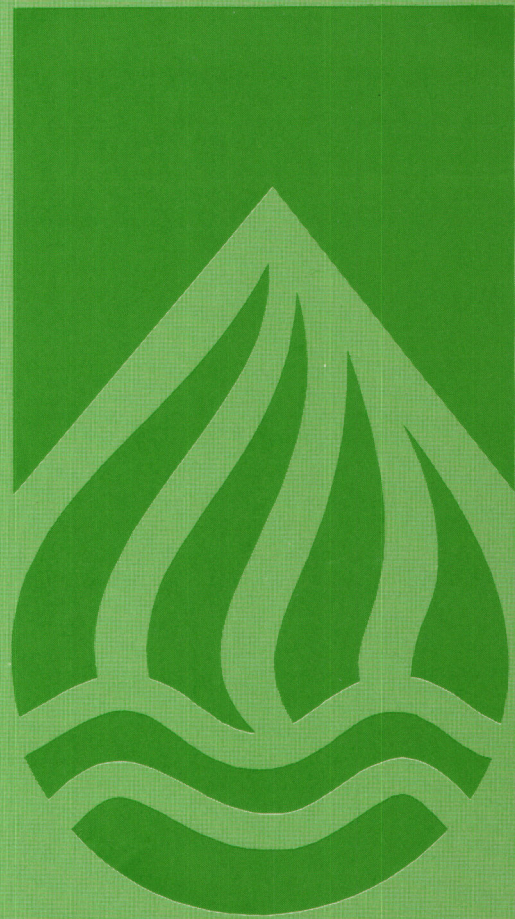


PALESTINIAN  
W A T E R  
R E S O U R C E S

A RAPID  
INTERDISCIPLINARY  
SECTOR REVIEW  
AND ISSUES PAPER

**THE WRAP TASK FORCE**

October 1994



# PALESTINIAN WATER RESOURCES

A RAPID INTERDISCIPLINARY  
SECTOR REVIEW AND ISSUES PAPER

**Produced by:**

**The Task Force of the  
Water Resources Action Program - Palestine  
WRAP**

**October 1994**

## **Water Resources Action Program - Palestine**

**Mail Address** : P.O. Box 51359  
Jerusalem

**Main Office** : Orabi Street, El Remal, Gaza, Gaza Strip.  
Tel: (972-7) 822-696/7  
Fax: (972-7) 822-696/7

**Sub Office** : 8 Mujeer Eddin St.,  
Sheikh Jarrah, Jerusalem.  
Tel: (972-2) 828-684  
Fax: (972-2) 810-768

**E-Mail Address:** [papp1mjk@papp1.papp.undp.org](mailto:papp1mjk@papp1.papp.undp.org)

## ACKNOWLEDGMENTS

This report was prepared by the WRAP Taskforce under the guidance of the WRAP Steering Committee and with the support and advice of numerous organisations and individuals in an ever growing WRAP network. The list below gives many of our main contacts: to any organisations that we have inadvertently omitted we offer our apologies.

### WRAP Steering Committee (in alphabetical order)

#### Core team:

Mr. Ali Al-Waihideh  
Mr. Taher Nasser El-Deen  
Dr. Riad El-Khudari (Acting Co-ordinator)  
Dr. Marwan Haddad

Mr. Fadel Ka'awash  
Dr. Jad Isaac  
Mr. Osama Nimer  
Mr. Abdul Rahman Tamimi

#### Donors:

Mr. David Grey  
Mr. Brian Grover

Gaza Agriculture Department (Water Section)  
General Director-West Bank Water Department  
President of Al-Azhar University  
Director of Water and Environmental Studies  
Centre -Al-Najah University  
Economics and Planning Department-PNA.  
ARIJ/PEPA  
Ministry of Transport  
PHG

UNDP/ODA  
CIDA

### WRAP Taskforce (and authors)

Ms. Basma Abu-Sway  
Dr. Khairy Al-Jamal  
Mr. Nader Al-Khateb  
Mr. Sami Hamdan  
Mr. Yousef Nasser  
Mr. Hisham Zarour

Social Scientist  
Acting Project Manager, Senior Engineer  
Senior Water Engineer  
Hydrogeologist  
Senior Economist  
Senior Hydrogeologist

### The WRAP Network

Organisations that have contributed to /participated in WRAP activities up to the date of this report (September 1994) include:

#### Municipalities and Village Councils :

Gaza  
Deir El-Balah  
Khan Yunis  
Rafah  
Jabalia  
Ramallah  
Al-Bireh  
Nablus  
Hebron  
Jenin

#### Universities :

Al-Azhar University, Gaza  
Islamic University, Gaza  
Birzeit University, West Bank  
Al-Najah University, West Bank

#### National NGOs :

Palestinian Medical Relief Committees  
(UPMRC, Gaza and West Bank)  
Palestinian Agricultural Relief Committees  
(PARC, Gaza and West Bank)  
Palestine Hydrology Group (PHG, Gaza and West Bank)  
TAMER Institute (Gaza and West Bank)  
Arab Scientific Institute for Research and Transfer of Technology, ASIR  
Water and Research Department, Arab Studies Society.

#### International NGOs and Companies :

SCF (US/UK)  
CRS  
IWACO (Netherlands)

#### Government Organisations :

PECDAR  
PEPA

#### Utilities :

Jerusalem Water Undertaking, JWU  
Water Supply and Sewerage Authority of Bethlehem, Beit-Jala and Beit Sahur (WSSA)

#### UN and other donor organisations:

UNRWA  
UNDP  
CIDA (Canada)  
ODA (UK)  
DGIS (Netherlands)  
World Bank

## PREFACE

### **The Report: what, why and for whom?**

This report represents the first product of the Water Resources Action Programme's (WRAP's) Taskforce, at the end of its first quarter of operation. It reviews the current status of the water resources sector in the Palestinian territories and identifies and prioritise the issues - threats, constraints and opportunities - that the sector faces. The report then identifies a plan of action for the WRAP, within the broader framework of the current and planned activities of other institutions.

As an early product of the newly-formed (April 1994) WRAP Taskforce, working in the complex field of water resources, the report does not pretend to be a final or a comprehensive statement of the status of the sector and the issues that are faced. Rather, the report aims both to lay the foundations for the WRAP and to provide the reader with a readily accessible compilation of information and a rational analysis of problems. There is little doubt that the report will soon be superseded by products of the WRAP and of other institutions.

The target audience for the report includes the recently announced Palestinian Water Authority, charged with the responsibility for determining priorities for, and co-ordinating actions, in the management of the water sector, as well as the different Palestinian NGOs and academic institutions active in the sector. In addition, the report is also aimed at the numerous external agencies supporting the sector, as it provides information on sector needs, guidance on priorities and a road map of active institutions and their current and planned activities.

### **The Water Resources Action Programme (WRAP): what is it?**

The WRAP is a partnership of Palestinian individuals and institutions active in the water sector, which seeks to identify and resolve issues constraining the sustainable development of Palestinian water resources and, at the same time, to build Palestinian capacity in water resources management. The WRAP comprises: a Steering Committee of senior sector professionals, representing eight Palestinian institutions and the three donors, UNDP, CIDA (Canada), and ODA (UK) supporting the WRAP; a multidisciplinary Taskforce of six sector professionals and three support staff, charged with co-ordinating the implementation of the WRAP workplan; and a growing network of other institutions contributing to WRAP activities.

### **Key problems to be addressed by the WRAP are:**

- *The need for data, knowledge and skills.*
- *The need for co-ordination, co-operation and information exchange.*
- *The need to identify water resource management options.*

### **Key strategies to be adopted by the WRAP are:**

- *To assemble a specialist Palestinian Taskforce for a Water Resources Action Programme.*
- *To ensure co-ordinated action and accountability to Palestinian leadership.*
- *To identify and address priority water resources problems constraining social and economic development.*
- *To promote and provide a focal point for- and not to duplicate- the work of other Palestinian institutions in current and planned water resources projects.*
- *To provide a central information and data archive, freely accessible to all Palestinian institutions.*
- *To ensure long-term sustainability of the functions of the interim Taskforce, both in institutional and financial terms.*

### **Key activities to be undertaken by WRAP will include:**

- *Establishing priorities for action in the water resources sector.*
- *Promoting co-ordination of and providing support to institutions in the water resources sector and building capacity in the water resources community as a whole.*
- *Enhancing public awareness in the scarcity and value of water in the Palestinian community and the need for water conservation and protection.*
- *Enhancing water resources monitoring, databasing, assessment, planning and management.*
- *Identify appropriate economic and regulatory instruments and mechanisms which will ensure efficient use, and appropriate allocation of water.*

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## List of Acronyms

ANERA	American Near East Refugee Aid
ARIJ	Applied Research Institute of Jerusalem
ASIR	Arab Scientific Institute for Research and Transfer of Technology
CA	Civil Administration
CEP	Centre for Engineering and Planning
CIDA	Canadian International Development Agency
CRS	Catholic Relief Services
EPC	Environmental Protection Centre
ESAs	External Support Agencies
EU	European Community
GAD	Gaza Agricultural Department
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HRD	Human Resource Development
IHS	Israeli Hydrological Service
JWU	Jerusalem Water Undertaking
NGO	Non-Government Organisation
ODA	Overseas Development Administration (UK)
PARC	Palestinian Agricultural Relief Committees
PCG	Palestinian Consultancy Group
PECDAR	Palestinian Economic Council for Development and Reconstruction
PEPA	Palestinian Environmental Protection Agency
PHG	Palestinian Hydrology Group
PNA	Palestine National Authority
PWA	Palestinian Water Authority
PVO	Private Volunteer Organisations
QA	Quality Assurance
QC	Quality Control
SCF	Save the Children Fund
UNDP	United Nations Development Programme
UNRWA	United Nations Relief and Works Agency
UPMRC	Union of Palestinian Medical Relief Committees
WBDP	West Bank Data Project
WBWD	West Bank Water Department
WSSA	Water Supply and Sewerage Authority of Bethlehem, Beit-Jala and Beit Sahur

## EXECUTIVE SUMMARY

In this executive summary key points have been identified and are drawn from the report in the sequence of presentation as follows:

### **Section 2: The context**

- 1- *Military occupation of the Palestinian territories by Israel, has severely affected water resources, in terms of both quantity and quality.*
- 2- *As a result of the peace process, Palestinians are assuming responsibility for water resources, including a legacy of problems to set right.*
- 3- *The population of the Palestinian territories is growing rapidly, and will continue to grow to perhaps 6 million by 2020, and population densities in Gaza are already extremely high.*
- 4- *After 27 years of Israeli occupation, the economy is distorted, but in the aftermath of peace it is expected to adjust and grow rapidly.*

### **Section 3: Water Resources**

- 1- *Water is Palestine's most precious natural resource and is relatively scarce.*
- 2- *Water scarcity is a major constraint on economic development.*
- 3- *The two major groundwater resources in the country are the 'mountain' and the 'coastal' aquifer systems.*
- 4- *The 'mountain' aquifer system is divided into three subsurface drainage basins: the western, the north-eastern and the eastern. The first two are shared with Israel.*
- 5- *A large proportion of Palestinian water resources is shared with at least one other neighbouring country.*
- 6- *Groundwater is extremely important, with the 'mountain' aquifer system of the West Bank representing the chief resource of water in Palestine, currently heavily exploited by Israel.*
- 7- *Gaza's groundwater resources are heavily over-exploited and contaminated.*
- 8- *Water quality in Gaza is one of the Strip's most serious problems.*
- 9- *The Jordan Basin includes five riparian entities: Israel, Jordan, Lebanon, Syria and Palestine.*
- 10- *Allocation of the Jordan River's water to different riparian has been the subject of lengthy negotiations for decades; the Palestinians currently have a negligible share.*
- 11- *Rainwater harvesting has always been and remains a major source of water in the West Bank.*
- 12- *Most of the wastewater used in irrigation in the West Bank is used without any kind of treatment.*
- 13- *The lack of proper sewage collection systems in most of the Palestinian territories severely limits the potential for sustainable development of this resource.*
- 14- *On a world-wide scale, desalination is still considered to be one of the most expensive sources of water.*

### **Section 4: Water resources management**

- 1- *Under occupation, Palestinian water resources have been managed under military authority and through military orders.*
- 2- *The constitutional status of surface and groundwater rights within the Palestinian territories is unclear.*
- 3- *There has been no Palestinian institution with the responsibility for water resources management or with any powers or mandate.*

- 4- *The 'infrastructure gap" caused by minimal investment and reinvestment in water and sewerage services is growing.*
- 5- *Region-wide, the need to deal with water as a scarce and precious resource is increasingly a point of consensus.*
- 6- *The future of water resources management in the region must lie in joint management of a large proportion of the total resource.*
- 7- *There is inequitable apportionment of water between the Israelis and the Palestinians, with 80% of the water originating in the West Bank exploited by the Israelis, either in settlements or in Israel.*
- 8- *Reliable data are required for assessing available water resources and then the potential for meeting current and future demands.*
- 9- *Under occupation, Palestinians have had no access to raw data which appear to have been regarded as a security secret by the Israeli military authorities.*
- 10- *All data collected by Palestinian employees in the Civil Administration have had to be forwarded to the Israeli Hydrological Service. Palestinians had no access to the raw data after it reaches the IHS.*
- 11- *The hydrometric data collection programme in the Gaza Strip and the West Bank needs rehabilitation and updating.*
- 12- *The Palestinian Authority needs a modern water resources data archive.*
- 13- *Water resources data are needed to inform Palestinian negotiators in the current and future peace and regional co-operation talks.*
- 14- *The karstic nature of the West Bank aquifers makes it highly vulnerable to pollution.*
- 15- *Major sources of pollution are uncontrolled disposal of wastewater and solid waste, uncontrolled use of pesticides and fertilisers, and over-exploitation of groundwater.*

### **Section 5: Demand and supply: some economic perspectives**

- 1- *Water in Palestine is a scarce and valuable resource but is not being used efficiently.*
- 2- *Water in agriculture is massively under priced, illustrating that water costing methods ignore economic principles and result in inappropriate water allocation.*
- 3- *The continuation of present supply practices and consumption behaviour will increase the cost of water significantly.*
- 4- *Demand for water is expected to grow rapidly.*
- 5- *The introduction and development of water markets may lead to efficient allocation of water.*
- 6- *Demand management of water has been ignored and must be seriously considered.*

### **Section 6: Water use and society**

- 1- *Inefficient and insufficient water and wastewater services are widespread problems.*
- 2- *There is a general lack of understanding and concern about the value and scarcity of water.*
- 3- *Changing people's beliefs and practices regarding water need to be linked to overall social and economic development.*
- 4- *Community participation in water management and supply can be a key element for sustainable service provision but is not common in the Gaza Strip and West Bank.*

### **Section 7: Existing Sector Institutions and Activities**

- 1- *Many water institutions are weak due to their lack of financial and managerial autonomy.*
- 2- *Many external agencies are supporting the sector: lack of co-ordination may lead to duplication and inadequate attention to Palestinian capacity building.*

## خلاصة

يتم هنا عرض لأهم النقاط التي يتناولها التقرير والتي تم استخلاصها منه حسب تسلسل ورودها فيه، وهي كما يلي:

### قسم (٢): خلفية عامة

١. كان للاحتلال العسكري الاسرائيلي للأراضي الفلسطينية آثارا بالغة السوء على مصادر المياه - سواء من ناحية الكمية أو النوعية.
٢. كنتيجة للعملية السلمية، بدأ الفلسطينيون بتولي مسؤولية ادارة مصادر المياه - بما في ذلك المشاكل من مخلفات الماضي.
٣. يزداد تعداد السكان في المناطق الفلسطينية بسرعة، ومن المتوقع أن يستمر الوضع على هذا الحال بحيث قد يصل العدد الى ٦ ملايين نسمة بحلول العام ٢٠٢٠. علما بأن الكثافة السكانية عالية أساسا في قطاع غزة.
٤. رغم الدمار الكبير الذي أصابه نتيجة للاحتلال الاسرائيلي الذي دام ٢٧ عاما، فإنه من المتوقع تعافي الاقتصاد الفلسطيني وعودته فور استتباب السلام في المنطقة.

### قسم (٣): مصادر المياه

١. يعتبر الماء أثمن المصادر الطبيعية في فلسطين، رغم قلته النسبية.
٢. تشكل قلة الماء في فلسطين العائق الأساسي أمام امكانية النمو والتطور الاقتصادي.
٣. ان أهم مصدرين للمياه الجوفية في البلاد هما النظامين الجبلي والساحلي الحاملين للماء الجوفي.
٤. يقسم الخزان الجبلي الى ثلاثة أحواض تحت أرضه هي: الغربي، والشمال الشرقي، والشرقي. وبينما تشارك اسرائيل الفلسطينين في الحوضين الأولين، فإن الحوض الأخير يقع بالكامل ضمن أراضي الضفة الغربية.
٥. ان أغلب مصادر المياه الفلسطينية مشتركة مع دولة مجاورة واحدة على الأقل.
٦. للمياه الجوفية أهمية بالغة في فلسطين نظرا لأن النظام الجبلي الخازن للماء الجوفي - والذي تستنزفه اسرائيل حاليا - هو مصدر المياه الرئيس في البلاد.
٧. المياه الجوفية في غزة تستنزف بشدة، كما أنها ملوثة جدا.
٨. نوعية المياه في غزة تعد واحدة من أهم المشاكل التي يواجهها القطاع.
٩. يتشاطأ في حوض نهر الأردن خمسة كيانات هي: اسرائيل، الأردن، لبنان، سورية، وفلسطين.
١٠. شكلت مسأله تقاسم مياه نهر الأردن بين مشاطئيه المختلفين موضوعا لمفاوضات مطولة دامت عقودا. والآن، يحصل الفلسطينيون على حصة لا تكاد تذكر من مياه النهر.
١١. لقد شكل حصاد مياه الأمطار - ولا يزال - مصدرا رئيسيا للمياه في الضفة الغربية.
١٢. تستعمل نسبة عالية من مياه المجاري في الضفة الغربية لغرض ري المحاصيل الزراعية دون أي نوع من أنواع المعالجة.
١٣. نقص نظم مناسبة لجمع المياه العادمة في معظم المناطق الفلسطينية يحد بشدة من امكانية تطوير مصدر المياه المحتمل هذا.
١٤. على صعيد عالمي، ما زالت تحلية المياه تعتبر من أكثر مصادر المياه كلفة.

#### قسم (٤): ادارة مصادر المياه

١. خضعت ادارة مصادر المياه تحت الاحتلال للسلطة العسكرية وتمت عبر أوامرها.
٢. الوضع الدستوري لحقوق المياه السطحية والجوفية في المناطق الفلسطينية غير معرف بوضوح.
٣. لا وجود لمؤسسة فلسطينية مسؤولة عن مصادر المياه أو ذات سلطة وتفويض لادارة هذه المصادر.
٤. ما زالت "الهوة في البنية التحتية" في اتساع مستمر نتيجة لبقاء الاستثمار واعادة الاستثمار في مجال خدمات المياه والمجاري ضمن الحد الأدنى.
٥. هناك اجماع في الاقليم على ضرورة التعامل مع المياه كمصدر نادر وثمين.
٦. ان مستقبل ادارة مصادر المياه في الاقليم لا بد وأن تكمن في الادارة المشتركة لجزء كبير من هذه المصادر.
٧. هناك اجحاف كبير في توزيع المياه بين الفلسطينيين والاسرائيليين، حيث يستهلك الاسرائيليون حوالي ٨٠% من مياه الضفة الغربية الجوفية اما في المستوطنات أو في اسرائيل.
٨. وجود معلومات موثوقة ضروري لغاية تقدير مصادر المياه المتوفرة ومن ثم قدرتها على تلبية الحاجات الحالية والمستقبلية.
٩. لم يتح للفلسطينيين حرية الوصول والحصول على المعلومات الخام والتي يبدو أن السلطة العسكرية الاسرائيلية قد وضعتها في عداد الأسرار العسكرية.
١٠. استلزم تقديم كافة المعلومات التي يجمعها الموظفون الفلسطينيون العاملون في الادارة المدنية للخدمات الهيدرولوجية الاسرائيلية والتي لا يستطيع الفلسطينيون الحصول على معلومات منها.
١١. يحتاج برنامج المعلومات الهيدرولوجية في قطاع غزة والضفة الغربية للاصلاح والتجديد.
١٢. تحتاج السلطة الفلسطينية نظاما حديثا لأرشفة معلومات المياه.
١٣. تلزم المعلومات لاتاحة وضعها في خدمة المفاوضين الفلسطينيين في محادثات السلام والتعاون الاقليمي الحالية والمستقبلية.
١٤. الطبيعة الكارستية لخزانات المياه الجوفية في الضفة الغربية تزيد من خطر تلوث مصادرها المائية.
١٥. المصادر الرئيسية للتلوث هي: التخلص غير المتحكم به للمياه العادمة والنفايات الصلبة، الاستعمال غير المنضبط للمبيدات والأسمدة، والاستغلال الزائد عن الحد للمياه الجوفية.

#### قسم (٥): العرض والطلب: وجهات نظر اقتصادية

١. المياه في فلسطين نادرة وثمينة، ولكنها لا تستعمل بكفاءة.
٢. سعر المياه في الزراعة بخس مما يوحي بأن الطرق المستعملة لتسعير الماء جاهلة لمبادئ الاقتصاد ويؤدي هذا لسوء التوزيع.
٣. سترتفع كلفة انتاج المياه بحدة اذا استمر النهج الحالي لتزويد المياه والنمط القائم لاستعمالها.
٤. يتوقع النمو السريع للطلب على المياه.
٥. خلق وتعزيز أسواقا للمياه قد يؤدي لتوزيعها بفاعلية.
٦. يجب الأخذ بعين الاعتبار تدبر الطلب - بدلا من العرض - على المياه بشكل جاد، الأمر الذي تم تجاهله حتى الآن.

#### قسم (٦): المجتمع واستعمال المياه

١. يعاني قسم كبير من المجتمع من نقص وتدني نوعية خدمات المياه والمجاري.
٢. بشكل عام، يفتقد الادراك والاهتمام بقيمة المياه وحقيقتها.
٣. تغيير معتقدات الناس وممارساتهم بخصوص المياه يجب أن ترتبط بعملية التنمية الاجتماعية والاقتصادية الشاملة.
٤. رغم عدم دروجها في قطاع غزة والضفة الغربية، من المحتمل أن تساعد المشاركة الجماهيرية في ادارة مصادر المياه والتزود بها في توفير الخدمات بشكل ديمومي.

#### قسم (٧): المؤسسات والنشاطات القائمة

١. تعاني الكثير من المؤسسات من الضعف نظرا لعدم تمتعها بالاستقلال المادي والاداري.
٢. يوجد الكثير من الوكالات الخارجية التي تدعم قطاع المياه الفلسطيني. على الرغم من هذا، فإنه يخشى من أن يؤدي عدم التنسيق بشكل كاف للتكرار غير المفيد وكذلك عدم الانتباه بشكل مرض لبناء القدرات الذاتية الفلسطينية اللازمة لادارة مصادر المياه بكفاءة.









# PART A: A 1994 SITUATION ANALYSIS

## 1. Introduction

*This section comprises a position statement which summarises the current status of the water sector in the Gaza Strip and the West Bank. This study represents the foundation for the Water Resources Action Programme (WRAP) activities. A very brief review of the political, geographical, hydrological, hydrogeological, economic, social, and institutional situation in the area was undertaken between April and June 1994 by the newly formed Water Resources Action Programme's (WRAP's) Taskforce. Most of the data were collected from field observations and from discussions and meetings with Palestinian officials and active professionals, officials from the Water and Agricultural Departments, the municipal and regional water utilities, and various non-governmental organisations (NGO's), academic organisations and negotiators from the Gaza Strip and West Bank.*

## 2. The context

### 2.1. Brief historical context

At the beginning of the twentieth century the entire region (Palestine) formed part of the Turkish Ottoman Empire. Following World War I, the Ottoman Empire was dismantled and Britain ruled Palestine under mandate. In 1922, a new entity east of the river Jordan was established by the British, which in 1946 became the Hashemite Kingdom of Transjordan. In 1948 the British Mandate was terminated and Israel declared independence as a Jewish state within the land of Palestine. Subsequently the first Arab Israeli war erupted. Many Palestinians fled their homes to neighbouring Arab countries and to areas of Palestine not controlled by the newly-formed Jewish state. One of these areas came to be known as the West Bank and the other the Gaza Strip. The West Bank was inhabited by between 400,000 and 450,000 people prior to the 1948 War, and an additional 400,000 and dispossessed Palestinians after. The Gaza Strip had a population of around 80,000 prior to the 1948 War and a population close to 300,000 after the war.

After the armistice agreement between Israel and Egypt in 1949, the Gaza Strip became a de-facto political entity. The West Bank came

under the control of the Transjordanian forces in 1948 and annexed to Jordan in 1950. Between 1948 and 1967 the Gaza Strip was controlled by Egypt, apart from a short break in 1956 during the Suez Crisis and Sinai Campaign, and the West Bank ruled by the Hashemite dynasty. Following the second major Arab-Israeli War in 1967, Israel gained control over the remaining Palestinian territories (Gaza Strip and the West Bank), as well as the Sinai of Egypt and the Golan Heights of Syria. Following this war, hundreds of thousands of Palestinians fled the Gaza Strip and the West Bank and resettled in refugee camps established since 1948/9 in neighbouring Arab countries such as Syria, Jordan and Lebanon.

In 1979, the Egyptians and the Israelis signed the Camp David Agreement, which returned the Sinai to Egypt. The Palestinians, Jordanians, Syrians and Lebanese boycotted this process and rejected the initiative led by President Sadat of Egypt. In 1991, most of the parties involved in the Middle East conflict entered peace discussions, within a framework developed by the USA and culminating in the Madrid Peace Conference. Since then two important agreements have been signed; the Oslo Agreement in 1993 which resulted in the "Gaza/Jericho First" approach, and the Cairo Agreement which paved the road for the implementation of the Oslo Agreement with

regard to the limited autonomy for the coming few years. As a result Israel has withdrawn its military forces from Palestinian population centres in the Gaza Strip and Jericho. This transition is expected to take place in the rest of the West Bank in a later stage, for which the timing and logistics are currently being negotiated by the two parties.

*"military occupation over ... 27 years ... has had major impacts on sustainable development of Palestinian water resources..."*

Thus, over the last 80 years, the Palestinian territories have been under Turkish, British, Jordanian, Egyptian and Israeli rule, with harsh military occupation over the last 27 years. This has had major impacts on the management and sustainable development of Palestinian water resources, not least because of differing water laws and policies, military restrictions, and a lack of adequate concern for the resource. This has had a particularly serious effect on the water resources in the Gaza Strip. Over the past year, the political geography has been changing rapidly and it will continue to change in the months ahead, as Palestine moves

*"...Responsibility for water resources ... will be assumed, bringing a legacy of mismanagement to set right ..."*

towards statehood. As part of this change, responsibility for water resources, essential for economic and social development of the State, will be assumed, bringing a legacy of mismanagement to be set right.

## 2.2. Geographic context

The Palestinian territories (PT) are composed of two separated areas, the Gaza Strip and the West Bank, and have been under Israeli military occupation since 1967. The West Bank is situated on the Central Highlands of Palestine. The area is bounded by the Jordan river and the Dead Sea in the east and the 1948 cease-fire line in the north, west and south. The West Bank's total area is 5,788 km<sup>2</sup>. This includes 283 km<sup>2</sup> of the area of the Dead Sea that falls within the West Bank's boundaries. It is approximately 130 km long and 50 km wide. Under occupation, the West Bank has been administratively divided into eight districts, namely: Bethlehem, Hebron, Jenin, Jericho, Jerusalem, Nablus, Ramallah and Tulkarem.

Although the two territories occupy a tiny area, they comprise two quite different landscapes.

While most of the West Bank lies in a hilly region, the Gaza Strip shows desert characteristics, bounded by the Negev to the south-east and the Sinai to the south-west. Furthermore, the climate is significantly different between the two areas, with substantially lower rainfall in the Gaza Strip.

## 2.3. Demographic context

Accurate population figures are hard to find, due to the absence of a national government, the occupation of the Gaza Strip and the West Bank, and the distribution of the civilian population under different responsible bodies like the United Nations (UN) and Israeli Civil Administration (military government). The United Nations Relief and Works Agency (UNRWA) is directly responsible for the people who are living in the camps and can accurately count them. In the Gaza Strip, this population accounts for 60% of the total, with significant errors arising in the other 40%, living outside the camps, due to the fact that many newly born or dead people are not reported. The Israeli Central Bureau of Statistics figures are widely used in the literature and are adopted in this study. Fig. A.1 shows the population pattern in the Gaza Strip and West Bank from 1967 to 1993.

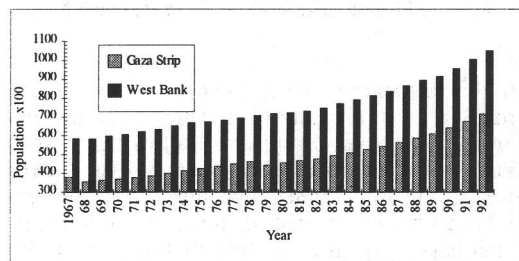


Fig. A.1. Total population of the Gaza Strip and the West Bank. [Central Bureau of Statistics]

As shown in Fig. A.2 the population growth rates in the Gaza Strip and the West Bank approximate to 6% and 4.5% respectively, according to the 1992 statistics. If these rates are maintained, the population will grow as shown in Fig. A.3. The expected influx of diaspora Palestinians, due to the implementation of the Oslo and Cairo agreements, could substantially increase these projections.

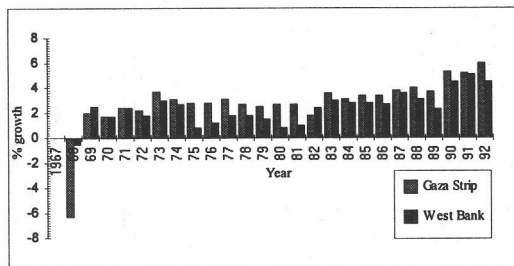


Fig. A.2. Rate of increase of population in the Gaza Strip and the West Bank. [Central Bureau of Statistics]

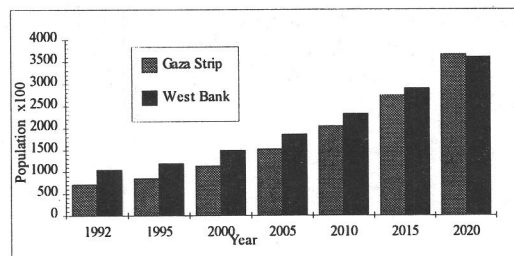


Fig. A.3. Projected population of the Gaza Strip and the West Bank, based on growth rates of 6% & 4.5% in the Gaza Strip and the West Bank respectively.

Over half the population live in rural and semi-rural settlement. Large district cities like Jerusalem, Nablus, Gaza, Hebron, and Bethlehem are good examples of urban communities. Many other towns, such as Khan-Yunis, Rafah, Tulkarem, Jenin, etc. can be characterised as semi-rural. About a quarter of the population live in rural communities and about 17 percent live in refugee camps. Looking at the West Bank and Gaza Strip separately changes the distribution significantly. The share of the rural population in the West Bank rises to between 65 and 70 percent, while in the Gaza Strip it falls with the refugee camp population rising significantly.

Table A.1. Distribution of Palestinian (West Bank and Gaza Strip) communities by size.

Community Type	Number	% Population
District Cities	4	25
Other Cities & Towns	9	14
Small Towns	50	19
Villages	70	10
Small Villages	376	15
Refugee Camps	28	17

Table (A.1) shows the distribution of the Palestinian communities and the percentage of the population in each of several somewhat arbitrary categories of settlement.

The age of over 50% of the population is less than 14 years, due to the large family size which is a typical characteristic of developing countries. Due to the relatively high mortality rate and the large family size only 10% of the population is over 45 years.

The population density varies dramatically across the country. While the average density is 292 person/km<sup>2</sup>, in the Gaza Strip it is 1,936 and in the West Bank 185 person/km<sup>2</sup>. The situation is worse still in the refugee camps, where the population density reaches a peak of 100,000/km<sup>2</sup> in Beach Camp outside Gaza City.

## 2.4. Economic context

The economy of the Gaza Strip and West Bank since becoming distinct entities after the 1948 War have experienced continuous deprivation of investment in both social and economic infrastructure. Historically, the economic policy of the governments in control of Palestinian territory (Jordan and Israel in the West Bank, Egypt and Israel in Gaza) was guided by the objective of minimising their costs and maximising their benefits. Both the West Bank and the Gaza Strip were hinterlands of the pre-1948 Palestinian economy. After 1948 the Gaza Strip and West Bank were cut-off from their major coastal markets, where their respective surplus goods were sold, but where a significant amount of surplus agrarian labour found employment (mainly seasonal, but also long-term).

Between 1948 and 1967 the West Bank, with an additional refugee population of around 300,000 was subjected to Jordanian economic development policy, which left the economy underdeveloped and agrarian based. In 1967 agriculture accounted for between 30 and 40 per cent of gross domestic product (GDP) and employed over 40 percent of the labour force. Services (public and private) became the most important sector, which accounted for over 55 per cent of GDP, and for around 40 per cent of employment. Manufacturing and mining, and construction made up for the balance. The scarcity of employment opportunities, and the static economic conditions induced thousands of West Bank residents to migrate eastwards to Jordan and the Gulf States in search of work.

After 1948 the Gaza Strip's already weak economy was overburdened, by the influx of over 200,000 refugees, increasing the population total to over 280,000. During Egyptian rule little economic development took place except for trade with (and smuggling between) Egypt, which prospered, and remittances from workers abroad. Yet income remained low. By 1967 per capita income was estimated at US\$ 80, one of the lowest in the world (Benvenisti, M., 1984). The economic

structure of Gaza, like the West Bank, was skewed towards agriculture and services. Agriculture accounted for over 32 per cent of employment and over 34 per cent of GDP, and services for over 50 per cent of employment and 55 per cent of GDP.

Under Israeli rule since 1967, the Gaza Strip and West Bank economic structure did not change much. However despite remaining the major productive sector, the relative share of agriculture to GDP declined, as did its share of employment. This was directly related to the substantial growth of the contribution of the factor services item to GDP. Factor services mostly consisted of labour power sold to Israel, of which around 70 per cent came from the rural sector. Its share rose to 25 per cent of GDP in the 1970s, and 30 per cent in the 1980s up to 1967.

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*"Since 1967.... basic.. infrastructure has remained primitive and... is in desperate need of rehabilitation."*

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Throughout the Israeli occupation period, basic economic and social infrastructure was deprived of any significant investment and has remained primitive. What exists is in desperate need of rehabilitation. After 27 years of occupation, four major distortions characterise the Palestinian economies of the Gaza Strip and West Bank: highly unbalanced trade in goods concentrated with Israel; a small and underdeveloped industrial sector; a high proportion of the labour force dependent on employment outside of the territories; and a poor, underdeveloped and ineffective infrastructure.

## 3. Water Resources

### 3.1. The resource base

In the Palestinian territories, water is the most precious natural resource and its relative scarcity is a major constraint on economic development. This applies throughout the region, which is generally characterised by aridity and water scarcity. With the majority of the region's water resources being shared by more than one country, allocation and management of transboundary water resources assumes great importance.

Palestine's position on the south-eastern edge of the Mediterranean makes it fall in the transitional zone between two major climatic zones: the Mediterranean and the arid Tropical zone. Rainfall is limited to the winter and spring months (October to May) and the summer is completely dry. The western slopes of the West Bank receives an annual rainfall of 500-700 mm, the eastern slopes 100-250 mm, and the Gaza Strip 150-400 mm. Hail associated with thunderstorms can occur anywhere in the area. Snow falls two days a year on average on the Highlands.

In the West Bank, rainfall averages 450 mm/year. This gives an average total of 2,600 mcm of rain per year. Around 650 million cubic meter (mcm) of this rain is estimated to infiltrate in the soil to replenishes the aquifers annually. The remainder is lost either through

surface runoff or evapotranspiration. Annual potential evaporation averages between 1,900 mm/yr on the western slopes of the Central Highlands to 2,600 mm/yr on the shores of the Dead Sea.

The Gaza Strip receives an annual average of 325 mm of rainfall, totalling over the Strip's area to 120 mcm per year. Of this amount, about 40 mcm percolate to recharge the shallow aquifer which underlies the Strip, while the remainder is either lost to the Mediterranean through surface runoff or to the atmosphere via evaporation.

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*"... groundwater is the major source of fresh water and is of primary importance to the Palestinians."*

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Temperatures are relatively high and vary from one place to another. January is the coldest month with temperature averaging between 8-10 °C in the Highlands, 12 °C in the Coastal Plains and 12-13 °C in the Jordan Valley. On the other hand, August is the warmest month, with temperature ranging between 22-26 °C in the Highlands, 24-26 °C in the Coastal plains and 28-34 °C in the Jordan Valley. Potential evapotranspiration is high: typical values are 1,900 mm/year in the Gaza Strip, 1,900 mm/yr

in the western part of the West Bank and 2,600 mm/yr around Jericho in the Jordan valley.

In the area confined between the Jordan River in the east and the Mediterranean in the west, groundwater is the major source of fresh water and is thus of primary importance to the Palestinians. The two major aquifers in this area are the mountain Cenomanian-Turonian carbonate aquifer system, and the Plio-Pleistocene alluvial coastal aquifer system. Apart from the Jordan River, the area does not have access to any source of surface water, with the exception of a few small perennial or seasonal streams fed through springs. In addition, rainwater harvested at a household level has long been an indigenous source of water for the Palestinians. More recently, growing water scarcity has resulted in the increasing use of unconventional water sources, such as desalinated water and reclaimed waste water.

## 3.2. Groundwater hydrology

### 3.2.1. The 'mountain' aquifer system

The system of aquifers in the West Bank comprises several rock formations from the Triassic (Lower Cretaceous) to Recent age. These formations are composed mainly of limestone, dolomite and marl. In limited areas, the system includes clastic rocks - sandstone, conglomerates and clays - which form variable (good to poor) aquifers. In the inner valleys, there are alluvial and other deposits of Neogene and Pleistocene age which act as local aquifers. The various formations occur in a series of aquifers and aquicludes.

The Cenomanian-Turonian mountain aquifer system is by far the most important source of water to the Palestinians.

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*"... two basins are shared between the West Bank and Israel, the eastern basin falls ... within the West Bank."*

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Rocks belonging to this system underlay and outcrop throughout the West Bank, which constitutes the recharge area for this hydrological system. The Cenomanian-Turonian aquifer system was first systematically described by Blake and Goldschmidt in 1947. The aquifer system consists largely of dolomite and limestone and include some clay and chalk strata. Where the complete section of formations is found, the total thickness is about 600-700 meters. The

Cenomanian-Turonian formations constitute a highly permeable aquifer. Exceptionally high permeability coincides with ancient drainage patterns and/or fault zones. In some places, the aquifer is overlain by as much as 400 meters of relatively impermeable strata, and is probably underlain by less permeable Lower Cretaceous strata.

Groundwater in the aquifer system flows in three main directions, according to which three main groundwater drainage basins can be identified. These are the western, the north-eastern and the eastern basins. While the first two basins are shared between the West Bank and Israel, the eastern basin falls entirely within the West Bank. In Israel, the aquifer is confined (and originally often under flowing artesian conditions) while it is under water table conditions in the West Bank.

Within the western subsurface drainage basin, the Cenomanian-Turonian aquifer system consists mainly of limestone and dolomite beds which outcrop over the mountains and dip westwards, where they are overlaid by the Eocene foothills and the Pliocene-Pleistocene-Recent deposits which cover the coastal plain at depths that range between a few tens to a few hundreds of meters. The safe yield of the western basin aquifer system is estimated at about 340 mcm, of which 40 mcm is brackish water. Transmissivity is in the range of 10,000 to 200,000 m<sup>2</sup>/day and wells tapping the system in this basin typically have high yields and small drawdowns.

In the north-eastern basin, the mountain aquifer system includes shallow Eocene rocks in addition to the Cenomanian-Turonian formations. The groundwater potential of the aquifer system in this basin is estimated to be around 130 mcm/yr.

The Cenomanian-Turonian aquifer system in the eastern subsurface drainage basin can be divided into two sub-units: the shallow, relatively thin Upper Cenomanian-Turonian and the deep Lower Cenomanian aquifer systems. In the northern section of the basin, the Upper Cenomanian-Turonian aquifer drains into a series of springs such as Uja and Wadi Quelt, which are characterised by unsteady discharge. Major inter-seasonal fluctuations in spring discharge and high dependency on the amount of rainfall received in the previous season is due to the nature of the aquifer, which is of a very limited storage capacity.

Groundwater in the deep Lower Cenomanian aquifer is initially of low salinity. Flowing eastwards from the recharge area where the aquifer rocks outcrop downward towards the deeper saline groundwater strata in the Jordan Valley, the aquifer's freshwater mixes with saline water and becomes brackish. Some of the flow seeps to the surface along the Jordan Valley floor where it evaporates while the

remainder of the flow reaches the Jordan River, rising the Jordan's water salinity.

In the southern section of the eastern basin, groundwater of the Cenomanian-Turonian aquifer system naturally drains through a number of brackish springs such as Ein Fashkha and Turieba along the shores of the Dead Sea. Part of the water is lost through evapotranspiration while the rest flows to the Dead Sea. The source of salinity is believed to be mixing with very deep, highly saline connate groundwater. Intercepting freshwater before it mixes with connate water is believed to be economically feasible.

### 3.2.2. The 'coastal' aquifer system

The coastal aquifer is composed of Tertiary-Quaternary sands, calcareous sandstone and pebbles interbedded with impervious and semi-pervious clay. The aquifer extends from the Gaza Strip in the south to Mount Carmel in the north over some 120 km along the Mediterranean coast. The width of the aquifer varies from 3-10 km in the north to about 20 km in the south where it constitutes the chief resource of water for the Gaza Strip. The aquifer's thickness ranges between 120-180 meters at the coastline in the west to zero at the foothills of the West Bank mountains in the east. Flow in the aquifer is in general from east to west.

The coastal aquifer is divided into three sub aquifers composed mainly of sand, sandstone and pebbles of Pleistocene age. In places, the sub aquifers overlie each other and are separated by impervious and semi-pervious clay and clayey layers. The uppermost sub aquifer extends only a few hundred meters inland, up to 2 km from the shore line. The lower the sub aquifer, the farther it extends inland from the coast. The lowest sub aquifer extends up to 30 km inland. The total thickness of the aquifer layers varies from 10 meters on the eastern boundary to 120 meters near the coast. Depth to groundwater in the Gaza Strip ranges between 60 meters along the Strip's eastern borders and 8 meters and less near the shore. The aquifer is replenished from rainfall (35 to 40 mcm/yr), irrigation returns (20-30 mcm/yr), underground flow from the east (10-20 mcm/yr), and infiltration from storm runoff conveying intermittent winter flows descending from the Hebron mountains to the sea, especially in the Gaza Valley. Infiltration from storm runoff has all but dried up, and recharge through under ground flow from the east is thought to have been significantly reduced due to the drilling of wells directly to the east of the border of the Gaza Strip, within Israel. Hence, it is believed that the total recharge of the aquifer is about 55 to 70 mcm/yr.

In 1967, the aquifer was tapped by 1,200 wells in the Gaza Strip. These wells pumped about 65 mcm of groundwater a year. Now, 3,000 wells, of which only 2,100 wells are registered and licensed, tap the aquifer in the Strip and abstraction is estimated at 100-110 mcm of groundwater per year, causing a negative balance of about 40 mcm/yr. Pumping at a rate larger than replenishment leads to declining groundwater levels, reduction in well capacities, and increasing salinity, caused by seawater intrusion and upconing saline connate groundwater. In the northern part of the Strip, groundwater levels at a distance of 1-2 km from the shoreline have dropped to about one meter below sea level. If overexploitation continues, the groundwater table will continue to decline and salinity will continue to rise. A situation where damage becomes irreparable could easily be reached.

Poor water quality is one of the Gaza Strip's most serious problems. Much of the water of the coastal aquifer in Gaza Strip could be classified as saline. In 1993, three wells in Sheikh Radwan in Gaza City were closed, as chloride content of their water exceeded 1200 ppm. Salinity in the remaining wells in the vicinity is increasing and the wells will soon need to be closed. Three major sources of groundwater salinity exist in the Gaza Strip: saline groundwater flowing from the east (600-2000 ppm chloride); sea water intrusion from the west; and mixing with deeper, very saline water from beneath. Salinisation from various

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*"Poor water quality is one of the Gaza Strip's most serious problems."*

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sources is chiefly reflected by increasing chloride, fluoride, and nitrate levels. Chloride in groundwater north of Gaza ranges from 50 to 200 ppm and in the area between Gaza and Deir El Balah from 200 to 1000 ppm. Relatively fresh water of 100 ppm is encountered near the coast south of Deir El Balah, and saline groundwater with chloride ranging from 600 to 1000 ppm and more is found in the area between Gaza and Khan Yunis. As salinity increases with depth due to the stratification of the aquifer structure, boreholes in the eastern part of the Gaza Strip penetrating the deep sub aquifer have the highest salinity. Wells in the western part which penetrate the upper sub-aquifer have in many cases lower salinity. Hence, it becomes obvious that Jewish settlements in the Strip add to its water problems, not only through over pumping, but also as they appear to have been deliberately placed in areas where groundwater quality is the best.

In an attempt to enhance water resources in the Gaza Strip and improve water quality, a large pool has been constructed in the Sheikh Radwan area of Gaza City to collect storm

runoff in the winter and permit artificial recharge to the aquifer. Unfortunately, the project has not been completed yet and sewage is flowing to the pool, creating pollution and nuisance problems in the area.

### 3.3. Surface water

The only significant surface water source in the area is the Jordan River, which is about 260 km long and drains a total area of 18,300 km<sup>2</sup>. The River's largest tributaries in the north are the Dan, which rises in Israel and has an annual average flow of about 260 mcm/yr, the Hasbani (with about 160 mcm/yr, rising in Lebanon) and the Banias (also about 160 mcm/yr, rising in Syria). These rivers, which are fed with water from springs characterised by having steady discharge, feed Lake Tiberias, together with other minor streams. The Yarmouk River is another major tributary which rises in Syria and Jordan and originally fed the Lower Jordan River, to the south of the Lake, with about 475 mcm/yr. The Yarmouk is 40 km long and has a catchment area of 7,250 km<sup>2</sup> (80% of which is in Syria). Originally the outflow from Lake Tiberias to the Lower Jordan was about 540 mcm/yr. This outflow added to flows from the Yarmouk River and several seasonal wadis on both the east and west of the Jordan Valley (providing about 250 mcm/yr), to give a total Jordan Valley water supply of about 1300 mcm/yr. To provide a perspective, the 1300 mcm/yr is less than 7% of the annual flow of the Euphrates and only about 1% of that of the Nile.

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*"... annual flow of the Jordan system is less than 7% of the Euphrates and ... about 1% of the Nile"*

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The Jordan Basin includes five riparian entities: Israel, Jordan, Lebanon, Syria and the West Bank, which has about 90 km of frontage on the banks of the Lower Jordan River. Over the last 40 years, the Jordan river system has been the subject of much engineering ingenuity and heavy exploitation. The allocation of the river's water has been the subject of lengthy negotiations and agreements for decades. Israel takes about 500 mcm/yr from Lake Tiberias into its National Water Carrier, and Jordan and Syria take almost all of the Yarmouk flow. This leaves only about 250 mcm/yr to flow on to the Dead Sea in the Lower Jordan and the salinity of this water is high, due to both the presence of saline springs in the upper reaches and to irrigation returns. Palestinian access to fresh surface water resources of the Jordan Basin is thus currently approaching zero (and only comprises diverted springflow), although a West Bank riparian share of around 100 mcm/yr was estimated to have been allocated via the West Ghor Canal, whose construction was prevented by the 1967

War. A rational allocation of Jordan River water resources to the Palestinians would be at least 200 mcm/yr, taking full account of Jordan's special case (as the Jordan River Basin is Jordan's only major water resource).

### 3.4. Unconventional resources

#### 3.4.1. Rainwater harvesting

Rainwater harvesting at the household and small community level has always been and remains a major source of water for domestic purposes in rural areas of the West Bank, as well as in major cities, including Ramallah, Jerusalem, etc. People collect rainwater falling on roofs or rock catchments and store it in cisterns, to meet part of household water needs. The volume of water collected in this way is not known.

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*"Wastewater needs to be considered as a major resource of water... "*

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#### 3.4.2. Wastewater re-use

Wastewater is another non-conventional resource of water that has begun to be used by Palestinians, following 25 years of success by the Israelis. The total quantity of wastewater from domestic and industrial uses in the Gaza Strip and West Bank is roughly estimated at 40 mcm. Most of this wastewater in the West Bank is used without any kind of treatment for irrigation. In the Gaza City area, sewage from non-functioning treatment plants is discharged on to adjacent land. Treated wastewater needs to be considered as a major resource of water, particularly for agriculture and especially in the Gaza Strip. However, the lack of proper sewage collection systems in most of the Palestinian territories severely limits the potential for development of this vital resource. In addition, the lack of wastewater treatment induces serious risks to health and the environment.

#### 3.4.3. Desalination

On a world-wide scale, desalination is still considered to be one of the most expensive sources of water. Although desalination of brackish water is less expensive than that of sea water, cost continues to be a major constraint. Nevertheless, the Municipality of Deir Al-Balah in Gaza now has a pilot reverse osmosis desalination plant to potentially and



partially satisfy its needs. At the time members of the Taskforce visited the plant in mid July it was not operational.

*"Desalination is still the most expensive source of water."*

Deir Al-Balah's plant has the capacity to desalinate 45 cm of brackish water per hour. Brackish water with salinity of 1050 ppm is pumped from a well to the plant where salinity is reduced to 50 ppm. The 45 cm of water desalinated every hour is mixed with 15 cm of brackish water before it is pumped into the distribution system.

Reliable cost estimates of production were not available given that the plant was not operational. In addition desalination of brackish groundwater does not ameliorate the crisis caused by overabstraction of

groundwater, thus leading to further lowering of the groundwater table and enhancing salinisation. This environmental cost must be added to the cost of brackish water desalination, offsetting some of the cost benefits over sea water desalination.

Extensive consideration is currently being given to the question of large-scale desalination in the region, including schemes that would derive hydropower from Mediterranean Sea - Dead Sea or Red Sea - Dead Sea canals. Immense investment costs (US\$ 3-5 billion) need to be offset against potential benefits to the regional parties. In addition, there is active discussion of a possible seashore desalination plant in Gaza. While the economics of such a scheme need careful consideration, there is a clear need to implement rehabilitation and conservation measures first and there are alternative water augmentation options which are also worthy of careful evaluation.

## 4. Water resources management

### 4.1. Occupation and negotiation

Over the past 27 years, the Palestinian territories have been occupied by Israel. Under occupation, Palestinian water resources have been managed under military authority and through military orders. A set of military

*"... military orders severely restrict Palestinian use of water."*

orders was issued following the occupation of Gaza Strip and the West Bank in 1967 that severely restricted Palestinian use of water. Palestinians have had almost no access to the information needed for assessment and no control of water resources. Under occupation, the mountain aquifer system, like all other water resources, was managed in a manner that responded primarily to the needs and interests of the Jewish settlers and Israel, largely at the expense of the Palestinian population.

*"... discriminatory policies... led to inequitable apportionment of the groundwater of the mountain aquifers."*

The discriminatory policies of the occupation authority has led to inequitable apportionment of the groundwaters of the mountain aquifers. While most of the groundwater originates as rainwater falling over the West Bank (about 95%), Israel and Jewish settlers now use 80% of the total resources. Estimated groundwater potential and current utilisation of the mountain aquifer system in the three subsurface drainage basins is shown in Table A.2.

Table A.2. Current utilisation of the West Bank groundwater basin in mcm.

Groundwater Basin	Overall Capacity	Palestinian Share	Israeli Share
Northeastern	140	30	110
Western	335	25	300
Eastern	125	60	65
Total	600	125	475

Following the signing of the Cairo Agreement between the Palestinian Liberation Organisation (PLO) and Israel on 4 May 1994, civil responsibilities, including the responsibility for water, in the self-rule areas of Gaza Strip and Jericho have become that of the Palestinian National Authority. Item 31, Section a. of the Agreement reads as follows:

*"Water and Sewage (hereinafter referred to as "water") 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.'*

Palestinian self-authority is expected to start to expand over the remaining parts of the West Bank over the coming months, although the extent to which this will include water is uncertain.

## **4.2. Rights, laws and institutions**

As already discussed, the constitutional status of water in the Palestinian territories is unclear and confused, due to the legacy of Turkish, British, Jordanian and Egyptian water law and the still current Israeli military orders. The military authorities have issued various military proclamations and orders that control and severely restrict Palestinian use of water resources.

Military Proclamation 2 of 7th June 1967 stated that all water resources in the newly-occupied territories were to be state (Israel) owned. Three military orders that followed in 1967 and 1968: granted full control to an Israeli Water Officer; established a permit system for the drilling of new wells, fixing pumping quotas; and declared all settlements of water disputes invalid. While some of the substance of the orders were rational steps needed for the management of scarce water resources, controls were exerted firmly on the Palestinian population and few permits were issued, while rapid development of water resources took place to supply the needs of Israel and Jewish settlers. The Israeli water companies Mekerot and Tahal were given a very important role in planning, implementing and operating water projects in the territories under occupation, to the degree that Mekerot was drilling wells in Palestinian land to sell water to Palestinians. Most water projects in Gaza were designed and implemented by one Israeli company.

Until very recently, there has been no Palestinian institution with the responsibility for water resources management or with any powers or mandate. However, both the West Bank Water Department (WBWD) and the Gaza Agriculture Department (GAD) (the former still within the Israeli Civil Administration and the latter within the Palestinian National Authority since May 1994), are staffed with Palestinian water sector professionals who have been responsible for carrying out a range of water resource management tasks, such as hydrometric monitoring. However, these departments have been tightly controlled by the respective Israeli Water Officers and starved of resources, staff, equipment and training. Despite all the restrictions, water supply infrastructure for

municipalities and agriculture has been kept functioning, though barely adequate in terms of quantity and quality of service.

In the Gaza Strip and the West Bank, the majority of irrigation water comes from private wells, drilled before 1967. These wells are privately managed and their operation and water shares are determined according to the customs which prevail in various areas. In the West Bank, irrigation water also comes from a few springs, such as Ein el Soltan. Shares in such springs are well known and shareholders have documents that establish their rights. Such shares can be sold and the transaction is registered.

Domestic and industrial water supplies are managed either by utilities or municipal or village councils. Two major utilities exist in the West Bank, the Bethlehem-Beit Sahour-Beit Jala Water and Sewage Authority and the Jerusalem Water Undertaking, located in Ramallah. Municipalities, village councils and specialised water utilities may have their own wells (most but not all drilled before 1967) and/or receive water from Mekerot. In the Gaza Strip, UNRWA operates eight wells and supplies 20% of the refugees in the camps with water. The remaining refugees in camps in the Gaza Strip and the West Bank are served by the institutions which supply water in their areas. Domestic water is also supplied by individual owners to users in many places throughout the Gaza Strip and the West Bank, especially in rural areas. Besides rainwater harvested at the household level, water from such private suppliers which is delivered by tanks to customers constitutes the chief source of domestic water supply, especially in areas where public water is insufficient. Hebron is a good example as it receives only about 10% of the water it needs from public sources. Throughout the Gaza Strip and the West Bank, water from non-public sources does not undergo any treatment or purification processes, while domestic water from public sources is treated by chlorination.

From visits to various type of public suppliers of domestic water, the following common problems among the institutions were recognised: (a) inadequacy of available water supplies to meet

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*"... huge unaccounted-for (water) losses in distribution networks."*

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domestic water requirements, especially during the summer, (b) the absence of a rational basis for water pricing, although water revenues generally subsidise other municipal services, and (c) huge unaccounted-for losses in distribution networks. In the Gaza Strip, raw water quality is another problem that is faced by all suppliers. These issues need to be urgently addressed.

### 4.3. Institutional framework within the Palestinian National Authority

Under Israeli occupation Palestinian institutions, as revealed in the previous sections, are only responsible for delivery of water and wastewater services. Weak institutional structures and deteriorating infrastructure have resulted in poor services. The absence of, and need for effective management of water resources is a major problem facing the sector. This problem was recognised, assessed and alternative structures considered by a workshop held at Birzeit University between 21 and 24 April 1994.

In this workshop a set of principles were recommended and adopted in establishing an institutional framework for water management and service delivery (Workshop report, April 1994, p. 2). On the basis of these principles the workshop participants developed and recommended a future institutional framework and detailed functions. The proposed framework consisted of a Palestine Water Authority (PWA), a National Bulk Water Utility (NBWU), a set of Regional Water Utilities (RWUs), and a Central Support Service Company (CSSC). "The... PWA would have as its objective the management and efficient allocation of **all water**, to achieve social, economic and environmental goals." The "...NBWU is an executive and autonomous body whose objective would be the provision of large-scale, "wholesale" **all water** services." The objectives of the RWUs "...would be to deliver "retail" **all water** services to the customer." The CSSC objective "...would be to provide support to the RWUs in areas which can be more efficiently provided by a central organisation". (Workshop Report, April 1994, p.4). A number of actions were recommended by the workshop, first of which was the adoption of the institutional framework followed by a set of action necessary for implementation of the framework.

One of the major conclusions of the workshop was to institutionally separate responsibility of functions according to regulatory and to service activities. The rationale for this was that it is not possible to regulate resources effectively if you are also the resource developer.

### 4.4. Regional water scarcity and joint management

The Middle East is a region that is characterised by its limited water resources. All too often, this leads to over-exploitation of renewable water resources beyond safe yield limits, resulting in increasing costs of

abstraction, deteriorating water quality, and eventual loss of the source. Region-wide, the need to deal with water as a scarce and precious resource is increasingly a point of consensus.

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*"Region-wide, the need to deal with water as a scarce and precious resource is... a point of consensus."*

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Water problems in Israel, Jordan and the Palestinian territories are a consequence, first, of overall water scarcity, as well of mis-allocation and mis-management of water resources. In other countries of the region, such as Lebanon, Syria and Egypt, although the surplus in the overall water budget may be high, water shortages occur due to spatial and temporal variations in supply. In relative terms, Turkey is a water-rich country, and it could solve all the region's water shortages.

The military occupation of the Gaza Strip and the West Bank accounts for much -but not all- the reasons for the insufficiency of water resources in those territories. First, there is the inequitable apportionment of water between the Israelis and the Palestinians. At present, 80% of the water originating in the West Bank is exploited by the Israelis, either in the settlements or in Israel itself. In addition, Israel is using a disproportionate amount of the Jordan River's water. Second there is the growing 'infrastructure gap', caused by minimal investment and reinvestment in water and sewerage services. This leads to poor reliability, high physical losses in pipe networks, and the prevalence of untreated sewage in the urban environment.

Per capita consumption of domestic water is very low in Gaza Strip and the West Bank. At present, public sources provide some two million Palestinians in these areas with only 60 mcm of water to meet their annual domestic water requirements. Given that average distribution network losses is estimated at about 40%, per capita consumption of domestic water from public sources in Gaza Strip and the West Bank is estimated at as little as 41 litres per day. Assuring adequate water

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*"... the future of water resources management in the region must lie in joint management..."*

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supplies for current residents and for those returning to Palestine is an important task for the newly-established Palestinian National Authority.

Assuming Palestinians reach a settlement with the Israelis which recognises an equitable Palestinian share of the region's water

resources, the Palestinian community will have access to greater amounts of fresh water. A recent study by the Centre for Engineering and Planning (CEP) in Ramallah estimates that agricultural water demand in the Gaza Strip and West Bank will reach about 600 mcm per annum by the year 2000. The argument was made by CEP that this would leave over 400 mcm per annum of fresh water that can be allocated for domestic, industrial, recreational and other uses. Meanwhile, per capita domestic consumption is expected to rise from the current levels (of around 50 litres per capita per day) to about 160 litres per capita per day. At this rate of per capita domestic consumption, the quantity of water left for non-agricultural purposes could support a Palestinian population of about 6 million people.

Ultimately, the future of water resources management in the region must lie in joint management of a large proportion of the total resource. Achieving equitable and efficient allocation and effective joint management would benefit all the peoples of the region.

#### 4.5. Data availability and limitation

Sound water resources planning, management and protection are impossible without good data. Reliable data are required for assessing available water resources and then for developing strategies for meeting current and future demands.

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*"Sound water resources planning ... impossible without good data."*

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Data is also required for monitoring the impact of human activities, drought and climate change on water resources. In addition to needing data for resource management and economic development objectives, the Palestinian leadership needs water resources data to inform its negotiations in the current and future peace and regional co-operation talks. Until the implementation of the Cairo Accord earlier in 1994, the Palestinian community at large has had no access to raw water resources data, which appear to have been regarded as a military secret by the Israeli military authorities. Analysed data has, however, been available to a limited extent through the annual yearbooks of the Israeli Hydrological Service (IHS).

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*"... raw water resources data... regarded as a military secret."*

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Before 1967, the Department of Municipal and Rural Affairs in Gaza was responsible for domestic water supply and wells in the Strip. The 1934 Water Law was never enforced and there was no regular system of hydrometric data collection and archiving in Gaza. However, some data relating to that era is available from a number of one-off studies (e.g. Blake and Goldschmidt, 1947; and Shata and Salim 1965). In 1967, the responsibility for collecting hydrometric data in the Gaza Strip shifted to the Gaza Agriculture Department (GAD) of the Civil Administration. In 1969, the GAD carried out a detailed survey of the existing wells. In 1970, GAD embarked on monitoring wells in the Gaza Strip on a regular basis, since which time it has been measuring water levels in about 120 wells on a monthly basis. In addition, the Department has been collecting water samples from domestic and agricultural water wells for chemical analysis. The GAD laboratories generally undertake the analysis, reporting the results to the Health Department in the Gaza Civil Administration.

GAD also maintains lithological logs for some water wells in the Strip, together with abstraction and license information for all licensed/registered wells in the Strip. By military order, GAD was required to provide all data it collects to the Israeli Hydrological Service (IHS), although it has kept copies. Collection and dissemination of meteorological data in the Gaza Strip has been the responsibility of the Department of Transportation. Maps for the water distribution networks do not exist.

Until 1967, a branch of the Jordanian Water Authority located in Jerusalem was responsible for monitoring wells, streams and springs in the West Bank. Pre-1967 hydrological data for the West Bank is currently held by the Jordanian Ministry of Water and Irrigation. In addition, some hydrometric data for the West Bank can be found in the archives of consulting companies, such as the British consultancy Rofe, Kennard and Lapworth.

After the occupation of the West Bank by Israel in 1967, the Jerusalem branch of the Jordanian Water Authority was seized by the occupation authority and attached to the West Bank Civil Administration as the West Bank Water Department. The WBWD measures water levels in wells, reads meters and collects samples from wells, springs and streams for complete chemical analysis on a bimonthly basis. In addition, it measures flows in main wadis and receives meteorological reports from about 50 stations in the West Bank on a regular basis. Unlike the GAD, the WBWD is not in possession of any laboratory facilities. Therefore, water samples collected by the WBWD are sent to Israeli laboratories for chemical analysis. Like the GAD, all data collected by the WBWD on stream and spring flows, groundwater levels, water abstraction

and type of use, and water quality has had to be forwarded to the IHS for processing and archiving. WBWD has not been allowed to keep copies of the data it has collected.

Both the GAD and the WBWD have no access to IHS's computerised databases or to the processed records of the data they collect. Furthermore, the two Departments are not allowed to provide data to any party without the permission of the Water Officer of the Civil Administration in their respective areas. There are no known cases in which such permission has been granted in the past by Water Officers, either in the West Bank or in the Gaza Strip.

In recent years, two Palestinian non-governmental organisations (NGOs) have developed significant water resources capacity and have initiated some hydrometric data collection and databasing activities. The Palestinian Hydrology Group (PHG) has been engaged in data collection since its establishment in 1987. The Applied Research Institute-Jerusalem (ARIJ) is currently undertaking a survey of agricultural wells and springs in the West Bank, as part of an agricultural research project. The PHG has just started a pilot hydrometric monitoring and databasing project at the Zeimar catchment.

In addition to GAD, WBWD and NGOs, Palestinian water utilities and municipal water departments collect and keep records of hydrometric data in relation to their operational needs. UNRWA, which is responsible for providing essential services such as water supply, in refugee camps, also collects hydrometric data and tests water quality in their wells, to assure the suitability of water for drinking purposes. Nevertheless, the bulk of hydrological data on the Gaza Strip and West

Bank continue to be collected by GAD and WBWD and is held by IHS.

While hydrometric data on the Gaza Strip has now become accessible directly from GAD following the transfer of responsibility of civil affairs from the Israelis to the Palestinian National Authority in May 1994, hydrological data on the West Bank is still only available from the IHS, at least for the time being. GAD is now pursuing its activities in the Gaza Strip as they were before the transfer of the civil responsibilities from the Israelis to the Palestinian Authority. However, GAD has become a Palestinian governmental institution and, accordingly, no longer has to provide IHS with the data it collects. The situation in Jericho is different. Until 4 May 1994, WBWD was responsible for the collection of hydrometric data in the Jericho area. As of that date, WBWD lost its authority over the self-rule area of Jericho. A Water Office has been set up in the Jericho area to pursue hydrometric monitoring in the area.

The hydrometric data collection programme in the Gaza Strip and the West Bank is believed to be needing major rehabilitation and updating. Many of the measurements that are needed are not carried out and the programme does not cover the West Bank adequately. In addition, the Palestinian authority needs to establish a modern data archive, which facilitate the manipulation and modelling of water resources data, which will be a cornerstone of economic planning and management in the years to come.

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*"... need... modern (water) data  
archive... cornerstone of  
economic planning."*

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# 5. Demand and supply: some economic perspectives

## 5.1. Water scarcity and the national economy

The preceding sections make clear that natural, institutional and political constraints mean that water in Palestine is a scarce and valuable resource. Even if Israeli-imposed constraints are removed and water rights are resolved with a substantial increase in the share allocated to Palestinians from the common aquifers, water would continue to be a scarce resource, potentially constraining the national economy. In this sense, scarcity refers to absolute physical limits of resource stocks. This is important, given future population projections, combined with the expansion of and development of the Palestinian economy, which is expected to grow rapidly

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*"... Water will continue to be a scarce resource ... constraining the national economy."*

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once the constraints of occupation are removed and international and local capital are invested. However, physical scarcity is not the only kind of water resources constraint facing the national economy. Water is also economically scarce. In this sense, water is scarce in terms of its increasing marginal cost of provision, that is the extra cost of supplying an additional unit of water is greater than the benefit, and therefore the willingness of society to pay the extra cost.

Given that scarcity is both physical and economic, and existing limited supplies are already fully exploited (mainly by the important but water dominated irrigation sector), how is growing water demand to be met, in the short run and in the long run? The central economic question here is to what extent will water scarcity today, and increasing water scarcity in the future, be a constraint on economic growth, with the trends towards industrialisation, urbanisation, population growth and increasing demand for services?

At present the role of water resources in the national economy is obscured. This does not only derive from the issues of water property rights, Israeli-enforced restrictions, out-dated and muddled water legislation, and an acute lack of reliable information. The failure to recognise and treat water as a scarce and

valuable economic resource, and the tendency to blame Israeli occupation practices for scarcity, has added to the lack of comprehension of the role of water in the national economy. In addition there is an absence of comprehensive understanding of the linkages which major water using sectors (irrigated agriculture) have with the rest of the economy. Although the major productive sector of the Palestinian economy is agriculture, and irrigated agriculture in particular, it is not clear how and to what extent developments in this sector (fall or rise in income) related to water (costs and pricing policy) will affect other sectors of the economy.

## 5.2. Supply: sources and costs

Current conditions in the water sector vary between regions of Palestine and between sectors of the economy. The overall situation in the Palestinian water economy is characterised by conditions of excess demand. In Gaza, the major constraint on the available supply of water is physical: the natural rate of recharge. In the West Bank, the available supply of water is determined by limits set and strictly enforced by military occupiers. In addition to the physical constraints set by nature in Gaza, and by the Israeli authorities in the West Bank, supply is further constrained by economic scarcity.

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*"... massive under-pricing in agriculture ..."*

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Poor maintenance and operation practices, deteriorating extraction and distribution networks, poor cost recovery performance, a wide range of tariffs, with massive under-pricing in agriculture, over-pricing in the West Bank domestic sector and under-pricing in the Gaza domestic sector have all given inappropriate signals regarding allocation and conservation of water.

The source of water supply in the Gaza region is the coastal aquifer, in some areas of which water can be found a few meters below the surface. This makes it relatively inexpensive to drill and pump water to the surface. Of the nearly 3,000 wells thought to exist, an estimated 500 to 700 have been drilled illegally, and are drawing unknown amounts of

*Table A.3 Total Cultivated Land in The Gaza Strip and West Bank by Irrigated and Non-Irrigated Area, and by Quantity of Water Supplied 1991/1992.*

	Rainfed Area (000s Dunums)	Irrigated Area (000s Dunums)	Quantity of Water Supplied (mcm)
West Bank	1,500	100-110	95-100
Gaza Strip	80	120*	90-95
Total	1,580	220-230	185-195

Source: Gaza Water Department, 1994 and World Bank 1993, and various issues of Israel, Central Bureau of Statistics, Statistical Abstract of Israel.

\* This reflects more intensive use of land in Gaza than in the West Bank.

water. Massive overexploitation of the aquifer results in one of the most important costs not accounted for in the prevailing water tariffs in Gaza. This is a cost that will be paid for by future generations, if the situation is not stopped and reversed before the coastal aquifer is destroyed.

*"A cost that will be paid by future generations if ... the coastal aquifer is destroyed."*

The bulk of Gaza water supply is allocated to irrigation (see Table A.3 above). It is estimated (by the Gaza Agricultural Department) that in 1992 over 92 mcm were allocated to irrigate 120 thousand dunums (1 dunum = 0.24 acre). Of this, about 57 thousand dunums were low value citrus crops, irrigated with over 51 mcm of water. Total income of the citrus crop was estimated at around NIS 55 million (US\$ 18 million) or 14.6 percent of total agricultural income. In other words, one crop is allocated over 55 percent of irrigation water and contributes only 14 percent to total agricultural income. This is an explicit example of misallocation of water.

*"... misallocation, where 25% of water is allocated to crop producing 7- 9% of total output."*

The source of water supply in the West Bank is the groundwaters of the mountain aquifer system, whose inequitable apportionment between Palestinians and Israelis is discussed elsewhere. As in the case of Gaza, the bulk of West Bank water is allocated to irrigation. Between 80 and 100 mcm/yr are allocated to the irrigation of around 100 thousand dunums. Around 25 thousand dunums are citrus, irrigated with around 25 mcm/yr. Estimates of

the value of output of the citrus in 1989 (a poor olive crop year) was equal to around nine percent of total value of agricultural output, and in 1990 (a good olive crop year) it was seven percent. Again we find misallocation, where 25 percent of water is allocated to a crop producing seven to nine percent of total output. This is confirmed by the recent World Bank report which found that, "Water costs as a percentage of gross value of production is highest for citrus (43 percent, using 1600 m<sup>3</sup> per dunum)..." (World Bank, Vol. 4, p.55, 1993).

Costs of supplying irrigation water vary between Gaza and the West Bank. In the West Bank the average cost of supplying a cubic meter of water, according to the World Bank, in 1990 was around US\$ 0.16 and in Gaza around US\$ 0.10. The difference reflects the lower pumping cost in Gaza. The main reason for the low cost is related to farming on land with a very high groundwater table, or water exploited through private wells, or using springs in the West Bank. The significance of these low costs becomes more pronounced when compared to the subsidised cost of water to Israeli farmers, which was estimated at US\$ 0.14 per cubic meter. The implication here is that present costs in the Palestinian territories do not reflect the true value of water.

Costs could further be reduced if major rehabilitation is permitted. Well owners in both the West Bank and Gaza were historically denied permits to carry out rehabilitation. As a result, the condition of most operating wells is poor; with pumps and well casings not refurbished for 30 years, using inefficient engines to power pumps and distribution systems with at least 20% losses (World Bank, 1993). However, with Gaza now free of Israeli restrictions, the potential for improvement exists, although a service industry and appropriate incentives and financing are still lacking.

The costs of supply to the domestic sector vary widely from region to region, and within regions. The greatest variation exists between Gaza and West Bank municipal suppliers. Low pumping costs in Gaza, and low elevations from source to point of use imply much lower costs than West Bank municipalities, who have much higher pumping costs as well as elevations from source to point of use. For example the Rafah municipality has four wells and sells the first 20 cubic meters/month to its customers for NIS 12 (US\$ 4.00) or NIS 0.6/cm (US\$ 0.33/cm). Whereas the municipality of Nablus, which owns two wells, estimates the cost of supply of one cubic meter of water at NIS 2.1 (US\$ 0.69), and sells the first five cubic meters per month at an average of NIS 2.4 (US\$ 0.79) with ascending rates for the next 6-10 cm/month, rising to NIS 3.4/m<sup>3</sup> (US\$ 1.12/m<sup>3</sup>).

Although costs to the irrigation sector have been roughly estimated in the West Bank and the Gaza Strip (see above), no concrete cost estimates are available. Present water rights in the irrigation sector are based on pre-1967 legislation and practices which have been modified by Israeli Military Orders. At present a land owner who owns rights to withdraw given amounts is only liable to the production costs and to a yearly fee (of around US\$ 15-30) for this water. The amount of water abstraction from this wells varies from between 180,000 to 500,000 mcm/year. In some cases it was reported that only a fraction of this amount of water is utilised by farmers. The absence of reliable information on this subject is one of the problems identified in the water sector and needs urgent resolution. From the scanty information available, the response from water rights owners, and from suppliers indicates support for the development of water markets in both the West Bank and Gaza Strip.

Despite the current and dangerous levels of overabstraction of water in Gaza, there are no effective dis-incentives or incentives to limit the rate of water consumption. In addition to excess water extraction in Gaza, there are problems of misallocation and loss of valuable water. In the West Bank, where the problem is not overabstraction but limits on available supply, the problems of misallocation and wastage are acute. The absence of economic signals, in the form of appropriate tariffs, contributes significantly to misallocation and waste of water resources, and thus does not provide an incentive for conservation and efficient water use within and between sectors.

*"Despite overabstraction ... no incentive to limit ... water consumption."*

In both Gaza and the West Bank, water tariffs range widely between and within sectors, and fail to reflect the real cost of supply. This is reflected by the average price of irrigation and domestic water in the territories. Furthermore, the structures of water tariffs are generally inadequate and do not take advantage of the elasticity of demand in both the domestic and irrigation sectors. In the West Bank, municipal tariffs more or less reflect the high, but inefficient cost of supply; in contrast agricultural tariffs are close to zero. The wide regional variation in costs of domestic supply are relatively well reflected in municipal tariffs. West Bank tariffs on domestic consumption are very high compared to West Bank and Gaza tariffs on irrigation water, and also compared to tariffs on domestic consumption in Gaza.

### 5.3. Demand: allocation, pricing and elasticity

It is clear that present water supply does not satisfy the prevailing demand in both agriculture and domestic use. Industrial demand for water is very low at present (two percent of total consumption in the West Bank and a similar rate in Gaza). In agriculture present demand (and supply) per dunum of irrigated land is equivalent to Israeli levels. In both the West Bank and Gaza the average quantity of water utilised per dunum is around 600 cm/yr. However, total potential demand is much greater. In the West Bank it is estimated that another 500 thousand dunums can be irrigated, if water were available. In Gaza a further 80 to 100 thousand dunums can be irrigated. This implies that potential demand in West Bank agriculture could rise by 300 mcm/yr, and in Gaza by 60 mcm/yr.

*Table A.4. Domestic (and Industrial) Piped Water Supply by District, and by Type of Settlement in the Gaza Strip and West Bank 1992/1993 (in million of cubic meters).*

Location	Urban	Semi Urban	Rural	Ref-ugee Camp	TOT mcm /yr
Jerusalem	2.7	0.8	0.8	0.2	4.6
Nablus	4.0	0.2	1.2	0.6	5.9
Hebron	2.4	0.5	1.3	0.2	4.4
Ramallah	1.4	0.3	1.4	0.2	3.3
Tulkarem	2.0	0.3	0.7	0.2	3.2
Jenin	1.0	0.3	0.4	0.1	1.8
Bethlehem	1.1	0.3	0.6	0.1	2.2
Jericho	0.2	---	0.2	0.1	0.4
TOTAL for West Bank	14.5	2.7	6.6	1.6	25.5
Gaza Strip	11.5	5.7	2.5	1.5	21.0
TOTAL	26.0	8.4	9.1	3.1	46.5

*Source: Haddad, M., 1992, and UNRWA, 1993.*

In the domestic sector the situation is different (Table A.4). Average daily consumption of water in the West Bank and Gaza is below 50 litres per person per day, whereas in Israel it is 250-300 litres per person per day. While low current income levels constrain increasing levels of domestic consumption, despite the low prices of water in Gaza, income levels will rise in the near future as a consequence of the peace process. Effective demand for water will increase to provide per capita consumption levels approaching those of Israel, placing enormous pressure on resources. In the West Bank, the limiting factor on domestic consumption is less income, than military restrictions and physical limits on water supply. In some regions consumers are willing to pay up to US\$ 1.5/cm, but still cannot get the water they demand at the time they demand it. Water during peak demand is cut off, due to the inability of the system to produce the



required supply, and to the limits on pumping set by the Israeli authorities.

In the West Bank, prices have risen substantially over the years, this has reduced excess demand but not eliminated it, reflecting the inelasticity of domestic demand. The high prices in the West Bank have prompted conservation habits of water use among households, thus reducing demand, but population growth and income growth - as was the case during the 1970s and 1980s due to high employment rates in Israel - lead to increasing demand. For example in the village of Kufer-Ain, when over 60 percent of the village labour force was employed in Israel, the villagers were able to contribute to the extension of piped water to the village (the

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*"... high (water) prices in WB ... prompted conservation habits ... among the households."*

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major share was funded by PLO steadfastness funds), and then were able to pay their water bills. However, after access to jobs in Israel were curtailed, the village was unable to pay its water bill and the utility cut off water supply for days at a time, only supplying limited amounts to the village to avoid accusations of cruel and inhumane treatment. Prior to the loss of jobs, an international NGOs offered to contribute the material cost for building cisterns for rainwater harvesting. There were only 17 households out of a total of around 145 willing to take up the offer. After the loss of jobs and income from Israel, the majority of households wanted to take up the offer.

The price elasticity of demand for water varies across sectors. As shown above, domestic demand continued to grow in the West Bank despite price rises, indicating an inelastic demand for water. In industry, technical developments will allow the use of substitutes for fresh water in the form of saline water and also treated waste water. Elasticity of demand in industry is expected to be inelastic as well. In agriculture, on the other hand, price elasticity of demand is expected to be high. Thus a given percentage rise in the price of water will lead to a greater percentage fall in the demand for water in agriculture. Increasing the price of water supplied to agriculture by legislation, or providing a market for water to encourage owners of wells to sell water to municipalities, would reduce excess demand in agriculture, and lead to increased efficiency in water use and to a fall in the irrigation of low value crops. In the first case it would make cultivation of certain crops unprofitable and lead to new cropping patterns which would benefit the economy. In the second case, the opportunity cost of applying water to cultivation, as opposed to selling it, would induce owners of water rights to re-allocate their water to domestic and industrial use.

## 5.4. Water quantity and quality deterioration

The main factor contributing to overabstraction and therefore increased economic scarcity is the wide range of tariffs which provide inappropriate signals for allocation and conservation. In most cases the price of water does not reflect the cost of supply, and is below the value of water attached to it by the user (domestic and irrigation). In Gaza the price does not reflect the environmental cost of overabstraction, or the cost of damage to or loss of the aquifer. The major problem identified with overabstraction is the prevalence in the view that scarcity is only physical and not economic scarcity. Thus there is no incentive

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*"... tariffs which provide inappropriate signals for allocation and conservation."*

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(appropriate tariff and tariff structures) or disincentives for the property right owners of the resource to change their supply behaviour. The same applies to the consumers of water, particularly in Gaza, and in West Bank agriculture.

Deficient financial capacity, poor and deteriorating water networks, combined with improper pricing policy, and the absence of demand management, all contributed to the overexploitation of the Gaza water aquifer. This in turn has produced the pressing problem of continuous deterioration of water quality in Gaza, due to saline intrusion. The initial impact of this was felt in the agricultural sector, specifically in citrus. Today many orchards lie abandoned, because the water salinity is too high for the crop. Today it is uncertain whether Gaza citrus production can utilise the full capacity of a newly constructed orange juice production plant.

Gaza municipal water supplies are facing continuous deterioration. Gaza municipal water engineers revealed that, during recent years, three wells had to be shut down because the salinity level of water increased by 1,000 mg/l from 200 to 1,200 mg/l while the water level remained constant. One of the major concerns this raises is that current practice may lead (or may have already led) to irreversible damage to the aquifer, and therefore the loss of a major water resource. Economic constraints on augmenting supply have been minimal, given the technical ease and low elevations from which water is pumped and conveyed. Other factors contributing to the deterioration of Gaza water, include the uncontrolled, mismanaged and inappropriate costing of sewage disposal, and of agricultural waste

(infiltration of herbicides and pesticides into the aquifer).

## 5.5. Water investment and sources of capital

During the period of Israeli occupation the major source of capital for investment in the water sector was from the Israeli military government through their development budget (as opposed to the regular budget, which mainly comprised recurrent cost of education and health services). The development budget has historically been insignificant, and during the Intifada years was practically zero.

In 1987 total military government and local authorities capital formation was less than six percent of GDP, and a little over four percent of GNP. A primary economic objective of Israel has clearly been to minimise the cost of occupation and to maximise the benefits. Over the years a host of policies, laws and

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*"The development budget has historically been insignificant, and during the Intifada years was practically zero."*

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regulations were formulated and imposed on the occupied Palestinian territories that have more or less achieved this objective. One of the most prominent and harmful economic policies of the Israeli occupiers has been a tight fiscal policy. By minimising spending and maximising revenue collection (income tax, VAT, and customs duties), the Israeli government between 1967 and 1986 had accumulated a surplus, from the West Bank alone, of around US\$ 700 million (Benvenisti, 1986). In Gaza net transfers to Israel since the late 1970's and until recently have been positive.

However, if other parties desired to invest in infrastructure, and as long as it did not threaten security, the Israelis allowed it, even if the source was the PLO. During the late 1970s and early 1980s a joint Palestinian-Jordanian committee was set up to channel funds to the occupied territories for the purpose of steadfastness. Part of these funds were allocated to extension of water networks in municipalities and villages. One of the major problems this financing has caused has been the attitude towards and treatment of these funds by officials and recipients. The funds were gifts, with no repayment necessary, and normal and efficient economic practice was not used to assess the rate of return necessary for capital recovery on the invested capital. Consequently, when it came time to refurbish or replace the machinery and equipment, there were no funds to do so. The only thing to do

was to patch up an inefficient system whenever funds were available.

Over the past five years, another substantial source of investment has been from donor countries. These donations have either been directly given to recipients for specific water projects, or through other agencies. Significant among these are UNDP support to water projects in over 25 villages during the past six years and German and Italian support to the Bethlehem area water and sewerage project.

## 5.6. Current sources of revenue

The only other source of capital for investment in water is revenues from municipality-run services. Ironically, when municipalities took on the function of a water utility, they often did so with the aim of financing other activities from the profits to be made from provision of these services. In most cases, when employment in Israel was steady and personal income growth prevailed, these services did provide a source of revenue for the municipalities, which was used to subsidise the loss-making sectors of municipal services. However, when income fell after 1987, the ability to pay deteriorated, and so did revenue collection. Systems deteriorated, losses through leakage and illegal connections compounded the burden on the municipalities, and soon many found that water services could be a loss-making venture.

Among the municipalities providing water services, there are no clear cut economic or financial policies. The accounting system does not correspond to the economic and financial needs of the services provided. There is an attitude of trying to make ends meet on a day-to-day basis. Financial profitability analysis at market prices is absent, as is economic profitability analysis at shadow prices. There is a lack of knowledge of the impact of projects and pricing policy on income distribution, on savings, and on social equity. However, in the case of utilities the situation seems to be different. There appears to be appropriate cost accounting, which takes into account the required rate of capital recovery when pricing for full cost recovery.

In recent years an additional problem related to cost recovery has arisen, due to deteriorating employment conditions, utilities have found it increasingly difficult to collect due bills. Given the political situation, they have been constrained from enforcing sanctions (fines, disconnection) against individuals or institutions for non-payment.

## 5.7. Demand management and economic development

Historical data reveals that the focus of water policy in most countries has been and continues to be on supply and supply augmentation of the resource. Demand side policy and management of water have, until recently, been more or less ignored. In the West Bank and Gaza Strip both supply and demand aspects have been distorted and mismanaged. The natural and enforced limits on supply augmentation of water, coupled with inefficient allocation, have been and will continue to be constraints on economic development. Demand management is likely to be the only effective strategy to cope with water scarcity over the longer term.

In Gaza, given the current rate of overabstraction and the imminent destruction

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*"Demand management is ... only effective strategy to cope with water scarcity..."*

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of the only water source if the present situation continues, and in the West Bank, given that access to significantly greater quantities is not foreseeable in the short run, water supply and demand conditions must be evaluated and policy formulated to minimise the constraint on economic development and to maximise the benefits from available water resources. In this particular case, an overall economic strategy and a strategy for water resources management are inextricably linked and both need to be

urgently addressed. Given the current and foreseeable water situation, a water-dependent economic development strategy is to be avoided. The formulation and identification of a non-water dependent economic development strategy needs to be pursued.

The major difficulty facing economically and socially efficient water resources development lies in the conflicting perceptions of how this resource should be and is treated. To arrive at an appropriate strategy, water must be viewed as an economic resource. The value of water must therefore be reflected in costs to suppliers, and in prices to end users. At the same time, policy makers and the public must become aware of their role in conserving and protecting scarce and valuable water resources.

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*"... water must be viewed as an economic resource."*

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In recent years alternative supply augmentation proposals have threatened and may yet undermine the acceptance and implementation of economically and socially efficient water resources development. Among these proposals are transport by canal of the Nile waters, importing of water from Turkey, and the most cited among these options has been desalination. As noted in section 3.4.3 desalination is the most expensive source of water. Recent estimates of the costs of desalinated water at point of source vary between US\$ 0.80 and US\$ 1.40. Although this might seem to be competitive with prevailing tariffs in some areas (Ramallah) it does not include the cost of conveyance, but more significantly it does not reflect the opportunity cost of desalination projects. These costs are very high.

## 6. Water use and society

### 6.1. Water Use Patterns

Obtaining accurate statistics on water use and consumption patterns has been very difficult, due in part to Israeli military restrictions on releasing information held by the West Bank Water Department, and in part due to the lack of structured surveys. As a consequence, different sources give substantially different figures for the quantities of water consumed in

the domestic, agricultural and industrial sectors. It is, however, obvious that domestic water consumption in the Gaza Strip and West Bank will have increased due to population growth - especially in the Gaza Strip whose population has already more than doubled within the last 27 years (see Fig. A.2 above). An overall picture of water consumption in the West Bank and the Gaza Strip is illustrated in Table A.5.

*"... about 200 villages are still without piped water..."*

Table A.5. Water use in the West Bank and the Gaza Strip by sector, [World Bank, 1993].

Demand Sector	Consumption (mcm/yr)	
	West Bank	Gaza Strip
Domestic, Industrial	30 - 38	20 - 35
Agriculture	80 - 100	55 - 80
TOTAL	110 - 183	75 - 115

Water supply coverage is wide, although it is estimated that about 200 villages, primarily in the West Bank, are still without piped water; in the Gaza Strip most villages and camps are served with piped water supply for domestic and industrial use. Unserved villages depend on household rainwater cisterns and communal sources such as wells, springs or canals. Where communal sources are used, water is transported to the home in jerrycans, sometimes loaded onto donkeys. Getting water from the source to the home is generally regarded to be women's work. In a few rural settlements (such as Barta'ah, and Nisf Jubail in Nablus district, and Burqah in Ramallah district), piped networks have been constructed through local community participation efforts.

## 6.2. Wastewater and Pollution: responsibilities and practices

The collection of wastewater in the Gaza Strip and West Bank is the formal responsibility of municipal and village councils or other local representative institutions. Most municipalities have unsatisfactory wastewater collection systems. In the West Bank, 40% to 50% of the urban areas and almost all of the rural areas lack water-borne sewerage collection systems. In these areas, the population relies mainly on septic tanks, that are usually designed to serve a single house or small group of houses. A major problem of septic tanks is the risk of groundwater pollution, particularly in the

*"... 50- 60% of urban sewage is discharged into wadis without treatment... the health risks are considerable."*

karstic aquifers of the West Bank. Even where sewerage systems exist, sewage is generally discharged untreated into open channels or wadis, often adjacent to residential areas. It is estimated that 50% to 60% of urban sewage is discharged into wadis without any treatment; it

is then frequently used to irrigate market gardens. The health risks are considerable.

In Gaza Strip, in particular, wastewater collection and treatment has received very little attention to date. Sewerage systems exist only in Gaza City, where the network covers approximately 65% of the population, and in Jabalia, Nazla, and Beit Lahia, with a small proportion of the population in Rafah also connected. Other settlements have septic tanks and rely on vacuum tankers for disposal. These tankers are mostly operated by the municipalities, with private sector trucks serving some independent private housing projects. Within these communities there are no drains (unlike in the refugee camps), with sullage creating offensive living conditions, which are exacerbated by solid waste and winter storm periods.

In refugee camps, which contain 65% of the Gaza population, sewerage systems only cover Jabalia camp, one third of Beach Camp and 20% of Rafah Camp. In other camps, houses are typically served by unsealed vaults, which are emptied by vacuum tankers. The average cost of tank emptying is NIS 25 per eight m<sup>3</sup> of waste, which puts a financial burden on the residents, particularly as the vaults are small and need to be emptied regularly. Vaults are also often hard to find. This provides an incentive for residents to discharge sullage water in the streets, an activity which becomes acceptable within the community, as people think that they have no other alternative. A similar practice is also found in Khan Yunis town. Open drains exist within some camps, predominantly for the conveyance of storm water run-off, but even in the dry season these carry wastewater.

Wastewater collection systems are increasingly being identified as a priority need in most towns, villages and camps in the Gaza Strip, and for many communities in the West Bank. There are good environmental and health reasons for this investment as untreated wastewater not only pollutes surface water and groundwater, it also jeopardises treated piped water supplies, whose often old pipelines go near the open drains and vaults.

*"... efforts to change peoples belief will fail if ... not linked to ... social and economic development."*

There are many traditional practices regarding wastewater and pollution, practised over many years in towns and villages, such as:

- Rainwater cisterns (which were and still are the main source of drinking water for many villages) are located some distance

away from the septic tank and on higher ground if possible, to avoid pollution.

- Pigeons are not reared, as it is thought that they will contaminate rainwater catchment surfaces, leading to the water pollution.
- The first flush of rainwater after a dry spell is not collected, in order to avoid the washing of accumulated dirt from the catchment into the cistern; various kinds of cloth and fibre filters are often used to strain solids from the collected water.
- The bucket which is used for water abstraction is often stored on a hook under the cistern trapdoor, to keep it conveniently located but away from the risk of contamination.

Religious beliefs often require that water should be kept clean and should be used to keep the person and the home clean. For instance, Muslims wash with water 5 times daily before prayer. This water must be kept pure; if it is polluted by wastewater, it becomes impure and washing with it makes their prayer unacceptable. However, social stresses caused by, for example, poverty or the trauma of occupation, can result in people accepting practices which contradict their cultural, traditional and religious beliefs. Because of this, any efforts to change people's beliefs and practices will fail if they are not linked to overall social and economic development. Very little is known about this subject and thorough investigation is needed to understand social and cultural practices and values related to water and wastewater.

### 6.3. Perceptions of water scarcity and value

As with water quality and pollution, there is a general lack of understanding and concern

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*"... there is a general lack of ...concern about the value and scarcity of water."*

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about the value and scarcity of water, especially in the communities that are served with piped supply systems, even when volumes delivered are small or intermittent supply common. People perceive these problems to be a result of not paying for their water supply in Gaza Strip, and to the Israeli restrictions in the West Bank. There are specific practices that suggest limited perception of water scarcity and value, such as illegal connections and the general misuse of water in both the agricultural and domestic sector.

Communities not served with piped water, where they still depend on rain-fed cisterns and communal springs, are much more aware of water scarcity and value. They manage water very carefully and it is perceived as having considerable value. Although community participation in water management and supply is not a common practice in the Gaza Strip and West Bank, where experience has been gained, it demonstrates that participation is a powerful tool for improving the sustainability of water and sanitation services in rural areas, and for enhancing the accountability of municipal service providers.

The general lack of understanding and concern about the value and scarcity of water resources is likely to be a major constraint to sustainable water resources management. Public awareness campaigns are needed to raise public concern for and understanding of this valuable resource. Generic, multidimensional campaigns at the national level are one vehicle to inform and encourage people to value, protect and use water more effectively and efficiently. Targeted, mini-campaigns, with specific messages on water misuse and abuse can reach selected groups, such as farmers, householders or small industries. Campaigns use a variety of media, including:

1. Mass media: newspapers, radio, and TV.
2. Posters, leaflets, stickers, newsletters, etc.
3. Social and cultural events.
4. Face-to-face techniques, using public health workers, teachers, youth and women's groups.

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*"Participation is powerful tool for improving sustainability... and enhancing... accountability"*

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The lack of understanding and concern regarding water as a valuable and scarce national resource is widespread. Overcoming this general apathy needs a network of governmental and non-governmental organisations working in partnership in the implementation of formal and informal public awareness activities.

# 7. Existing Sector Institutions and Activities

## 7.1 A preliminary survey

During its first 3 months of activities, the WRAP Taskforce sought to meet all the key institutions and individuals active in the water sector in the Gaza Strip and West Bank. A questionnaire was used to try to obtain standard information about the nature, size, staff, plans and funding of each organisation. A goal of the WRAP is to support and work with a wide range of formal and informal institutions, to build overall capacity for water resources management. A summary of findings is presented in Table A.6 below. A key conclusion was the lack of a national focus and the absence of co-ordination between the institutions. In many cases this has led to duplication of efforts and waste of resources. In particular, many utilities lack the capacity for long term planning and suffer from poor management and accounting systems.

## 7.2. Municipal and regional water utilities

In the Gaza Strip and West Bank there are several municipalities and two major utilities that provide water services in the urban areas. In the rural areas, village councils and water committees provide these services. These institutions are characterised by limited quantity of available water supplies and a high percentage of unaccounted water. During the survey, it was clear that many (although not all) of these water institutions are weak for many reasons, but particularly due to their lack of autonomy, inadequate performance incentives, no access to capital, insufficient dedicated revenues and human resource constraints.

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*"Many ... water institutions ... are weak ... due to their lack of autonomy"*

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Some municipal water departments and utilities have had master plans prepared several years ago, typically by Israeli consultants. However, these plans have rarely been implemented, again for many of the reasons given above, and also due to failure to obtain permits to increase the water supply. Tariff and financial management studies are rare and

tariffs are generally inappropriately structured. The staff involved with municipal services lack motivation and have little opportunity to improve their skills. Co-ordination among the municipal departments, and between the water utilities themselves, is poor.

## 7.3. Water Departments of the Civil Administration

The West Bank Water Department and the Water Division of the Gaza Agricultural Department have been the Civil Administration agencies responsible for water since 1967. The Gaza Water Division recently came under Palestinian control, as a result of the Cairo peace agreement. Some of the work of these departments has been discussed in Section 4.3. and 4.4 and is summarised in Table A.6. The whole range of data and studies available in the Gaza Agriculture Department are now accessible, as the Gaza Strip is a self-rule territory. In contrast, the West Bank Water Department is still under restrictions and military rules imposed on its Palestinian workers. Even though the department is managed by Palestinians, it is controlled by an Israeli water officer and the employees of the department are prohibited from giving information on water resources. Although activities are summarised in Table A.6, access to data is denied. It is clear that, if the West Bank Water Department is transferred to Palestinian control, then data can easily be made available.

## 7.4. Non-Governmental Organisations (National)

Several NGOs, are involved in executing water projects and research. Water projects include rainwater harvesting, spring development, irrigation systems, water quality analysis, land use management, public awareness campaigns and sanitation. Most water projects are small in scale and usually in rural areas. The main NGOs include the Palestinian Hydrology Group (PHG), the Applied Research Institute Jerusalem (ARIJ), the Environmental Protection Centre (EPC) and Birzeit,

Bethlehem, Al-Najah (Nablus), Al-Azhar (Gaza), and the Islamic (Gaza) Universities. Other NGOs are involved to a lesser extent. In addition, there are a number of individual researchers and small private companies active in the sector, particularly in the field of water and sanitation.

## 7.5. Involvement of External Agencies

There are a growing number of external support agencies (ESAs) active in the sector in the Gaza Strip and the West Bank. Until there is an effective national water authority, these ESAs are working in a vacuum and their well-meaning efforts may even be detrimental, due to duplication and the risk of inadequate attention to Palestinian capacity building. Some of the ESAs are described below.

*United Nations Organisations.* The UNDP & UNRWA are the main active organisations of the United Nations involved in water resources and water and sanitation projects. UNDP - together with financial support from several bilateral agencies, in particular USAID

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*"... ESAs ... well-meaning efforts may even be detrimental."*

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and JICA of Japan - has been supporting the sector for over ten years and is active in water and wastewater projects and water resources management. UNRWA is active in providing water & sanitation services primarily within the refugee camps, with its water sector activities falling within its Special Environmental Health Programme.

*American Near East Refugee Aid (ANERA)* has initiated a storm water harvesting project in Gaza, which is potentially a very important pilot project. The harvested storm water is intended to recharge the groundwater, which is severely overexploited. The project, located in Sheikh Radwan area of Gaza City, is not working according to plan, and the recharge water is contaminated with sewage. Rectification is planned.

*Save the Children Federation (SCF)* is active in the Gaza Strip and the West Bank in small scale community projects, such as excavating cisterns and rainwater harvesting in rural areas.

*GTZ (Germany)* is providing both technical and financial support to several municipal water departments in the West Bank, contributing to wastewater projects in the Bethlehem area, water wells in the Nablus and Ramallah areas and the wastewater treatment plant of El-Bireh.

*The EU and the University of Delft* is sponsoring short term training courses and post graduate studies. At the moment Delft is supporting a Diploma course in waste water management at Birzeit University.

*The EU, ODA and the University of Newcastle Upon Tyne* is assisting the PHG in: the instrumentation and monitoring of a pilot catchment in the north of the West Bank; the installation of a water resources information system to support water resources data management and planning; and training programmes, including postgraduate studies and short term training courses in the UK.

*The Netherlands DGIS and consultants IWACO* are supporting the Palestinian Environment Protection Agency in conducting groundwater studies in Gaza, in co-ordination with WRAP.

*Canadian CIDA* is supporting the WRAP.

*Canadian IDRC* is giving support to ARIJ for developing hydrometric monitoring, and to the PCG for water related studies.

*The World Bank* is planning support to both technical assistance and capital investment in the water and sanitation sector.

Many other external agencies, including the development agencies of Norway, France and Finland, OXFAM of the UK are all contributing to the development of the water sector.

Table A.6 Summary of the activities of some Key institutions in the water sector. This list is not exhaustive, but is illustrative of the range of actors and activities.

Classification	Name	Activities
Governmental Institutions	Water Department, GS	1. Meteorological Data: precipitation, evaporation, humidity, sunlight, evapotranspiration, etc. 2. Water Quality. 3. Geological Data: stratigraphic and cross sections across the Gaza Strip are available. 4. Groundwater Data: pumpage records. 5. Well logs and groundwater levels in various wells locations, capacities, ownership, design, date of drilling, etc. exist. 6. Water consumption rates by various sectors.
	Water Department, WB	1. Meteorological data collection. 2. Spring & Stream Flows measurements. 3. Groundwater Level measurements. 4. Pumpage and consumption rates for all the water wells. 5. Water Quality monitoring. 6. Flood measurements. 7. Groundwater monitoring. 8. Well Logging. 9. Distribution system network data. 10. Some data about the settlements wells.
	PEPA	1. Natural resources inventory for Gaza. 2. Groundwater modelling for Gaza.
Palestinian NGOs	Palestinian Hydrology Group (PHG)	1. Data collection and Analysis. 2. Water quality test. 3. Rain harvesting, cisterns and pools, Gaza and WB. 4. Well rehabilitation. 5. Public awareness for water conservation and quality protection. 6. Building a data base.
	Palestinian Consultancy Group (PCG)	1. Study the management options for the joint aquifers. 2. Funding research in water and wastewater.
	Applied Research Institute of Jerusalem (ARIJ)	1. Data collection. 2. Data base. 3. Groundwater monitoring. 4. Land use patterns.
	Arab Scientific Institute for Research and Transfer of Technology (ASIR)	1. Data Collection. 2. Studies on the artificial recharge, options and feasibility. 3. Water quality tests.
	Environmental Protection Centre (EPC)	1. Data collection. 2. Water quality analysis. 3. Groundwater monitoring.
Universities	Birzeit	1. Water quality tests. 2. Wastewater treatment plant demonstration. 3. Public awareness. 4. Capacity building and training through Diploma course with Delth University.
	Al- Najah	1. Data collection. 2. Academic studies and training.
	Bethlehem	1. Data collection. 2. Water quality analysis. 3. Geological studies and mapping.
	Islamic, Gaza	1. Data collection. 2. Water quality analysis.
	Al-Azhar	1. Data collection.
UN Organisations	United Nations Relief Works Agency (UNRWA)	1. Water supply and distribution to some refugee camps. 2. Storm water harvesting, feasibility study related to the Jabalia camp and Beach camp in the Gaza Strip has been conducted. 3. Wastewater collection and disposal for the refugee camps.
	United Nations Development Programme (UNDP)	1. Water distribution network, rehabilitation and implementation. 2. Wastewater treatment and reuse, Gaza. 3. Co-sponsors of WRAP. 4. Financial support to active NGOs in the water sector.
Some Other External Organisations	American Near East Refugee Aid (ANERA)	1. Rain harvesting and ground water recharge (Sheikh Radwan, Gaza). 2. Wastewater collection, treatment and reuse, WB. 3. Well rehabilitation, WB. 4. Springs development, WB.
	Save the Children Federation (SCF)	1. Rain Harvesting, Cistern and pools, Gaza and WB. 2. Wastewater treatment and reuse, Subsurface drainage systems, Gaza and WB. 3. House connections to the existing sewerage systems in the Gaza Strip. 4. Contribution in groundwater abstraction, GS & WB. 5. Institutional development.
	Catholic Relief Services (CRS)	1. Springs development, WB. 2. Replacement of conventional irrigation systems by appropriate conservation ones.
	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ)	1. Technical and financial support to some municipal water and wastewater projects, Bethlehem area (wastewater), Nablus Ramallah (water wells) and Al-Bireh (treatment plant).





## **PART B: ISSUES AND ACTIONS**





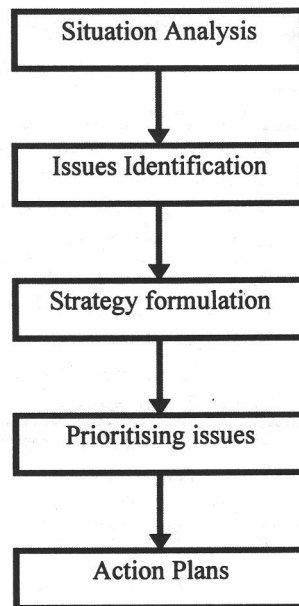


# ISSUES AND ACTIONS

## 1. Introduction

Part A of this report presented an analysis of the present situation of the water resources sector in the Palestinian territories. In this analysis, many issues emerged. Part B describes how the Water Resources Action Programme (WRAP) Taskforce has set an

agenda to address the priority issues, in a manner that represents a genuine attempt to reflect the actual needs and concerns of the Palestinian community. The approach that was adapted is shown graphically below (Figure B.1).



**Figure B.1:** Procedure adapted to set WRAP's agenda

## 2. Issues identification

During the period from April to June 1994, the Taskforce of the Water Resources Action Programme interacted with most institutions and individuals active in the water sector in the Gaza Strip and the West Bank. In addition, the Taskforce conducted a literature review, visited many water and wastewater projects, and consulted numerous active professionals and academicians in order to develop an overview of the water situation in the Gaza Strip and the West Bank.

Thereafter, the Taskforce was able to prepare a review of the sector which is presented in PART A of this report. Based on the findings of this review, key problems relating to the water sector were highlighted and identified as issues that need to be addressed. Table B.1 summarises the identified issues which reflect problems, threats and constraints in the water resources sector, in the Palestinian territories.

*Table B.1: Main water sector issues in Gaza Strip and the West Bank.*

<b>Field</b>	<b>Identified Issue</b>
<b>Hydrology and Hydrogeology</b>	<ul style="list-style-type: none"> <li>◆ Hydrometric Monitoring and Archiving</li> <li>◆ Gaza Water Resources Assessment and Management</li> <li>◆ West Bank Water Resources Assessment</li> <li>◆ Groundwater Pollution</li> </ul>
<b>Water Conservation</b>	<ul style="list-style-type: none"> <li>◆ Municipal Water Supply</li> <li>◆ Wastewater Reuse</li> <li>◆ Rainwater Harvesting</li> <li>◆ Water Resources Conservation, Pollution and Protection in Agriculture</li> </ul>
<b>Social</b>	<ul style="list-style-type: none"> <li>◆ Water Consumption Patterns and perceptions</li> <li>◆ Public Awareness</li> <li>◆ Community Participation</li> </ul>
<b>Economic</b>	<ul style="list-style-type: none"> <li>◆ Role of Water in the Economy</li> <li>◆ Water Tariffs</li> <li>◆ Water Markets</li> </ul>
<b>Planning and Management</b>	<ul style="list-style-type: none"> <li>◆ Water Legislation</li> <li>◆ International Water Resources</li> </ul>
<b>Human Resources Development</b>	<ul style="list-style-type: none"> <li>◆ HRD and Training</li> </ul>

### 3. Strategy formulation

Having identified the issues in the situation analysis, appropriate strategies were developed to address the issues, presenting these strategies in individual Issues Papers (see Appendix) which set out the problem, the objectives to be met in resolving the problem, the outputs, scope of work, potential partners

and the capacity building needs and opportunities. The strategies were then extensively discussed, analysed and refined. The essential aspects of the strategies developed to address the issues are outlined below in Table B.2. More details are given in "Issue Papers" presented in the Appendix.

Table B.2: Palestinian Water Sector Issues and Strategies.

Issue: Description	Strategy: Objectives	Strategy: Outputs
<b>Hydrometric monitoring &amp; Archiving</b>	<ul style="list-style-type: none"> <li>* secure access to existing data sets, establish appropriate archives</li> <li>* set-up national monitoring programme, to include institutional framework, training needs, network design, database architecture, data information dissemination, financing, &amp; ensuring compatibility with other regional and national programmes.</li> </ul>	<ul style="list-style-type: none"> <li>* functioning national data archive</li> <li>* operational monitoring network</li> </ul>
<b>Gaza Water Resources Assessment/ Management</b>	<ul style="list-style-type: none"> <li>* develop water resources management strategy options and recommend actions to resolve crisis by balancing demand and supply and control quality;</li> <li>* implement proposed strategies through PWA/ Water Department.</li> </ul>	<ul style="list-style-type: none"> <li>* digital models</li> <li>* report with options and recommendations</li> <li>* implemented water resources management programme</li> </ul>
<b>West Bank Water Resources Assessment</b>	<ul style="list-style-type: none"> <li>* quantify water balance;</li> <li>* provide politicians with essential information for water negotiations on both allocation rights and joint management as upstream riparian on mountain aquifers;</li> <li>* develop options and recommend actions for water resources management in the WB.</li> </ul>	<ul style="list-style-type: none"> <li>* digital models</li> <li>* report with options and recommendations</li> <li>* implemented programme in self-rule area.</li> </ul>
<b>Groundwater Pollution</b>	<ul style="list-style-type: none"> <li>* contain pollution problem through:               <ul style="list-style-type: none"> <li>- identifying its scale and sources;</li> <li>- Increasing public awareness;</li> <li>- regulating the protection of vulnerable areas.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>* diagnostic report and vulnerability maps</li> <li>* public awareness material</li> <li>* protection policy recommendation</li> <li>* periodic monitoring programme</li> </ul>
<b>Municipal Water Conservation</b>	<ul style="list-style-type: none"> <li>* ensure access to adequate water supplies of suitable quality;</li> <li>* promote and demonstrate maximum water conservation;</li> <li>* develop/recommend a policy and regulatory framework for water utilities.</li> </ul>	<ul style="list-style-type: none"> <li>* report</li> <li>* demonstration projects together with selected water utilities in WB and Gaza Strip</li> </ul>



Table B.2: Palestinian Water Sector Issues and Strategies (Cont...).

<b>Issue: Description</b>	<b>Strategy: Objectives</b>	<b>Strategy: Outputs</b>
<b>Waste Water Re-use</b>	<ul style="list-style-type: none"> <li>* promote acceptance and use of treated waste water by:               <ul style="list-style-type: none"> <li>- understanding caused of failures;</li> <li>- developing guidelines and standards;</li> <li>- implementing successful demonstration projects;</li> <li>- promoting public awareness.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>* report: recommendations on policy and procedures;</li> <li>* successful demonstration projects in the WB and Gaza using treated waste water; and their replication;</li> <li>* training materials for extension and participation</li> </ul>
<b>Rainwater Harvesting</b>	<ul style="list-style-type: none"> <li>* optimise the capture and use of rainwater at the domestic, catchment, and municipal levels for water supply and artificial recharge.</li> </ul>	<ul style="list-style-type: none"> <li>* report: review, guidelines and policy recommendations;</li> <li>* demonstration project, including wadi dams, pools, institutional catchments (e.g. schools)</li> <li>* urban runoff components within planned infrastructure projects</li> </ul>
<b>Water Resources Conservation &amp; Pollution Protection in Agriculture</b>	<ul style="list-style-type: none"> <li>* optimise water use in agriculture (crops, irrigation techniques, inputs);</li> <li>* minimise impacts of agriculture on water quality;</li> <li>* develop and demonstrate alternative agricultural systems, including strategies for financing agricultural substitutions.</li> </ul>	<ul style="list-style-type: none"> <li>* demonstration projects in WB and GS</li> <li>* technical reports on irrigation techniques and crop selection</li> <li>* groundwater protection policy recommendations</li> </ul>
<b>Water Consumption Patterns and Perceptions</b>	<ul style="list-style-type: none"> <li>* obtain basic knowledge to inform policy recommendation, public awareness programmes and economic analysis</li> </ul>	<ul style="list-style-type: none"> <li>* survey reports of consumption patterns in the various sectors, perceptions regarding the value of water and willingness to pay</li> </ul>
<b>Public Awareness</b>	<ul style="list-style-type: none"> <li>* conserve and protect water resources through community action and participation as well as enhanced public awareness</li> </ul>	<ul style="list-style-type: none"> <li>* educational, training and extension materials for all forms of media</li> <li>* national and local campaigns successfully conducted</li> </ul>
<b>Community Participation</b>	<ul style="list-style-type: none"> <li>* achieve public participation in the development and implementation of national policies for water conservation and ensure accountability</li> <li>* achieve sustainable and equitable water resources development through active public participation in the design and implementation of national policies for water conservation and protection and accountable service delivery</li> </ul>	<ul style="list-style-type: none"> <li>* report on policy and practice guidelines on participation</li> <li>* public information material on: potential initiatives; policies; and guidelines for community action</li> </ul>
<b>Water in the Economy</b>	<ul style="list-style-type: none"> <li>* identify the role of water in the economy, by sector and within each sector</li> <li>* analyse the appropriate macro- and micro-economic policies that will optimise water allocation and use (supply and demand)</li> </ul>	<ul style="list-style-type: none"> <li>* report including guidelines for policy</li> </ul>

Table B.2: Palestinian Water Sector Issues and Strategies (Cont...).

<b>Issue: Description</b>	<b>Strategy: Objectives</b>	<b>Strategy: Outputs</b>
<b>Water Allocation and Tariffs</b>	<ul style="list-style-type: none"> <li>* develop tariff policy recommendations for municipal and agricultural water supplies and waste water discharge, which will:</li> <li>- achieve financial self sufficiency in the sector</li> <li>- ensure appropriate signals for water conservation and pollution control</li> <li>- ensure economic efficiency in the use of scarce water</li> <li>- ensure access by the poor through appropriate tariff structures</li> </ul>	<ul style="list-style-type: none"> <li>* report, including tariff survey, national overview and policy recommendations</li> <li>* report including specific tariff structures for identified municipalities</li> </ul>
<b>Water Markets</b>	<ul style="list-style-type: none"> <li>* explore the feasibility of creating markets for water</li> <li>* reduce over-exploitation</li> <li>* meet municipal demands</li> <li>* improve allocation</li> </ul>	<ul style="list-style-type: none"> <li>* report on feasibility</li> <li>* possible contracts with specific water owners as a demonstration</li> </ul>
<b>Water Legislation</b>	<ul style="list-style-type: none"> <li>* develop effective legal framework for water</li> </ul>	<ul style="list-style-type: none"> <li>* draft legislation and regulations, including enforcement procedures and sanctions</li> </ul>
<b>International Water Resources</b>	<ul style="list-style-type: none"> <li>* assist Palestinian negotiators to achieve equitable allocation of the Region water resources</li> <li>* achieve efficient joint management of water resources including procedures</li> <li>* advise negotiators on alternative water augmentation schemes</li> </ul>	<ul style="list-style-type: none"> <li>* analysis of alternative negotiating positions</li> <li>* recommendations</li> <li>* assessment and advice on proposed regional water augmentation schemes</li> </ul>

## 4. Prioritization of issues

Once the major issues had been identified, a plan of action to address the issues was developed. As a first step, priorities had to be set, given resource constraints and the limited capacity of the Taskforce and other appropriate Palestinian institutions. Although it was clear that solutions to water resources management problems, such as in the Gaza Strip, could only be achieved through a broad approach to resolving many issues - technical, economic, institutional and social - it was nevertheless regarded essential to launch the Water Resources Action Programme by addressing a manageable number of top-priority issues, in the first instance.

The methodology employed in identifying the priority issues consisted, first, in identifying evaluation criteria and selecting those most appropriate to the current situation. The following criteria were adapted:

- ◆ political urgency and sensitivity;
- ◆ environmental urgency and sensitivity;
- ◆ PWA institutional foundation;

- ◆ potential for early impact on major problems; and
- ◆ essential linkages to other issues - i.e. a pre-requisite for other work.

Following a consideration of weighting the different criteria, each was considered of equal importance and thus assigned an equal weight. Each of the 16 issues was then scored in relation to each of the 5 criteria on an ascending scale of 1 to 4, by a group of 8 evaluators of a wide range of different disciplines. Thus each issue could receive a total score ranging from a minimum of 40 to a maximum of 160. The results are given in Table B.3 below, which sets out the issues in order of priority.

This methodology provided a relatively objective and transparent process of setting priorities, which can be evaluated by others. A different group of evaluators may, however, reach somewhat different conclusions.

Table B.3: Score and rank given to each of the issues by order of priority:

Issue description	Criteria					Total	Rank
	Political Impact	Environment	PWA formation	Impact	Linkages		
Public Awareness	23	32	27	20	29	141	1
Gaza Water Resources Assessment/ Management	31	29	30	28	21	139	2
West Bank Water Resources Assessment	29	19	30	30	30	138	3
International	32	19	25	29	26	131	4
Water Legislation	25	22	28	26	29	130	5
Hydrometric Monitoring & Archiving	21	25	26	27	30	129	6
Groundwater Pollution	21	29	18	23	24	115	7
Community Participation	22	22	18	27	30	111	8
Waste Water Re-use	16	28	18	22	23	108	9
Water Resources Conservation & Pollution Protection in Agriculture	18	25	14	21	28	106	10
Water Consumption Patterns and Perceptions	11	14	16	23	28	92	11
Water Allocation and Tariffs	24	16	17	18	17	92	12
Water in the Economy	19	12	15	22	23	91	13
Municipal Water Conservation	18	14	18	24	16	90	14
Water Markets	14	13	15	22	20	84	15
Rainwater Harvesting	13	17	10	20	19	79	16

## 5. Plan of Action

As a final step in this preparatory exercise, a Plan of Action was developed which took account of the capacity of the WRAP Taskforce and other Palestinian institutions to launch a complex programme of substantive activities. It was decided that activities should be initiated to address the first six issues as well as the issue of water allocation and tariffs. This latter was added due to the need to ensure and interdisciplinary perspective by bringing in the economic and financial dimension.

An outline workplan was developed to deal with these seven issues and each issue was assigned a co-ordinator from the Taskforce. The overall workplan was approved by the WRAP Steering Committee in July 1994 and work then started immediately. Table B.4 summarises the status of the seven activities. Partners are being actively sought by the

Taskforce to work together in addressing the issues. A good example of this partnership is the close co-operation with PEPA consultants IWACO, of the Netherlands, who are retained for the follow-up to the Gaza Environmental Profile, funded by the Netherlands. The IWACO hydrogeologist is working as an integrated member of the team tackling Issue 2, Gaza Water Resources Assessment and Management.

The Plan of Action is thus derived from a structured process of planning and is a direct reflection of the priority needs of the Palestinian community and the National Authority. As the work on the seven issues advances, additional activities will be initiated in order to provide a balanced focus on the overall problems of water resources management in the West Bank and Gaza Strip.

*Table B.4: Priority Issues, and Status of Work*

Issue by Priority	Start Date	Expected Completion Date
1. Public Awareness	July 1994	On-going
2. Gaza Water Resources Assessment/Management	July 1994	July 1995
3. West Bank Water Resources Assessment	October 1994	To be determined
4. International Water Issues	July 1994	February/March 1995
5. National Water Legislation	August 1994	March 1995
6. Hydrometric Monitoring and Archiving	July 1994	March 1995
7. Water Allocation and Tariffs	August 1994	July 1994







**APPENDIX**

**SUMMARY OF ISSUES BY ORDER  
OF PRIORITY**









## Issues by Order of Priority

Issue	No.
<i>PUBLIC AWARENESS.....</i>	<i>1</i>
<i>GAZA GROUNDWATER RESOURCES ASSESSMENT AND MANAGEMENT.....</i>	<i>2</i>
<i>WEST BANK WATER RESOURCES ASSESSMENT.....</i>	<i>3</i>
<i>INTERNATIONAL WATER RESOURCES.....</i>	<i>4</i>
<i>WATER LEGISLATION.....</i>	<i>5</i>
<i>HYDROMETRIC MONITORING AND ARCHIVING.....</i>	<i>6</i>
<i>WATER TARIFFS.....</i>	<i>7</i>
<i>GROUNDWATER POLLUTION.....</i>	<i>8</i>
<i>COMMUNITY PARTICIPATION.....</i>	<i>9</i>
<i>WASTEWATER RE-USE.....</i>	<i>10</i>
<i>WATER RESOURCES CONSERVATION &amp; PROTECTION IN AGRICULTURE.....</i>	<i>11</i>
<i>WATER CONSUMPTION PATTERNS AND PERCEPTIONS.....</i>	<i>12</i>
<i>ROLE OF WATER IN THE ECONOMY.....</i>	<i>13</i>
<i>MUNICIPAL WATER CONSERVATION.....</i>	<i>14</i>
<i>WATER MARKETS.....</i>	<i>15</i>
<i>RAINWATER HARVESTING.....</i>	<i>16</i>

## PUBLIC AWARENESS

### 1. Problems:

1. Lack of public awareness of the scarcity of water.
2. Lack of awareness of vulnerability of water resources.
3. Need for community support and participation in water conservation and protection.
4. Resource abuse through over-exploitation and pollution.
5. Indifference, helplessness and lack of empowerment within the community regarding water issues.

### 2. Objectives:

1. Conserve and protect water resources through community participation and action enhanced through public awareness.

### 3. Outputs:

1. Educational, training and extension material for all channels of media.
2. National and local campaigns successfully conducted.

### 4. Scope of work:

1. Rapid appraisal assessment of the present water consumption patterns and perceptions.
2. Initial consultation to assess awareness among key constituencies.
3. Generate, test and disseminate material.
4. Design and implement national water awareness campaign.
5. Integrate a public awareness component into all WRAP activities and promote it in others.

### 5. Potential Participants:

1. Wrap for PWA.
2. Consultants.
3. NGOs.
4. Water institutions.

### 6. Capacity building:

1. Project management level within WRAP for PWA.
2. Train personnel on how to design and carryout public awareness campaign.
3. To assemble and activate a Palestinian expertise in public awareness campaign.
4. Create public awareness campaign.

# GAZA GROUNDWATER RESOURCES ASSESSMENT AND MANAGEMENT

## **1. Problems:**

1. Demand is not fully met (constraining socio-economic development).
2. Consumption exceeds supply.
3. Drop in water levels due to over-exploitation of resources.
4. Deterioration in water quality (sea water intrusion, upconing of saline connate water, point and non-point pollution, etc.).
5. Incompetent water resources management.
6. Remarkable dearth in basic information on the water system(s).

## **2. Objectives:**

1. To develop and evaluate alternative water resources management options and make recommendations on the strategy to resolve the crisis by proposing appropriate exploitation patterns.
2. To implement the recommended strategy for water resources management through PWA.

## **3. Outputs:**

1. Operational model.
2. Report with alternative management options and recommendations on strategy.
3. Implement programme.

## **4. Scope of Work:**

1. Collection and synthesis of hydrometric data.
2. Modelling the water system.
3. Development and evaluation of alternative water management options (demand and supply).
4. Build public awareness of problems and alternative solutions.
5. Recommend strategy and action programme in steps.
6. Advocate implementation of recommended action programme.

## **5. Potential Participants:**

1. WRAP for PWA.
2. Consultants.
3. Local and national government bodies.
4. NGOs.

## **6. Capacity Building:**

1. Project management capacity within WRAP for PWA.
2. Technical level experience on field work (sampling and monitoring).
3. Updating and upgrading technical knowledge through working with consultants.

## WEST BANK WATER RESOURCES ASSESSMENT

### **1. Problems:**

1. Palestinians do not have control of all West Bank water resources.
2. Lack of knowledge for resource management (on both supply and demand).
3. Very complex hydrology and geology.
4. Resources are joint with other entities making joint management and analysis necessary.
5. Water rights in the region are not recognised or determined.
6. Decision-makers lack understanding of the water situation.
7. Exceptional demand on water resources throughout the region leading to competition and conflict.
8. Palestinians have to assume responsibility for water resources in self-rule areas and negotiate water shares with regional parties.

### **2. Objectives:**

1. To provide politicians with essential information for water negotiations on both allocation rights and joint management.
2. Quantify and understand water balance (past and future).
3. Develop options and recommend activities for water resources management in the West Bank.

### **3. Outputs:**

1. Digital model(s).
2. Report on water resources management options and recommendations.
3. Implemented water resources management programme in self-rule area.
4. Strategy and redlines for negotiations.

### **4. Scope of work:**

1. Collect and analyse all required data (both existing and new).
2. Develop conceptual and digital model(s).
3. Develop supply and exploitation options (scenarios).
4. Investigate water allocation alternatives.
5. Develop appropriate institutional framework options for water resources management.

### **5. Potential Participants:**

1. WRAP for PWA.
2. Consultants.
3. Local and national government.
4. NGOs.

### **6. Capacity Building:**

1. Project management skills within WRAP for PWA.
2. Hydrological field sampling and monitoring techniques.
3. Experience in studying and modelling complex groundwater systems.

## INTERNATIONAL WATER RESOURCES

### 1. Problems:

1. Shared surface and groundwater resources in water scarce region (Jordan, Syria, Israel, Lebanon and Palestine).
2. No recognition of Palestinian entity, hence water rights.
3. Hostile relationship with riparian countries.
4. Present allocation of water developed through conflict.
5. Geographic split and the uneven water distribution between the Gaza Strip and the West Bank.
6. Lack of precedence on shared aquifers.
7. Inadequacy of international water laws and their enforcement.
8. Differing Palestinian situations, downstream in Jordan and Gaza aquifer, but upstream on mountain aquifer.
9. Palestinians handicapped in negotiation by lack of data and scarcity of expertise.
10. Diverse proposals for water resources augmentation in the region.

### 2. Objectives:

1. To assist Palestinian negotiators to achieve equitable allocation of the region's water resources.
2. Achieve efficient joint management of water resources including procedures.
3. Advise negotiators on alternative water augmentation schemes.

### 3. Outputs:

1. Analysis of alternative negotiating positions.
2. Recommendations.
3. Proposed designs of regional management structures.

### 4. Scope of Work:

1. Identify suitable expertise in international water law and international negotiation.
2. Establish multi disciplinary advisory Taskforce.
3. Reviewing existing codes draft treaties and precedents in settling transboundary water disputes.
4. Establish the preferred outcome.
5. Review the likely position of other riparians.
6. Establish proposed negotiating position.
7. Prepare recommendations of structures and procedures for joint management.
8. Review alternative proposals for water resources augmentation in the region and provide briefing and guidelines to negotiators.

### 5. Potential Participants:

1. WRAP for PWA.
2. National and international experts.

### 6. Capacity Building:

1. International negotiating experience in water disputes.
2. Water guidelines for regional management and co-operation.



## WATER LEGISLATION

### **1. Problems:**

1. Multiplicity and confusing water laws.
2. Differences between West Bank and Gaza water laws.
3. Lack of control over water abstraction, discharge, and water pollution.
4. Complexity in establishing control over water due to both legal and political factors.

### **2. Objectives:**

1. Create a new efficient legal framework.

### **3. Outputs:**

1. A report including recommendations of appropriate laws and regulations including enforcement procedure and sanctions.

### **4. Scope of Work:**

1. Review historic and present legal framework.
2. Review the current status and compliance.
3. Consider the future options (laws, regulations and standards).
4. Draft proposal for legislation.
5. Public participation and consultation.

### **5. Potential Participants:**

1. WRAP for PWA.
2. Palestinian Authority in particular PEPA, Justice.
3. Legal and technical consultants.
4. Media for public campaign.

### **6. Capacity Building:**

1. To assemble and activate Palestinian experts in the formation of water legislation and regulations.

## HYDROMETRIC MONITORING AND ARCHIVING

### 1. Problems:

1. Lack of:
  - 1.1 institutional framework;
  - 1.2 continuing records of comprehensive and reliable data for resource assessment;
  - 1.3 QA/QC procedures and standards on existing data;
  - 1.4 access to the Israeli held data;
  - 1.5 adequately designed network of monitoring stations;
  - 1.6 appropriate designed data archive;
  - 1.7 access to data available on joint and regional water resources of riparian;
  - 1.8 appropriate training;
  - 1.9 financial and human resources for sustainability.
2. Absence of data dissemination procedures among the Palestinians.
3. Reluctance of the Palestinian officials to take action in obtaining data.
4. Limited knowledge of what data are needed and why.
5. Uncertainty of legality of monitoring in the West Bank from the Israeli side.

### 2. Objectives:

1. Secure access to existing data sets, establish appropriate archives.
2. Set-up national monitoring programme, to include institutional framework, training needs, network design, database architecture, data information dissemination, financing, & ensuring compatibility with other regional and national programmes.

### 3. Outputs:

1. Functioning national data archive.
2. Operational monitoring network.

### 4. Scope of Work:

1. Collection of existing data and ensuring access to data held by the Israelis and the Jordanian Ministry of Natural Resources.
2. Build up of capacity in monitoring and archiving.
3. Review of the various computer software which can be used in databasing and archiving.
4. Establishment of the monitoring network.
5. Disseminating data through periodic reports.

### 5. Potential Participants:

1. WRAP for PWA.
2. NGOs.
3. Local and national government.

### 6. Capacity Building:

1. Project Management skills within WRAP for PWA.
2. Technical skills in hydrometric monitoring.
3. Network linkages (national and international) towards enhancement of:
  - 3.1 dissemination of information; and
  - 3.2 policy communications.

## WATER TARIFFS

### **1. Problems:**

1. Water tariffs do not reflect economic costs.
2. Poor cost recovery performance by water suppliers.
3. Very wide range of water tariffs.
4. Price distortions produce miss-allocation, waste, and pollution.
5. Water tariffs subsidise other services, and lead to deterioration of infrastructure and services provided.

### **2. Objectives:**

1. To develop macro and micro tariff policy guidelines and recommendations for supplies of water and discharge of wastewater which will:
  - 1.1 achieve financial self sufficiency in the sector, and among individual suppliers;
  - 1.2 ensure appropriate signals for water conservation and pollution control;
  - 1.3 ensure economic efficiency in the use of scarce water;
  - 1.4 ensure access by the poor through appropriate tariff structures.

### **3. Outputs:**

1. 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.
2. A number of municipal (2-3) and utility case studies (1-2) assessing present tariff formulation practices, a seminar on the results and a report providing recommendations for appropriate tariff policy.

### **4. Scope of Work:**

1. Identify all costs associated with the provision of water supply.
2. Establish tariff levels on the basis of long run marginal costs.
3. Assess the application of alternative tariff structures.
4. Assess the ability and willingness to pay by consumer groups and by regions.
5. Develop and recommend practical tariff strategies and implementation strategy on a national, regional and individual supplier level.
6. Recommend procedures for subsequent tariff adjustments.
7. Establish current levels of government subsidies to the sector.

### **5. Potential Participants:**

1. WRAP for PWA.
2. Consultants.
3. Universities.

### **Capacity Building:**

1. Capacity to design and administer tariff studies.
2. Training a core Taskforce/group of field researchers in the skills and methods of data collection, survey design, enumeration and evaluation.
3. Ability of municipal and utility suppliers to assess economic cost and determine value.

## GROUNDWATER POLLUTION

### 1. Problems:

1. Palestinian water resources are endangered by pollution from many sources (sea water intrusion, upconing of connate water, agricultural and industrial activities and by-products, uncontrolled waste disposal, urban runoff, accidents, etc.).
2. Pollution at the moment is unabated due to lack of full control over water resources.
3. Palestinian water resources are very vulnerable (shallow groundwater in Gaza and karstic aquifers in the West Bank).
4. Lack of protection regulations (on source and resource levels) and absence of enforcement tools.
5. Apathy and limited public awareness.
6. Liquid and solid waste disposal systems are inadequate.
7. Remediation is expensive and slow.

### 2. Objectives:

1. To contain the problem through:
  - 1.1 identification and evaluation of the problem;
  - 1.2 enhancement of public awareness; and
  - 1.3 recommending necessary regulations to protect water resources.

### 3. Outputs:

1. Diagnostic report (including vulnerability maps).
2. Public awareness material.
3. Recommendations on water resources protection policy.
4. Constant monitoring programme.

### 4. Scope of Work:

1. Collection of historic and new data (3D).
2. Analysis and modelling to determine vulnerable areas, source of pollution and pollutants.
3. Preparation of public awareness materials for the national public awareness campaign.
4. Draft and develop pollution protection policy and recommendation.
5. Set up of a monitoring programme and a mechanism for disseminating the results.
6. Develop groundwater abstraction and management strategy.

### 5. Potential Participants:

1. WRAP for PWA.
2. Consultants.
3. NGOs.
4. Research institutions and universities.
5. Local and national government.
6. Media and contractors.

### 6. Capacity Building:

1. Experience in detecting sources and extent of pollution, vulnerability of resources, and remedy and protection actions through contacts with consultants.
2. Training on modelling contamination.

## COMMUNITY PARTICIPATION

### 1. Problems:

1. Exclusion of the community from participation in water related issues.
2. Indifference of the community regarding water issues.
3. Absence of mechanisms for accountability of water institutions to the community.

### 2. Objectives:

1. Achieve public participation in the development and implementation of national policies for water conservation ,protection and ensure accountability.
2. 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.

### 3. Outputs:

1. Policy and practice guidelines on participation.
2. Public information material on initiatives, policies and guidelines for community action.

### 4. Scope of Work:

1. Consult with community activists and organisations to identify opportunities for community action.
2. Review past experiences.
3. Generate report and public information materials.
4. Test and disseminate materials.

### 5. Potential Participants:

1. WRAP for PWA.
2. Consultants.
3. Private voluntary organisations (PVOs) and NGOs.

### 6. Capacity Building

1. Build and develop the community capacity to assure the accountability of the water institutions.
2. Build a system for designing , developing and disseminating public information.

## WASTEWATER REUSE

### 1. Problems:

1. Lack of recognition that wastewater is a resource.
2. Pollution of water and soil.
3. Risks to health.
4. Environmental degradation.
5. Lack of treatment.
6. Barriers to reuse wastewater.
8. Past failures.

### 2. Objectives:

1. Promote acceptance and use of treated wastewater by:
  - a. Developing guidelines and standards.
  - b. Understanding causes of failures.
  - c. Implementing successful demonstration projects.
  - d. Promote public awareness.

### 3. Outputs:

1. Report with recommendations on policy and procedures.
2. Successful demonstration projects in the Gaza Strip and West Bank using treated wastewater and their replication.
3. Training materials for extension and participation.

### 4. Scope of Work:

1. Identify wastewater potential.
2. Assess local experience.
3. Assess impacts of wastewater reuse on health, groundwater, agricultural production and dual systems for water conservation.
4. Develop policy, procedures, guidelines and standards patterns.
5. Design demonstration projects.
6. Enhance and develop public awareness and training.
7. Evaluation.

### 5. Potential Participants:

1. WRAP for PWA.
2. Universities.
3. Consultants.
4. Municipalities.
5. Agricultural co-operatives and grass roots organisations.

### 6. Capacity Building:

1. Management and allocation efficiency within WRAP for PWA and municipalities.
2. Irrigation techniques.
3. Underground storage and abstraction.
4. Pollution and contamination control and prevention.

## **WATER RESOURCES CONSERVATION & PROTECTION IN AGRICULTURE**

### **1. Problems:**

1. Eighty percent of water is allocated to agriculture.
2. Inefficient use of water within some sections of agriculture.
3. Agricultural water is not priced according to economic cost.
4. Uncontrolled application of polluting substances (fertilisers and pesticides).
5. Impacts of agricultural activities on water quality.
6. Crop selection practices.
7. Deficient infrastructure for abstracting and distributing water for agricultural purposes. (large numbers of small undisciplined wells, individual storage facilities, etc.).
8. Controlling abstraction in self-rule areas is difficult.

### **2. Objectives:**

1. Optimising water use in agriculture (from both the technical and economic points of view).
2. Minimising the impacts of agricultural activities on water resources (quantity and quality).
3. Develop, demonstrate and promote alternative agricultural systems to reduce stress on water resources.

### **3. Outputs:**

1. Demonstration projects in West Bank and Gaza.
2. Technical report on criteria for selecting irrigation techniques and crops.
3. Development and communicate policy recommendations for the agricultural sector in order to protect and conserve water resources.

### **4. Scope of Work:**

1. Apply ARIJ's approach in the West Bank to Gaza Strip.
2. Review agriculture substitution options in Gaza Strip and develop and implement a demonstration project employing innovative financial instruments.
3. Analyse the impacts of agriculture on water resources and water quality.
4. Development of remediation strategies and generation of water resources protection and conservation recommendations.
5. Producing material to build farmer awareness.

### **5. Potential Participants:**

1. Consultants.
2. WRAP for PWA.
3. Government organisations.
4. Departments of agriculture.
5. Agricultural co-operatives and grassroots organisations.

### **6. Capacity Building:**

1. Extension of ARIJ's experience in the West Bank to Gaza Strip.
2. Education of farmers through awareness campaigns.
3. Encouragement of innovative research to abridge agricultural impacts on water resources.

## WATER CONSUMPTION PATTERNS AND PERCEPTIONS

### 1. Problem:

1. Lack of basic information regarding domestic, agriculture and industry water consumption by total and by specific users.
2. Consumers perceptions regarding the value of water.

### 2. Objectives:

1. Establishment of basic knowledge to inform policy recommendation , public awareness programs and economic analysis.

### 3. Output:

1. Survey reports of consumption patterns regarding the value of water and willingness to pay.

### 4. Scope of work:

1. Design and test questionnaire for the survey.
2. Implement the survey.
3. Analyse the findings.
4. Writing the final report.

### 5. Potential Participants:

1. WRAP and clients (e.g. university students).
2. Consultants.

### 6. Capacity building:

1. Research and data collection personnel.
3. Data analysis capability.



## ROLE OF WATER IN THE ECONOMY

### 1. Problems:

1. Water scarcity and resource conflicts with riparian states and within the state.
2. Limited knowledge on the contribution of water to the economy and by sector.
3. Incorrect perceptions regarding scarcity inducing under-pricing and incentives for water overuse.
4. Price distortions leading to inefficient water allocation and use.
5. Inadequate regulation and licensing, compounding price distortions.
6. Over-exploitation leading to serious and likely irreversible degradation of sources.
7. Absence of environmental control policies contributing to scarcity and pollution of water resources.

### 2. Objectives:

1. To address the role of water in the economy, by sector and within each sector.
2. To analyse the appropriate macroeconomics and microeconomics policies that will optimise water allocation and use (supply and demand).

### 3. Outputs:

1. A report, which will include guidelines for policy.

### 4. Scope of Work:

1. Determine a reliable estimate of supplied water by sector in the Palestinian economy.
2. Estimate potential water resources available if no Israeli restrictions were imposed.
3. Derive the supply and demand curves for water in the economy and for each sector at market and at shadow prices.
4. Estimate the value of output per unit of water consumed in each sector.
5. Identify the major distortions in the water market.
6. Investigate the regulatory framework including legal and customary rights for water abstraction, use and discharge.
7. Assess and analyse the environmental costs of resources degradation through over-exploitation and pollution.
8. Develop recommendations for water policy and identify instruments for water allocation, conservation and protection, meeting policy goals.

### 5. Potential Participants:

1. WRAP for PWA.
2. Contractors.

### 6. Capacity Building:

1. Information and Knowledge on the role of water in economic activities.

## MUNICIPAL WATER CONSERVATION

### 1. Problems:

1. High physical losses ( leakage, black losses).
2. Insufficient source and/or supply to meet demand.
3. Lack of consumer awareness and responsibility.
4. Inappropriate water tariffs.
5. Lack of availability and use of water saving devices ( in households/ industry).

### 2. Objectives:

1. To ensure access to adequate water supplies of suitable quality.
2. Promote and demonstrate maximum water conservation.
3. To develop and recommend a policy and regulatory framework for water utilities.

### 3. Outputs:

1. Report includes current status, water conservation activities, policy and regulatory framework.
2. demonstration projects with conjunction with selected suppliers of WB and GS domestic water.

### 4. Scope of Work:

1. Desk study of municipal water use patterns ( by sector).
2. Survey domestic and industrial use on municipal level.
3. Identify opportunities for conservation through loss reduction and industrial/ domestic conservation ( e.g. policies, devices, tariffs, awareness, pipe rehabilitation, etc.).
4. Identify potential partners ( one or two utilities and/or municipalities to work with).
5. Joint (with partner) preparation of demonstration projects.
6. Implementation of the demonstration projects.
7. Draft of the policy guidelines.

### 5. Potential Participants

1. WRAP facilitates and co-ordinates contractors to execute utility work.
2. NGOs.
3. Local and national government.

### 6. Capacity Building

1. Management level within the water departments.
2. Operation and maintenance capability.
3. Well functioning hydraulic network.

## WATER MARKETS

### 1. Problems:

1. Water scarcity implies a high value of water.
2. Low cost leads to over-exploitation and inefficient use of scarce water.
3. Legal and political aspects of water rights: whose ownership?
4. Adequacy of infrastructure to shift/move water between different sectors, and within sectors.
5. Adequacy of present system to set appropriate tariffs.

### 2. Objectives:

1. Explore the feasibility of creating a market for water.
2. Reduce over-exploitation of water sources.
3. Meet municipal demands for water.
4. Improve allocation of water among and within sectors.

### 3. Outputs:

1. A report assessing the feasibility of establishing such markets, and a possible pilot project involving sale contract/s with specific water owners.

### 4. Scope of Work:

1. Examine current situation (in Gaza and Jericho).
2. Assess options and impacts.
3. Recommendations on the appropriate approach to develop effective and efficient water markets.
4. (Possible) demonstration by entering into a sales contract.

### 5. Potential Participants:

1. WRAP for PWA.
2. Consultants.

### 6. Capacity Building:

1. Management capability within WRAP for PWA.
2. Efficient allocation of water between and within sectors.

# RAINWATER HARVESTING

## 1. Problems:

1. Waste of water source under scarcity.
2. Soil erosion and flood.
3. Lack of:
  - 3.1 drains and funding;
  - 3.2 experience of large scale harvesting;
  - 3.3 awareness and tradition; and
  - 3.4 analysis of potential for the three type of rain harvest:
    - i. roof catchments;
    - ii. large scale storm runoff catchments; and
    - iii. municipal catchments.

## 2. Objectives:

1. Optimise the capture and use of rainwater at the domestic catchment and municipal levels for water supply and artificial recharge.

## 3. Outputs:

1. Report: Review, guidelines and policy recommendations.
2. Demonstration project, including wadi dams, pools, institutional catchments (e.g. schools).
3. Urban runoff components within planned infrastructure projects.

## 4. Scope of Work

1. Overview of potential to rainwater harvesting.
2. Proposals for the demonstration projects.
3. Implementation of demonstration projects and rehabilitation of the existing systems.
4. Evaluation.
5. Policy recommendations and guidelines.
6. Public awareness.

## 5. Potential Participants:

1. WRAP for PWA.
2. Local and national government.
3. NGOs.
4. Universities.
5. Consultants.

## 6. Capacity Building:

1. Management level within WRAP for PWA.
2. Rainwater collection, storage and quality protection.
3. Water resources management.

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