmental bodies, municipal councils or individuals.

4. Achieves highest level of cooperation between local administrative bodies to increase its efficiency in managing water use and estimating future demands.

5. Achieves highest level of cooperation among local administrative bodies and all parties with whom they share common interest.

Chapter -2-

Functions and Authorities of the Palestinian Water Authority

Article (4) : The Water Authority shall undertake the following functions :

1. Support centralization of hydrological data collection and publishing of all water resources data and information.
2. Plan, design, establish, manage and maintain laboratories, experimental stations, and research centers.
3. Issue permits, licenses, concessions for any type of water utilization or wastewater end use.
4. Evaluate projects related to water resources prior to licensing their implementation.
5. Participate in the preparation of regional water plans, supervise and monitor individual water projects as well as the preparation of a national water masterplan.
6. Specify and allocate water utilization rights for any purpose and resolve disputes that may arise from water use.
7. Prepare reports regarding water projects that have been approved for implementation and put forward plans for their implementation, clarifying their costs and all related matters according to what the National Water Council asks for.
8. Take all necessary measures to monitor the establishment and implementation of water projects that already has funds allocated by the Authority's budget.
9. Monitor, inspect and manage all water resources and their different uses.
10. Regulate and instruct the establishment of all private and public artesian wells and explore ground water resources.
11. Any other functions or authorities delegated to it by the Palestinian National Authority Council.

Article (5) : The Authority has all the power to achieve its objectives and therefore has the power to:

1- Enter others' land for the purpose to survey and plan for water.
2- Prepare draft regulations necessary to protect water resources from pollution and misuse.
3- Propose specific fees for granting of permits, licenses and concessions.
4- Acquire any existing rights to use water and pay compensation for it.
5- Acquire all statistical and technical data and reports related to the use of water resources from ministries, other governmental bodies, organizations and public institutions
6- Carry out any other activity deemed necessary for achieving its objectives.

Article (6) : The Water Authority Commissioner, as an Executive Director, undertakes the following activities:

1- Organizes and administers the activities of the Authority.
2- Prepares the annual budget of the Authority.

3- Implements the National Water Council decisions.
4- Coordinates the work of all the Authority's projects.
5- Administers the personnel, employees, and workers of the Authority.
6- Keeps all records necessary to show activities, inventories, income and expenditures of the Authority and prepare data and annual accounts to present to the National Water Council.

Article (7) : The financial resources of the Authority come from the following sources:

1- Money allocated to it from the general budget.
2- Money received from water fees, payment, concessions and beneficiaries payment.
3- Donations and grants received by the Authority and approved by the Palestinian National Council.

Chapter -3-

National Water Council

Article (8) : The National Water Council is established and consists of :

1- President of the National Authority	President of the Council
2- Minister of Agriculture	Member.
3- Minister of Justice	Member.
4- Minister of Planning and International Cooperation.	Member.
5- Minister of Local Government.	Member.
6- Minister of Industry	Member.
7- Representative from the Palestinian Universities.	Member.

Article (9) : The Council undertakes the following :

1- Prepares the water policy for Palestine and submits it to the Palestinian National Authority for approval in order to protect Palestine natural and political rights in water resources, to enhance, develop, conserve and maintain it, to make use of it for different purposes in order to promote the economic, social and health status in Palestine.

2- Prepares a policy to develop and make use of water resources in Palestine in cooperation with concerned bodies and submits it to the Palestinian National Authority for approval.

3- Promotes regional and international cooperation in water issues.

4- Implements strategic decisions related to the application of the Palestinian National Authority's policy for water including monitoring of pollution and protection of the environment.

5- Defines the money necessary for investment in the water sector.

6- Support the activities of the Palestinian Water Authority and facilitates its work.

7- Treats any other important issues raised by the Palestinian Water Authority.

Article (10) :

(1) The National Water Council meets regularly, once every three months upon the request of its President and may be invited to irregular meeting, upon a written request to the president, of three members of the Council, clarifying the reasons behind their request.

(2) The attendance of minimum four members of the Council constitutes the legal quorum for the meetings. Decisions are taken with the consensus of the majority of the attendees.

Article (11) : The Council can call upon experts, consultants, employees or observers to attend its meetings to consult with them without them having the right to vote.

Article (12) : Upon the request of the Council's President or one of its members, the Council can form subcommittees to study specific problems related to water.

Chapter -4-

General Legislation

Article (13) : The National Water Council issues all necessary regulations to implement this law

Article (14) : Any law that contradicts this law is cancelled.

Article (15) : All relevant bodies each in its specialization, should implement & comply with this law from its date of publication in the newspaper.

Issused in Gaza City on 18/01/1996
Corespondes to Sha'ban 27, 1416

Yasser Arafat
The Chairman of the Executive Committee of the Palestinian Liberation Organization
The Chairman of the Palestinian National Authority

Elements of the Palestinian Water Policy

The Palestinian water policy, as set out in the following principles, will be the basis for decisions on the structure and tasks of the water sector institutions, and the water sector legislation.

(1) All sources of water should be the property of the state.

In a situation of acute shortage of available water resources, a just, equitable, and sustainable allocation among all legitimate users may be best ensured by the state.

(2) Water has a unique value for human survival and health, and all citizens have the right to water of good quality for personal consumption at costs they can afford.

The right to water for survival is seen as a universal human right. However individual water rights do not necessarily imply free access to water supply or disposal services. Standards for assuring a safe quality of drinking water, and for water supply, derive from policy principle (2). Such standards must comply with resource assessment based on scientific methods.

(3) Industrial and agricultural development and investments must be compatible with water resource quantity available.

An important means to meet this goal, is consistency between national economic planning and the national water policy. Economic development should not imply, even inadvertently, unsustainable water use, or irreversible environmental damage. The regard for resources and environment should lay the premises for the economic solutions.
The role of agriculture is particularly important in the economy of the Palestinian territory, and the major share of the water resources are being used for agricultural purposes. Water consumption in the agricultural sector will have to adjust on a cost-efficiency basis, to issues such as choice of cultivars, use of marginal - quality water, and improved irrigation technology.

(4) Water indeed is an economic good, therefore the damage resulting from the destruction of its usefulness (pollution) should be paid by the party causing the damage (polluter).

As recognized for instance by the UNCED conference, sustainable management of water as a scarce resource is only possible when its full cost is acknowledged during the planning and development of water projects. Pricing policy may, however, have to be formed so as to provide drinking water to poor parts of the population at an affordable price.

(5) Water supply must be based on sustainable development of all available water resources.

In this context, available resources include : sharing of regional water resources, recycling, reuse, use of marginal-quality water, and unconventional sources such as desalination. Sustainability in the context of Palestinian water resources means, in particular, long-term maintenance of groundwater levels, and water pollution prevention.

(6) The development of the water resources of the Palestinian territory must be co-ordinated on the national level, and carried out on the appropriate local level.

The scarce and limited resources of catchments and aquifers must be managed in their entirety, preventing upstream overuse to the determent for downstream users. This is best achieved through overall central co-ordination, complemented by local implementation.

(7) The national water sector management should be carried out by one responsible body; with the separation of institutional responsibility for policy and regulatory functions from the service delivery functions.

The water resources of the Palestinian territory is of such overriding importance for human welfare and national economy, that water matters should be dealt with at the highest level within the government, for effective co-ordination of sectorized interests. The Palestinian Water Authority should carry out its activities in close collaboration with relevant sectorial authorities.

(8) Public participation in water sector management should be ensured.

Local participation in planning, operation, and management is one key to ensuring proper management of water demand. Public awareness of the role of water in both the public and private domain, and its social, environmental, and economic value, is important for informed decision - making.

(9) Water management at all levels should integrate water quality and quantity.

Usable water is always a function of both quality and quantity, and the two are strongly interconnected. Disregard of this fact is disastrous, and has led to e.g. saltwater intrusion from the Mediterranean in Gaza. Integrated water management should include monitoring and other data collection.

(10) Water supply and wastewater management should be integrated at all administrative levels.

Water consumption will inevitably lead to spill or sewage. The economy and technology for managing both supply and sewage can be optimized by an integrated approach. Moreover, in some circumstances wastewater as well as stormwater drainage are potential resources for raw water supply. The integrated approach inherent in principles 9 and 10 will be facilitated by the creation of one national water authority (principle 7).

(11) The optimal development of water supply must be complemented by a consistent water demand management.

Use of appropriate technology should be encouraged in water-saving practices, both in households, industry, and above all in agriculture. Pricing policies are important tools for managing water demand, and must be a part of the overall water policy. In this context, it is also essential to modernize surface and ground water monitoring systems.

(12) Protection and pollution control of water resources should be promoted and enhanced.

In this context, all preventive measures against pollution should be ensured and legal actions against offenders should be taken. For example, industrial waste should be treated on-site and then discharged to the waste water network.
Areas of good water quality, should be protected and safeguarded against pollution and major development projects.

(13) Conservation and optimum utilization of water resources should be promoted and enhanced.

Water resources should be developed and managed to optimize the efficiency of their utilization, recognizing their scarcity, the need for their conservation, and the importance of pricing to promote economic efficiency.

(14) The Palestinians will pursue their interests in connection with obtaining the rights of water resources shared by other countries.

The above means :

- The Palestinians are committed to implement Article 40, agreed upon with the Israelis
- The Palestinians will negotiate with the Israelis, in the final stage, to reach a final agreement.
- Accordingly, The Palestinians will seek other agreements with other countries.

(15) The government will cooperate with regional and extra-regional parties to promote the optimum utilization of water resources, to identify and develop new and additional supplies, and to collect and share relevant information and data.

Regional cooperation will include sharing of information and data on water resources and promotion of regional seminars, meetings and publications. The government will cooperate on regional initiatives to identify likely sources of new and additional supplies and agree on the development of such resources.

Nabil Al Sharif
Commissioner
Palestinian Water Authority
Gaza - January 1996

Appendix IV
Current Vision, Institutions, Donor Organizations, Activities and News of the Palestinian Water Sector

(This appendix material was published in H_2O Water Resources Program Quarterly Update of June 1997)

1. The Vision for Development of Palestinian Water Resources

The vision for development of Palestinian water resources has four major components :

- Economic and social development.
- Public health and environmental protection.
- Autonomous water resources management of shared water resources.
- Efficient and equitable water allocation.

1.1 Economic and Social Development

Water is an economic good. Palestinian economic and social developments are constrained by lack of water, by lack of security of water supplies and by inequities in water supply and prices. Palestinians are entitled to sustainable, secured water supplies at dependable, affordable prices, and their economic and social development depends on having those resources.

In the long-term, it is unlikely that the agricultural sector will be able to provide sufficiency in farm-produce or to be a powerful enough engine to drive the Palestinian economy. Economic growth will require the development of light industry and regional commerce. Therefore, plans must be made to increase water supplies for commercial and industrial users in the coming years.

1.2 Public Health and Environmental Protection

The scarce Palestinian water resources must be protected from pollution and over-exploitation. To protect public health, preserve scarce Palestinian water resources and responsibly participate in the management of regionally shared water resources, an effective program of wastewater management ought to be implemented.

1.3 Autonomous Water Resources Management

Policies of the Palestinian Authority will seek to extend control by Palestinians over Palestinian water resources. These policies must be founded on regional cooperation in the management of shared water resources and they will include the possibility of exchange of water in the interest of minimizing costs.

1.4 Efficient and Equitable Water Allocation

Infrastructure need to be provided to supply water to all Palestinians in an equitable efficient and reliable manner. This will address historic regional inequities in water supply and prices.

2. Water Sector Institutions

2.1 Palestinian Authority Institutions and Programs

2.1.1 Palestinian Water Authority (PWA)

Organizational Development: The Internal Regulations of PWA were signed by the President of the Palestinian National Authority (PNA) on June 5, 1997. A staffing plan with complete job descriptions is ready for implementation. (See Appendix III)

Project Coordination : The main activities of the PWA in the water sector are: organization of the water sector; development of the West Bank Water Department; multilateral, bilateral and international cooperation and project coordination. The latter activity includes; *the water Resources Program of the Municipal Services Project* sponsored by the US Agency for International Development (USAID), the Water and Wastewater Service Improvement Project sponsored by the World Bank (WB), the Water Sector Strategic Plan and Priority Investments (WB), the Strategy for Capacity Building of the Water Supply and Sanitation Department of the Municipality of Nablus (GTZ) and the Water and Sanitation Services Projects in the Municipality of Hebron (SOGEA).

2.1.2 The Norwegian Institutional Cooperation Programme

This programme is funded by the Norwegian Agency for Development Cooperation (NORAD). Its goal is to build a sustainable PWA, which can adequately manage Palestinian water resources. The components of the programme include:

- Partial funding of PWA running costs.
- Contracts between PWA and Norwegian consultants. So far, three such contracts have been signed. Theses are Audit of Gaza Services Management Contract; with Deloitte & Touche, Drafting of Water Regulations, with CESAR and Water Tariff Study, with Norconsult.
- Activities between PWA and the Norwegian institutional partner; Norwegian Water Resources and Energy Administration (NVE). The activities include: budgeting and accounting, water licensing system, water quality laboratory, technical standards and guidelines, water master plans, water data bank support and institutional framework for the water sector including the West Bank Water Department Development Plan.

2.1.3 Public Awareness Activities

Under the activities of the National Public Awareness Campaign: "Water Resources Conservation and Protection", PWA organized two workshops on February 24 and on May 26, 1997. The main goal of these two workshops was to centralize and coordinate all the activities of public awareness campaigns undertaken by different projects so as to ensure that the public receives consistent information and unified messages. This is achieved by identifying the common themes, problems, target groups and messages throughout the municipalities of Gaza Strip.
The participants have identified that "improper" connections are the major problem facing the water and wastewater sectors. Other problems in the water sector include pollution, overuse of water and the lack of proper and regular maintenance of domestic networks.
Twelve -TV-spots were produced and aired on Palestinian Television. These spots form an output of the workshops and a tangible outcome of technical and financial cooperation among the PWA, the United Nations Development Programme (UNDP), Save the Children Fund (SCF) and Metcalf & Eddy Int. Inc.; with PWA taking the leading role.

2.1.4 The Jerusalem Water Undertaking/ Ramallah District (JWU)

The official inauguration of Ein Samia groundwater well no. 2A took place on May 13, 1997. Around 83% of the total cost of the project (equivalent to 0.815 MDM) was donated by the German Government through BMZ; the remainder was provided by JWU. The drilling project was carried out as a comprehensive assistance project jointly planned by JWU and GTZ. The average annual production of the well is 1.32 mcm/yr.

2.1.5 The West Bank Water Department (WBWD)

The four-year plan that was formulated and completed by the WBWD in October 1996 is still awaiting funding. It involves the rehabilitation of old water networks and the construction of new ones throughout the West Bank. In addition, the project requires the drilling of around nine new wells. The estimated rehabilitation cost is U.S.$ 53 M and that for the new networks is U.S. $ 57 M.

WBWD's institutional news includes :

- A course on Global Position System (GPS) for WBWD's engineers was held in June 1997.
- Recent moves have been taken by the PWA to equip the Department with computers.
- Building extension works are ongoing to house a new Water Quality Control Laboratory.

The WBWD has been involved in the design of numerous water-related projects, and in June 1997 many of which were under construction or at tendering stage. These projects were mostly funded by PECDAR, the UNDP, Catholic Relief Services (CRS) or Save the Children Fund (SCF), and include:

- Upgrading of Water Networks for Salfeet (P: $ 0.68 M, S: O/C), Tayaseer (Nablus, P: $ 233,000, S: O/C), Beitunya (S: C/C), Al-Nazleh Al-Sharqiyyeh (Tulkarm, S: O/C), Beit Iba (Nablus, S: O/C) and Beit Emrein (Nablus, S: O/C)
- Water Reservoirs at Kufr Abboush (Tulkarm, P: $ 0.22 M, S: O/C), Deir Istya (Salfeet, P: $ 227,500, S: O/C). Ras Atiyyeh (Qalqilya, P: $ 800,000, S: O/C), Deir Al-Asal (Hebron P: $ 77,000, S: O/C), Beitunya (S: O/C) and Jamma'en (Nablus, S: O/C).
- Water Networks for Kufr Lagef (Qalqilya, P: $ 101,000, S: O/C), Al-Mughayir (S: AF), Kharbata Bani Harith (Ramallah, S: AT) and Izbet Shufa (Tulkarm, S: D/C).
- Water Main Lines & Networks for Ein Areek (Ramallah, S: AT), Kufr Ne'meh & Deir Ibzi' (Ramallah, S: AT) and As-Soumo' (Hebron, S: O/C).
- Main Line, 2 Reservoirs & Pumping Stations at Rameen (Tulkarm, S: D/C) and Ektaba (Tulkarm, S: D/C).
- Reservoir & Pumping Station at Kufr El-Labad (Tulkarm, S: O/D).
- Well Drilling at Odala (Nablus, S: C/C).

Where: AF= Awaiting Funding. AT= Awaiting Tendering, C/C= Construction Completed, D/C= Design Completed, O/C= Ongoing Construction, O/D= Ongoing Design, P= Tender Price, S= Status.

2.2 Municipal Institutions

2.2.1 The Municipality of Al-Bireh

- The Municipality is currently (June 1997) evaluating offers from local and international contractors for the construction of a wastewater treatment plant. The project is due to commence at the beginning of September 1997 and is expected to be completed within eighteen months. The cost of the project is around $ 1.30M. The German Development Bank, KFW, will be providing full funding.
- The Municipality has prepared the design of 7 Km of sewerage network for the Southern Area of El-Bireh and is currently (June 1997) in the process of evaluating the offers from contractors. The cost of the project is around $ 3.0 M, to be funded by the KFW. Work is expected to commence within three months.

2.2.2 The Municipality of Jenin

The construction of the new Jenin 2000 cum (m^3) water reservoir will commence in September 1997. The project is funded by the European Union.

2.2.3 The Municipality of Nablus

The Municipality plans to install stormwater networks along the Municipality's main roads and has already installed such a network along Jaffa Street. Since April 1996, the Municipality has been purchasing water (150 m^3/h) from Mekoroth Co. from Huwarah Well. This is in addition to the 60m^3/h it purchases during the summer from Beit Iba Well. The Municipality has a permit to drill a new well in the eastern area; the project will be funded by GTZ.
A new 500 cum water reservoir has been constructed at Beita village as part of the Municipal Infrastructure Development Program funded by the World Bank.
The Municipality started two years ago a Water Quality Control Program to ensure acceptable quality at the source in the reservoirs and at the points of consumption. This monitoring process is done on a regular basis by taking around 1000 samples/year.

2.2.4 The Municipality of Qalqilya

The Municipality is currently undertaking the following projects:

- Projects partially funded by Save the Children Fund (SCF): The rehabilitation and maintenance of the domestic water network of the old part of the city at a cost of 135,000 NIS, installation of wastewater networks in Kufr Saba and Al-Qura'n suburb at a cost of 270,000 NIS (50% of funding for each of these projects will be provided by SCF, the remainder will be funded by the Municipality) and construction of stormwater lines in Al-Qura'n suburb.
- Projects funded by PECDAR: The installation of a wastewater mainline in the northern part of the city and the installation of stormwater lines in the main streets of the city.
- Projects funded by the Municipality: Network maintenance due to road construction at a cost of 157,000 NIS.

In addition, the Municipality has a number of projects planned for implementation in the near future. These include:

- The construction of a 2000 m^3 capacity water reservoir. Funding is to be provided by the UNDP.
- The rehabilitation and maintenance of the water network in Al-Qura'n suburb. The estimated cost of the project is U.S. $ 145,000. Funding is to be provided by the SCF.
- The rehabilitation and maintenance of three water wells in order to increase the capacity of domestic water production in Qalqilya.

2.3 Donor Organizations

2.3.1 The Austrian Federal Government

The sum of 27.70 M ATS (around U.S. $ 2.50 M) has been committed by the Austrian Federal Government for the implementation of a Desalination Project comprising three units in Khan Younis. The project will be implemented in 1997/1998 by an Austrian Consultant through the PWA.

2.3.2 The Canadian International Development Agency (CIDA)

CIDA is providing funding for the Gaza Water and Sewerage Project which is currently (June 1997) in its final stages. It consists of rehabilitation works, and includes the following;

- Installation of manholes, urgent water connections, procurement of 5,550 m of pipes, construction of a booster pump station at Al-Sabra area and the purchase of a water tanker.
- Supply of 11 jetter and suction units of various models and 3 excavators and providing training on the operation and maintenance of these equipment.

2.3.3 GTZ

GTZ is providing technical assistance, long term advisory and short term consultancy services, as well as capital investment for the construction of new and rehabilitation of existing deep wells for both the Water Supply Development Project and the Water Supply and Sanitation Development Project for the city of Nablus. The first Phase of the Water Supply Development Project is being implemented by JWU with GTZ support and is due to be completed by the end of 1997. The project aims at: improving the water quality; reducing water losses; extending the distribution network; improving institutional capacity, management and staff qualification; raising public awareness concerning water conservation and preparing integrated plans for wastewater and solid waste management.

The Water Supply and Sanitation Development Project is currently (June 1997) being implemented by the Municipality of Nablus with GTZ support. Its objective includes: increasing the quality of potable water; utilizing more optimally existing water resources; developing and implementing management and manpower development plans; establishing and/or improving financial management and assets systems; raising public awareness concerning water conservation and substantially improving the overall sanitation situation.

2.3.4 Representative Office of Germany

The following new projects have been approved for funding by the German Government for 1997:

- Water Supply Development for the city of Nablus (extension, Technical Cooperation (TC))
- Al-Bireh town Sewerage Project (Financial Cooperation (FC), inclusion of Al-Bireh South).

- Water Loss Reduction Program (FC, Phase 1: Jenin town).
- The city of Nablus Sewerage Project (FC, Phase 1).

2.3.5 Japan International Development Agency (JICA)

In 1996, JICA agreed to conduct a Study on Sewerage Development Plan for Khan Younis. The study team was selected and commenced work in September of that year. JICA has the overall responsibility for the study. It is assisted by an Advisory Committee responsible for the technical aspects of the study. A Steering Committee that includes the Ministry of Planing and International Cooperation (MOPIC), PWA, the Ministry of Agriculture (MOA) and the concerned Municipality and village councils was set up by the PNA. The two-year study aims at improving the environmental and hygienic conditions of the Khan Younis area by;

- Formulating a master plan of the sewerage system of the study area up to the year 2015.
- Conducting a feasibility study to prioritize projects identified from the master plan.
- Ensuring full technical transfer to the Palestinian counterpart staff.

3 Water Sector Activities

3.1 The Palestinian Water Tariff Study

The PWA has secured the financial support of the Norwegian Government in order to formulate a water demand management policy that will use pricing as a tool to encourage water conservation and to economically provide sustainable water supply and wastewater services. This water tariff study is being conducted by Norconsult International in association with the Center for Engineering and Planning, Ramallah, Nordic Consulting Group (NCG) and the Institute for Applied Social Sciences (FAFO).

The objectives of the study is to provide a generally applicable tool for the determination of concrete tariffs for municipal water supply, wastewater collection services, use of reclaimed wastewater and irrigation. The study will be based on actual data from eight existing water supply and sewerage systems, five wastewater reuse projects and about five irrigation systems in the West Bank and Gaza Strip.

A socio-economic survey to determine the affordability and willingness to pay for water and sewerage services will be conducted in two residential areas in the West Bank and Gaza. This survey will form the basis for determining the "basic need" for water supply and sewerage services at a price that will be affordable to the more disadvantaged households. A kick-off workshop was held on May 27, 1997, and the project is scheduled to be completed around May 1998.

3.2 Gaza Stormwater and Wastewater Project

This is a four-year, two-stage, U.S $ 40 M activity that will significantly improve wastewater management in the city of Gaza. The activities under this project are designed to mitigate a pressing environmental health problem in the municipality of Gaza. Residents of Gaza city will be receiving better stormwater drainage and wastewater services as a result of this project.

Phase I of the project deals with the emergency requirements of the existing wastewater and stormwater systems in order to reduce flooding and laying the framework for future improvements in the wastewater system by strengthening Gaza city's capability to operate and maintain the wastewater system. Phase I was undertaken through a USAID Grant Agreement with UNRWA in cooperation with the Municipality of Gaza, with strong technical support from the USAID funded Environmental Health Project (EHP). Residents of Gaza city are seeing benefits from this project. Sheikh Radwan Reservoir was rehabilitated and the pump station has been repaired and placed back into service. In the Asqola area the Waqf property has been excavated, sludge and debris removed and new pumps and force mains installed. Around 38 km of plugged sewers and 8 km of stormwater culverts were cleaned and 2 km of damaged sewers are being replaced with new lines. This year (1997), USAID interventions through the Gaza Wastewater Project prevented flooding in the homes of the area residents who in the past have suffered from this serious problem. During Phase II, the project will develop a Master Plan for a stormwater and wastewater systems. Over the next two years, engineering designs for new infrastructure, construction of new pump stations and conveyance systems, operations and maintenance training for Gaza municipality technical staff and implementation of a public awareness campaign will take place. Phase II is being implemented through a contract with Metcalf and Eddy International Inc. to provide technical and engineering expertise and to construct the needed facilities under this project. The Master Plan for the city provides a systematic approach to meeting the city's stormwater and wastewater facility needs through the year 2020.

3.3 Service Improvement Programme For Water and Wastewater Systems in the Gaza Strip

This project, Currently (1997) being undertaken by Lyonnaise des Eaux and Khatib and Alami, started in September 1996 and is of a four-year duration. The PWA is responsible for administering the contract. Its basic goals are to improve the quantity and quality of the water and to enhance the long term management of the water and wastewater systems. The efficiency and effectiveness of these systems are aimed to be enhanced through a multi-dimensional approach consisting of:

- Improving the quantity of the water through improving the efficiency of the water supply system and that of the water and wastewater system's operating equipment.
- Improving the quality of the water for public health through improving the disinfection of water supplies and improving the quality of the wastewater effluent.

- Improving the management of the water and wastewater systems through improving their operation, improving the efficiency of revenue collection and that of customer services and public relations.
- Improving the institutional aspects of the water and wastewater systems through improving the effectiveness of their management, improving their long term performance and preparing and assisting in the identification of the sub-investment projects.

4. U.S.AID Funded Water Resources Program Tasks

4.1 Improvements of the Water Sector Institutions

In the framework of the Water Resources Program in the West Bank and Gaza Strip, special attention has been given to the institutional support and commodity procurement for water utilities. It has been envisaged that the institutional development should be directed towards the specific needs of the water sector infrastructure development. In order to make this goal attainable, the PWA and CDM/Morganti made Comprehensive Needs Assessment Surveys, in order to identify the problems and needs of the water sector institutions. As a result of these surveys:

- Computers, equipment and software in the field of AutoCAD, GIS and GPS have been procured, and most of it has been delivered to PWA, WBWD, Hebron, Bethlehem Water Supply and Sewerage Authority (BWSSA), Nablus, Jenin and Jericho. At the same time, training courses for the staff of these utilities in addition to engineers from the JWA have been conducted successfully.
- Lists of prioritized materials and equipment requirements have been prepared, reviewed and approved by USAID and PWA. The procurement process has started. The required materials and equipment will be used for; basic repair required for maintenance of the water systems; maintenance, repair and calibration of water systems. The following institutions will benefit from the deliverables under this task: WBWD, Hebron, Bethlehem, Jericho, Nablus, Jenin and JWU.

4.2 Basic Training for Water Institutions: Planning, Administration and Management

A Training Needs Assessment Report, prepared in March 1997, presented details and a schedule for basic water utilities training to be provided by CDM/Morganti. Five areas were identified. Four courses will cover basic Planing, Administration and Management for water systems managers and engineers, while the fifth will address Water Meter Care and Maintenance for water system technicians. These courses were conducted between August 15 and September 30, 1997 and were designed to cover the following main subjects:

- Project Engineering and Construction
- Water Demand Management
- Operation and Maintenance of water facilities and utilities

- Cost Recovery of water supply
- Water Meter Repair and Calibration

4.3 Standard Operation and Safety Procedures (SOPs)

For the first time in Palestine, manuals, plastic cards and video tapes for SOPs were prepared and provided to water utilities. More training courses in Water Quality, Network Design, Cost Analyses, Water Resources Management are part of the deliverables under this contract and will be conducted before the end of 1997. Selection criteria have been set for the participants in each course and an evaluation process will be conducted upon the completion of each training course. It is foreseen that the supply of materials, equipment, computers, software, SOPs and the training in the above - mentioned fields will lead to substantial efficiency improvements, higher levels of services and ultimately will contribute to financial viability and strong and sustainable water utilities.

4.4 Integrated Water Resources Management Plans

Separate Integrated Water Resources Management Plans covering the period from the present through the year 2020, will be prepared for Jenin, Nablus and Jericho Districts, and a combined plan for Hebron and Bethlehem Districts. These plans will provide a comprehensive program for managing water resources in all of the services areas' identified in an effective and efficient manner. The plans will address the management of groundwater, surface water, stormwater, wastewater and irrigation water. A major component of these plans is development schemes for the collection, treatment and reuse of treated wastewater. Reuse schemes will span various options from district reuse of treated wastewater to regional transfer to neighboring districts.

4.5 Facilities Master Plan

Work on the planing of the facility master plan for the Ramallah and Nablus areas is still under progress. The purpose of this planing is to provide the basic information necessary to develop the municipal water supply facility master plan for these areas. The preliminary reports for both areas have already been submitted during April, 1997. The final reports are due by the end of August. It is worth mentioning that the final reports for the Bethlehem and Jenin areas were submitted in March, 1997.

5. The Palestinian Water Sector News

5.1 The Consequences of Israeli Water Policies

In an article on the consequences of Israeli Water Policies, Al-Quds newspaper pointed out, in its June 5 issue, that one and a half years after signing the Water Agreement between the Palestinian National Authority and Israel, the Palestinians have only received an additional 2.5 mcm of the urgently needed drinking water out of the agreed 28.6 mcm.

Al-Quds newspaper also indicated that Israeli bureaucratic procedures often lead to delays in granting drilling permits for new water production wells: so far, only two out of the eleven applications submitted over a year ago have been granted. Moreover, complicated procedures frequently hinder the progress of other water-related development projects.

5.2 The Distribution of Machines and Equipment

Al-Quds newspaper, June 5, 1997.

The PWA has, over the past three days, distributed equipment to a number of West Bank municipal water departments, as part of the Water Resources Program funded by the USAID, and assisted by the CDM/Morganti team in coordination with PWA. In this respect, the municipalities of Jenin, Nablus and Hebron, in addition to the Bethlehem Water and Sewerage Authority, received a number of computers and plotters which will be used for the production and updating of survey and water-related maps. It is worth mentioning that the PWA has conducted training courses for engineers and technicians from the staff of these municipalities on the use of computers for map production and for building local data banks. More equipment will be supplied to these municipalities in the coming few months to assist them in upgrading their Maintenance Departments.

Appendix V
Environmental Impact Assessment (EIA)

1. Environmental Legislation

The first step in the EIA processes is to ensure that there is in place an appropriate legal frame work. This usually consists of a law (the enabling legislation) that specifies:

- The governmental entity responsible for supervising the EIAs; and
- The scope of the work to be performed for an EIA.

The relevant legislation should also indicate the criteria to identify the projects for which an EIA is required, when it should be completed, and the rules by which it is decided who will pay for the work.

2. Scoping Sessions

It is essential that at an early stage the affected public is involved in assessing the impacts on their immediate environment. This can be achieved by organizing "scoping sessions" public meetings in the affected geographic areas where the public will be told what the proposed project will involve and how they may be affected. It is an opportunity for direct public input. The sessions should be attended by competent public officials, as well as by technical staff who can provide immediate responses to concerns by members of the public. The results of the sessions should be recorded in a Scoping Session Report.

3. The Scoping Statement

This phase is a more professional and formal sequel to the scoping sessions. It describes the scope of the activities to be covered by the EIA, including a definition of the legal and institutional framework, and the geographic scope of the impacts of the project. It makes a preliminary determination of the issues and potential impacts involved and of their significance, which in turn leads to a definition of the technical disciplines to be involved. The scoping statement describes the environmental assessment process, including a time schedule, the responsibilities, and the terms of reference for further activities. The scoping exercise is used to formalize the involvement of the public, and it may be supplemented by conducting a Public Opinion Survey. The output should be a report called the Scoping Statement.

4. The Baseline Survey

This stage factually describes in detail the physical, biological, cultural, social, and economic conditions in the area that may be affected. Its purpose is to create a numerical basis of comparison between the conditions that existed before the project is executed and after the impacts, if any, have become noticeable. Thereby the Baseline Survey provides a factual basis for later assessments, and possibly for the assignment of

responsibilities if serious negative impacts have developed. This basis is created by identifying and measuring a number of environmental indicators that need to be objective, repeatable, quantifiable, and representative of the conditions that may be affected by the project. Ideally, the indicators used in the Baseline Survey are exactly the same as the indicators used in the Environmental Impact Assessment and the Post Construction Survey, because in that way they are likely to give a true impression of the impacts.

The scope of the Baseline Survey is related to the nature of the project and there is no standard list of indicators. For water-related projects the categories of indicators usually are:

- The physical environment related to water, as observed by engineers, hydrologists, hydrogeologists, meteorologists, and similar scientists;
- The biological environment, assessed by biologists, foresters, and other scientists familiar with the living natural environment;
- The socioeconomic conditions, described by scientists in sociology, education, economics, health, and other fields related to the human habitat and to human economic activities; and
- The cultural setting, analyzed by historians, archaeologists, and anthropologists.

The size of a team assigned to conduct a Baseline Survey depends on the significance of the project, but it is clear that the wide variety of disciplines involved, and the areas to be covered should follow logically the Scoping Statement. At all times it is important that the team members bear in mind that the underlying purpose of the Baseline Survey is to provide future scientists with a basis for objective comparisons. Thus, the issues and parameters need to be numerical and measurable. This stage should result in a Baseline Survey Report.

5. The Environmental Impact Assessment

The Environmental Impact Assessment (EIA) is the core document of the process. It is a systematic, interdisciplinary evaluation of the potential impacts that the proposed project may have on the existing conditions, as described and quantified in the Baseline Survey, in the area where the project will be implemented. Its main contribution is the systematic and professional prediction of all significant impacts that the proposed project is likely to cause on its environment. If the impacts require mitigation measures the EIA will inclued a Mitigation Plan. Moreover, there will often be a need for a Monitoring Plan, indicating which ongoing observations will be required, and who will make and analyze them, to ensure that the impacts and their mitigation measures are properly monitored and possibly corrected. Sometimes the EIA is to be conducted subject to specific governmental conditions, regulations and requirements. This phase should result in a report entitled "Environmental Impact Assessment" and its contents may follow the following outline/chapters :

1. INTRODUCTION
(Objectives and scope of the EIA, projections, etc.)

2. PROJECT DESCRIPTION
(Factual description of the proposed project, including discussion of alternatives, if relevant)

3. EXISTING ENVIRONMENT
(A summary of the Baseline Survey, referring to the issues that were found to be significant during the scoping phase)

4. ENVIRONMENTAL IMPACTS
(A detailed discussion of the consequences to be expected from implementing the project as described in Chapter 2 and the environment as described in Chapter 3)

5. MITIGATION PLAN
(A plan for measures aimed at mitigating the negative impacts identified in Chapter 4)

6. MONITORING PLAN
(A plan to monitor the impacts identified in Chapter 4 and the measures proposed in Chapter 5). For very small projects some of the preliminary work may be incorporated into the EIA report

6. The Post-Construction Survey

Particularly for long-term projects with lengthy operation and maintenance phases it is important to periodically assess to what extent the project's impacts are in line with those projected in the EIA. In such cases it is customary to conduct a Post Construction Survey (PCS). It is conducted, possibly from time to time, after the project has been in existence and operating for some time. Its purpose is to compare the facts described in the Baseline Survey with the predicted impacts described in the Environmental Impact Assessment, and also with the latest observations at the time of the PCS. The main outcomes of the PCS may be:

- A change in the operation of the project;
- A modification of future projected impacts; and
- An improvement in the monitoring program.

For long-term projects the PCS may need to be conducted several times.

Appendix VI
Phases of Conducting Public Awareness Campaign For Water Conservation

1. Phase 1 : The Preparation Phase

This phase is largely a desk study phase, which could be performed by existing staff of the PWA or by a short-term consultant. It should result in a Work Plan and Several Components can be identified.

1.1 The Institutions in the Water Sector

Although the "Water Sector" in any society consists of similar functions, the institutional framework to perform water conservation functions differs sharply from one country to another. Therefor it is useful to clearly identify the various institutional actors in the water sector as a first step in any water conservation campaign. This will avoid that any segment of the water sector will consider itself excluded and thus will be reluctant to cooperate.

1.2 The Need for Water Conservation

Even before specific assessments are made of the current performance of the various subsectors (see phase 2) it is useful to describe the background for water conservation in general terms. This should include references to existing government policies, to the general climatological conditions, and perhaps to socioeconomic or religious constraints or duties. As with any other program or project, water conservation needs to be rationalized and its scope well defined.

1.3 Economic, Social and Environmental Consequences

Also before addressing specific conservation steps it is useful to highlight in a general way some of the (possibly negative) impacts that conservation may have on public health, on agriculture, and on the environment. This is also a good place to introduce estimates of the costs of some measures.

2. Phase 2 : The Assessment Phase

This phase is also largely a desk study phase, which could be performed by existing staff of the PWA or by a short-term consultant. It should result in a Conservation Potential Assessment, which will provide a numerical basis and justification for adopting conservation as a strategy.

2.1 Identification of the Water Resources

This section should summarize the existing water resources already available for use, and also estimate to what extent the existing resources can "easily" be supplemented. This is generally known as "Supply Management" and it may include several options. Generally, this effort defines the limits that exist on mobilizing water for various uses.

2.2 Actual Water Uses

This section should assess the actual, not the required or desired, uses of water in various subsectors. It is important that those subsectors are clearly identified, not only by type of use, but also by the different supply modes that each subsector uses. In some cases, such as in the industrial subsector, it may be necessary to distinguish between those users that rely on the municipal water supply systems and those that use their own sources of water.

One feasible subdivision is:

- The domestic sub-sector;
- The industrial sub-sector;
- The commercial/services sub-sector; and
- The agricultural and livestock sub-sector.

2.3 Water Use Targets, in Quantity and Quality

Once the users have been identified it is necessary to determine what the water use targets are, the minimum real needs, in terms of both quantity and quality, for the same subsectors selected earlier.

2.4 Integration of the Findings

On the basis of a quantification of the actual and the desirable uses it is now possible to make a comparison between the resources, the uses, and the targets.

This integration of the findings will:

- Determine whether conservation is called for (i.e. the uses exceeded the resources);
- Identify the sub-sectors of which conservation is most urgently called for (i.e. the actual uses far exceed the targets); and
- Make a preliminary selection of conservation options related to the findings.

The latter task should outline which sub-sectors should adopt conservation measures under the selected options, based on the findings analyzed above; it will result in identification of the various "publics" that need to be made aware of the need for conservation, because their sub-sectors are not performing well in terms of water use.

The Conservation Potential Assessment resulting from this phase should lead directly to a decision on whether to proceed with the Water Conservation Campaign.

3. Phase 3 : The Planning Phase (By Subsector)

This phase is more labor-intensive and it is likely to require a specifically designated public entity, or possibly a specialized private consulting company. A possible output of this phase is a Campaign Design Report.

3.1 Selection of the Executing Institution(s)

The first step is a formalization of the selection of the entity in charge of the campaign, and refinement of the earlier task distribution among various agencies in the water sector.

3.2 Identification and Sensitization of the Audience(s)

In order to enhance the chances of success it is important that the audiences are made aware of the importance of water conservation, and regardless of the sub-sector in which the conservation measures will be pursued.

3.3 Selection of Options

This section is a detailed refinement and elaboration of the out come of Phase 2. It will carefully analyze the available options, primarily supply management, demand management, and water reallocation. The outcome will be the basis for the detailed design of the water conservation campaign.

3.4 Drafting and Adoption of Regulations

This step should be taken in parallel to the earlier work. In some cases the proposed water conservation measures will require new or amended regulations, in which case the sometimes lengthy regulatory process needs to be identified and initiated. It will include the drafting and promulgation of rules, regulations, and codes that may be needed to implement certain water conservation options.

3.5 Design of Materials

This is the technical step involving the preparation of water conservation materials, for "public" awareness, or for direct contact purposes. This includes printed materials for the general public, and brochures, correspondence, or studies to be submitted to more limited or attentive publics.

3.6 Attracting Funding

The funding for the campaign depends on who has been selected to execute it. Sometimes public funds are available, while in other cases the campaign may have to mobilize the necessary financial resources to implement conservation, possibly from donors or from other outside sources.

The Campaign Design Report should incorporate the outcomes of the above mentioned steps.

4. Phase 4 : The Implementation Phase

4.1 Execution of the Campaign Strategy

Upon completion of all preparations, the staff of the PWA (or a private company) needs to be selected and the campaign executed. The execution should follow the steps identified in the Campaign Design Report.

4.2 Gampaign Monitoring

An important feature of the campaign is the inclusion of a mechanism to monitor the performance of the execution, and to assess the effectiveness of the water-conservation measures. Moreover, the expended funds need to be accounted for, in terms of the amount of water saved per unit investment.

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