Hillel Shuval
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(Eds.)

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Water Resources in the Middle East

Israel-Palestinian Water Issues – From Conflict to Cooperation

Springer

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With 96 Figures

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Foreword

Israeli-Palestinian Water Issues – From Conflict To Cooperation

This book Israeli-Palestinian Water Issues- From Conflict to Cooperation authored by a group of leading Palestinian, Israeli and international water experts is a unique and timely document illustrating the importance of mutual understanding, respect and amity among peoples during a difficult period of stress, whose leaders, sadly, have not yet found the way of resolving the conflicts between them and of living in peace with each other. Nevertheless it is a book which demonstrates hope, optimism and belief that people with good will in their hearts can help contribute to finding the way to peace and mutual cooperation in solving shared problems essential for their mutual survival and welfare.

The participants in the 2nd Israeli- Palestinian International Conference on Water for Life in the Middle East held in Antalya Turkey in October 2004, which served as the source of most of the papers in this book concluded the Conference with the following declaration:

> We two hundred participants in this Israeli-Palestinian International Conference ... complete our conference with a sense of optimism. It is clear that the Palestinian and Israeli participants, along with their international partners remain committed to solving the many challenges associated with water quantity and quality in our region. ... We recommend that the governments of the region and the international community undertake a commitment to support the development and implementation of collaborative work ... to ensure equitable utilization of the water resources among all the riparians...with priority given to meeting vital human needs.

This book is unusual since it represents true joint efforts of Israelis and Palestinians working closely together in coordination and harmony. All aspects of the conference and this book were planned, managed, organized and edited by joint Palestinian-Israeli teams working in a spirit of cooperation.

The water crisis facing the nations in the Middle East today will become even more serious over the next twenty years, unless dealt with energetically and in good time. Populations are growing and the standard of living is expected to increase, leading to increased demand for domestic and urban water supplies required to meet vital human needs, while the amount of the natural water resources available remains more or less fixed. Water from additional non-conventional sources such as recycling, desalination and import are all possible particularly in an era of peace and cooperation.

This is true for the water short Israelis, Jordanians and Palestinians and is particularly true for the Palestinians who are the most water deprived peoples on the Jordan River Basin. This situation requires urgent action on the part of the countries of the region, the international community and civil society generally. The human suffering and economic stress resulting from the evolving water crisis can be alleviated and even resolved in the framework of equitable reallocation of water resources, regional cooperation, peace promoting water projects and promising new technologies such as desalination and advanced water recycling and reuse for the benefit of all peoples of the area living side by side in peace.

The present situation as regards resolving the water issues through a much needed and much wanted long term peace agreement between Israelis and Palestinians is far from encouraging. Many people feel frustrated and impotent as a result of recent events. However, in October 2004 some 200 water scientists from 25 countries including about 120 Israelis and Palestinians joined by other leading water experts from the Middle East and the rest of the world gathered together at the 2^{nd} Israeli-Palestinian International Conference on Water for Life in the Middle East in Antalya Turkey. This superb turn-out of top level participants took place despite the very difficult, almost impossible, political and security situation in the area at that time. This included a security crisis and closure of the Gaza Strip, road blocks and a general environment of violence. We believe that this occurred because the participants shared with us the belief and conviction that there is a sign of hope on the horizon, even if distant, and there is something that each one of us can and should do to further this hope in his or her own way.

The overall goal of the Conference was the promotion of fruitful dialog, exchange of ideas, the development of mutual understanding and the desire to prepare the ground work for a better appreciation of shared problems and the development of approaches to resolving the water problems of the region in an era of peace.

Many of papers selected for publication in this book contain frank and outspoken comments and critical statements concerning the often conflicting positions and views of the Israelis and the Palestinians on shared water issues. No papers were censored and the views in each case represent the personal, often strong, views of the authors. They will surely stimulate discussion and at times heated responses. However, it is the view of the editors that all these conflicting views should be brought out frankly for open discussion so that both groups know what are the deep feelings, fears and concerns of the other. We believe that this way will lead, eventually, to understanding and resolution of conflicts.

We trust that this will further the preparation for the peace process that we believe is sure to come. We feel that this book and the delegates who participated in the process of promoting peace through dialog among scientists played an important role in what is called "second track diplomacy". We believe that this has helped shape a community of those who are directly concerned with water issues and helped develop closer personal relations between them. All this, in addition to making a positive and important academic contribution to the state of knowledge of the problems to be overcome.

This book includes 44 of the full texts selected from the 80 papers presented at the Conference as well as a number of other invited papers. These papers were all reviewed and adjudicated by the Academic Editorial

Committee and found worthy of publication as peer reviewed papers. To our regret some of authors who presented papers at the Antalyia Conference did not prepare full edited papers for inclusion in this book which may result in a degree of imbalance. It is particularly regretted that an important paper presented by a senior official of the Office of the Water Commissioner in Israel was not submitted for publication.

The proceedings are divided in to the following parts:

Part I: Geopolitical Israeli-Palestinian Water Issues

Part II: Trans-boundary Regional Issues: Jordan River and Dead Sea

Part III: Water Trade and Water Markets

Part IV: Water Imports In The Middle East

Part V: Water Co-operation and Conflict Resolution

Part VI: International Water Law

Part VII: Water Resource Management

Part VIII: Impact of Climate Change

Part IX: Water and Wastewater Technology in the Middle East

We believe that this book which contains the collected thoughts and ideas of leading Palestinians, Israelis and international water experts will provide valuable source material for water scientists, engineers, economists, lawyers, administrators, managers and policy makers interested in understanding, developing, managing and protecting the scarce shared water resources of the Middle East and for the promotion of "Water for Life" for the benefit of all the nations of the region.

Jerusalem, Spring 2007

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Preface

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The great majority of the contributions to this book have been selected from those which were originally presented to a Conference organized by the Israel Palestine Center for Research and Information (IPCRI) at Antalya in Turkey in October 2004. IPCRI is a Jerusalem-based NGO which was founded in 1989 by Israelis and Palestinians eager to work together on issues which had to be resolved before a final peace settlement can be reached between Israelis and Palestinians. IPCRI has always advocated a two state solution and the resolution of difficult issues by way of mutual understanding and creative compromise. It has been generously funded by the international community and private foundations since its inception and has organized a wide variety of conferences and seminars; undertaken joint research on political, educational and environment issues; and published many books and pamphlets. On this occasion we are happy that Springer Verlag has decided to publish selected articles based on presentations at Antalya, thus ensuring a wider distribution of the contents that IPCRI could normally obtain.

In the course of its fifteen years of work on issues which divide Israelis and Palestinians, the so-called final status issues, IPCRI has devoted much time to environmental and water problems. Even after the second *intifada* (outbreak of violence) broke out in 2000, IPCRI was able to organize small meetings of experts to discuss water related issues. These meetings were informal in character. They were not intended to reach decisions but to enable professionals from the two communities to meet in a relaxed atmosphere. Because Palestinians were unable to stay overnight in Israel and vice-versa, the meetings took place in Antalya, Turkey. It was at one of these meetings in 2003 that those present suggested there was a need for a larger gathering such as that which had taken place in 1992 in Geneva when IPCRI was one of a group of sponsors of the '*First Israeli-Palestinian International Academic Conference on Water*'. This would enable a review of current research and thinking about water problems to take place and at the same time provide a venue for a renewal of ties between professionals from the two communities. This recommendation was accepted and the Conference duly took place with financial support from the United States Information Services (USIA), UNESCO, the British Government, the Heinrich Boell Foundation and the German Association for Technical Cooperation (GTZ). The Turkish government also offered valuable logistic support.

The present volume contains substantial contributions by Israelis, Palestinians, Jordanians, Turks and experts from Europe and North America. They deal with the political and social issues related to water supply, quality, use and distribution as well as with basic hydrological concerns. Between them they demonstrate that there are grounds for hope in spite of the present difficult political situation. Professionals on both sides recognize that they must cooperate if they are to reach optimum solutions. The more effective treatment of waste water and the building of desalination plants which can provide fresh water at a reasonable cost, together offer grounds for hope that the amount of water available for domestic use, agriculture and industry can actually be increased.

The Conference in Antalya was attended by approximately two hundred officials, academics, representatives of NGOs and other concerned parties from Israel, Palestine, Jordan, Turkey, a variety of European countries, the United States of America and Canada. At the end of the conference a formal statement was agreed upon the text of which reads as follows:

> We, two hundred participants in the *Second Israeli-Palestinian-International Water for Life Conference* held in Antalya, Turkey (October 10–14, 2004), complete our sessions with a sense of optimism. After four days of discussions, it is clear that the Palestinian and Israeli participants, along with their international partners remain committed to solving the many challenges associated with water quantity and quality in our region.
>
> Water, so essential for life, is crucial for the region. Human activities caused most of our water problems and people can solve them. But this will require coordination and cooperation. The Israeli-Palestinian agreement with its water provisions, signed ten years ago was interim in nature, and anticipated a final, more comprehensive agreement. Since that time, the hydrological situation, shortages and contamination have grown more severe. Technological, regulatory and political solutions exist and need not wait until a comprehensive peace agreement is reached to be applied.
>
> We therefore call upon leaders in the region, the private sector, and the international community to reengage on the issue and for scientists, professionals and NGO's to resume cooperation, ensuring that water demand and supply management remain an issue that unifies and builds bridges, rather than dividing our peoples.
>
> We recommend that governments of the region and the international community undertake a commitment to support the development and implementation of collaborative work on the following regional issues (listed without priority):
>
> - To assure equitable utilization of the water resources among all riparians on an international water course with priority given to meeting *vital human needs,* particularly for domestic and urban water, above and beyond hydrological, geographic, prior use and geopolitical considerations.
> - Establishment of a Center of Excellence for research and training in the field of water;
> - Further study of transboundary and watershed management, and especially pollution prevention;
> - Research into the socio-economic aspects of water supply and demand management;
> - A study of the role of sustainable agriculture in the region;
> - How best to increase the amount of water available and ensure its equable distribution;
> - The potential impact of climate on the region's water resources.

The present volume illustrates, as did the Conference itself, that Israelis and Palestinians can co-operate and are willing to publish their findings under one imprint. This book in itself is a demonstration that not all in the Middle East is conflict and recrimination.

IPCRI would like to express its thanks to the joint editors of this book, Professors Shuval of the Hebrew University, Jerusalem, and Professor Hassan Dweik of Al Quds University, Jerusalem, and to the editorial committee – Professor Tony Allan of King's College, London; Professor Yoel Gat of the Weizmann Institute of Science; Nader al Khatib of the Water and Environment Development Organization (WEDO), Bethlehem; Professor Alfred Abed Rabbo of Bethlehem University; and Miriam Waldman, formerly of the Israeli Ministry of Science, Jerusalem. We would also like to thank our friend Hans Günter Brauch for his invaluable contribution and the Berghof Foundation for Conflict and Peace Research (Germany) that has been funding his work. Without his commitment it is unlikely the book would have appeared. Finally we acknowledge with thanks the work of Toby Brooks (Canada) who made a valuable contribution to the style and presentation of the text and of Thomas Bast (Germany) who produced the book and the index.

Part I Geopolitical Israeli-Palestinian Water Issues

1 Meeting Vital Human Needs: Equitable Resolution of Conflicts over Shared Water Resources of Israelis and Palestinians

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Abstract

The Israelis and Palestinians are partners in sharing the water derived from the Mountain Aquifer. The rainfall over that area flows naturally underground from the mountains towards the areas of Israel along the coast and some 80 per cent of it has been pumped up and utilized historically by Jewish farmers going back some 80 years within the current internationally recognized boarders of Israel. The Palestinians base their claim for their rights for these shared waters on the fact that some 85 per cent falls as rainfall over lands which will be included within the Palestinian State and should be allocated to them based on the concept that the water rights should go along with the land. The Israelis base their claim on the fact that international water law recognizes prior or historic use as a standard basis for water rights regardless of the sources of the water. Israel cites the case of Syrian and Iraqi claims of water rights to the Tigris and Euphrates rivers which are derived mainly from rainfall in Turkey.

Five riparians share the water resources of the Jordan River Basin: Syria, Lebanon, Jordan, Israel and the Palestinian Authority. Based on estimates from the World Bank and other sources, the 2005 availability of water resources/person/year is as follows: Lebanon: 1000 m^3/per/yr; Syria: 800 m^3/per/yr; Jordan: 200 m^3/per/yr; Israel: 240 m^3/per/yr, Palestine: 70 m^3/per/yr. This author has estimated that the *Minimum Water Requirement* (MWR) needed to maintain a reasonable level of social and economic life and to meet *vital human needs* in the Middle East is about 125 m^3/per/yr. The *MWR* would meet the needs for water for drinking, domestic and urban purposes for a hygienic standard of living and for commercial and industrial employment, but not for agriculture. Water for agriculture could be provided by recycled water. The MWR concept has been accepted by many as offering a fair basis for providing an equitable starting point for estimating vital human water needs. From the above it is clear that the Palestinians suffer from the most severe water shortages of the five riparians on the Jordan River Basin. The Lebanese and Syrians are the relatively water rich riparian partners with some ten times as much water per person/year as the Palestinians. This chapter proposes following the primary principle of international water law calling for an equitable sharing of the water resources on an international water basin, giving priority to meeting the *vital human needs* regardless of geographic considerations and historic claims.

Thus, this author proposes that Israel relinquish to the Palestinians a portion of the natural waters of the Mountain Aquifer that it currently uses. He also proposes that Lebanon and Syria, as the two relatively water rich riparians relinquish a portion of their Jordan River water to the Palestinians in the spirit of the proposal of the Johnston plan of 1956. A rightful reallocation of water to the Palestinians should have as its goal meeting their urgent needs for the *Minimum Water Requirement*. This would establish an equitable basis for sharing the water resources to meet *vital human needs* as called for by international water law from the five riparians.

Keywords: Israel, Palestine, Jordan River Basin, water-sharing, equitable- reallocation, mountain aquifer, vital human needs

1.1 Introduction

This chapter will present an equitable approach based on the concept of meeting the vital human needs of both the Palestinians and Israelis so as to achieve a just resolution of the water conflicts between these two peoples which will hopefully bring social and economic benefit to all. Such a resolution of these shared water problems could provide a major impetus to the peace process rather than being viewed as an obstacle to peace.

1.2 Water Resources of the Area

Based on World Bank data, this author's estimates and other sources, the current per capita annual availability of natural fresh water resources of the five riparians who share the water resources of the Jordan River Basin – Syria, Lebanon, Jordan, Israel and the Palestinian Authority (PA) is approximately as follows: Lebanon: 1000 m^3/per/yr; Syria: 800 m^3/per/yr; Jordan: 200 m^3/per/yr; Israel: 240 m^3/per/yr, Palestine: 70 m^3/per/yr (Shuval 2000). From the above it is clear that the Palestinians suffer most from the severe water shortages of the five riparians in the Jordan River Basin. In this author's view the issue of the final rightful reallocation of shared water resources between Israelis and Palestinians must be resolved in a final peace agreement between both sides. These shared water resources must be referred to in any peace agreement. They include the water of the Mountain Aquifer, the segment of Jordan River contiguous to the occupied areas of the West Bank[1] and the portion of the coastal aquifer opposite Gaza.

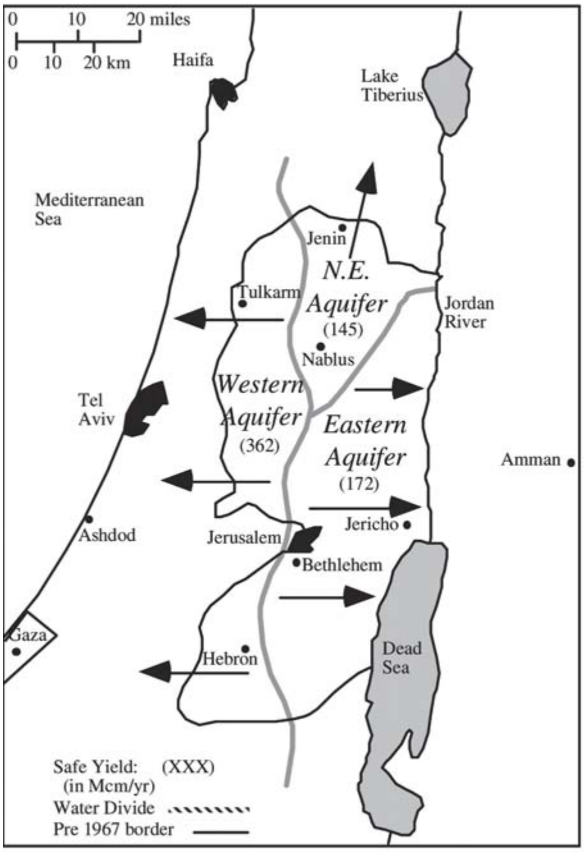
The waters of the Mountain Aquifer (see figure 1.1), the major portion of the recharge area which lies under the West Bank, flow naturally underground into Israeli territory both to the north-east and to the west where major portions of the ground water have been utilized by Jewish/Israeli farmers through springs and wells going back some 80 years, within what are now the internationally recognized borders of Israel.

This chapter is based on the assumption that an independent Palestinian State will eventually evolve in areas of the West Bank in the framework of the peace process under the 'Road Map' approved in principle both by the previous government of the Palestinian Authority and the Israeli Government, which calls for two states side by side living in peace. Whether or not the present administration of the PA plans to pursue this goal is not clear at this time, but for the purposes of this chapter this author assumes that the Mountain Aquifer will ultimately be considered, under the spirit of international law, as a shared body of trans-boundary groundwater with claims and counter claims by both sides for its future utilization and control, which must be resolved, if a peace agreement is to be achieved. International legal experts have pointed out that prior to the Israel occupation of the Jordanian administered areas of the West Bank in 1967; both the Jordan River and the Mountain Aquifer were considered to be trans-boundary or shared water resources. The same applies to the segment of the Coastal Aquifer opposite Gaza.

The pre-1967 ceasefire lines which serve as the recognized border between Israel and the West Bank are shown with a heavy black line. The hydrological divide between the three sub-divisions within the Mountain Aquifer are shown by the grey lines. The arrows show the general direction of flow of the ground wa-

1 The terms 'West Bank' or 'occupied areas' refer to areas formerly administered by the Hashemite Kingdom of Jordan, which were occupied by Israel in response to being attacked by Jordan in the 1967 War. This area is called the West Bank by Jordan and the Palestinians who live there since it was thought of as the West Bank of the Jordan River while the remainder of the Hashemite Kingdom of Jordan was on the East Bank of the River. The areas are referred to by their ancient biblical names of Judea and Samaria by official Israel Government sources. However, Prime Ministry Ariel Sharon referred to the areas as being 'under occupation' in his speech of 26 May 2003. In this chapter this author refers to the area as the 'West Bank' in accordance with terms of the Oslo agreement and international usage.

Figure 1.1: Schematic Presentation of the Mountain Aquifer. Source: Shuval, 1992a



ter. The estimated safe yield in million cubic meters/ year -MCM/yr is shown in (- - -).

1.3 The Mountain Aquifer

The Mountain Aquifer covers the central area of the occupied territories of the West Bank and portions of Israel on both sides of the mountain range and extends generally from the Jezreal Valley (near Afula) in the North to the Beersheba Valley in the South and from the foot hills of the Judean Mountains near the Mediterranean in the West to the Jordan River in the East (figure 1.1).

1.3.1 Historic Palestinian Use of the Mountain Aquifer Water

A full inventory of the historic Palestinian Arab use of the water of the Mountain Aquifer prior to 1967 is beyond the scope of this chapter; however, some qualitative descriptions based on estimates of past use are presented (Shuval 1992a, 1992b).

The early use of the Western Aquifer by the Palestinian Arab population was limited to a part of the flow of springs such as those at Rosh Ha-Ayin and the Tanninim as well as some traditional dug wells in the Qualqiliya and Tulkarim areas estimated at some 25–30 million cubic meters/yr (MCM/Yr). It is estimated that as a result of new wells dug by Palestinians in the area in recent years their total exploitation of the Western Aquifer is about 40 MCM/Yr. Other Palestinian Arab wells and springs prior to 1967 utilized some of the ground water in the Nabalus, Bet-Shean area from the North Eastern Aquifer amounting to about 25 MCM/Yr. The Palestinian use of the water from springs and wells in the Eastern Aquifer was relatively well developed prior to 1967 as confirmed by the extensive Palestinian agriculture that developed in the Jordan Valley area. The total withdrawal by Palestinians from the Eastern Aquifer is estimated at about 60 MCM/yr of which 20 MCM/yr is brackish.

Prior to the 1967 occupation of the West Bank by Israel, Palestinian farmers also pumped water for irrigation from a number of sites along the Jordan River. This was ended by the Israeli authorities after the occupation in 1967. According to a study by Jad Isaac of ARIJ (Applied Research Institute of Jerusalem), Bethlehem, prior to 1967 Palestinian farmers irrigated some 3000 hectares with water extracted from the Jordan River (ARC 2001). It thus, can be is estimated, based on irrigation rates of up to 10,000 m^3/hectre/ yr that the amount of water extracted from the Jordan River by Palestinian farmers prior to 1967 was about 30 MCM/yr.

There appears to be no evidence that there were any major official constraints on the development and utilization of the natural water resources of the Mountain Aquifer or Jordan River by the Palestinian Arab population living in the West Bank under the Ottoman, British or Jordanian Administrations between the turn of the century and the end of the Jordanian administration of the West Bank in 1967. However, during this period intensive Arab development of the ground water resources of the Mountain Aquifer would have required investments in hydro-geological investigations and modern deep well drilling technology costing more than was apparently available to individual Palestinian landowners, farmers, villages or municipalities. Thus, from a historical perspective, it appears that the relatively limited Palestinian Arab development of the water resources of the Mountain Aquifer up to 1967 were mainly by local farmers and villages and were limited by a lack of organization, planning and economic resources. This is one possible explanation for the fact that up to 1967, prior to the Israeli occupation of the West Bank, the Palestinian exploitation of the water of the Mountain Aquifer within the West Bank amounted to less than 20 per cent of the potential. There may be other views on this question.

After the occupation of the West Bank in 1967, Israel did not allow for any significant further utilization of the aquifer by the Palestinians. This ruling was based on the Israeli hydrological perspective that, in effect, the aquifer was already being pumped and exploited to its full *safe yield* and that any further pumping in the West Bank or Israel would lead to a dangerous lowering of the water table and eventual intrusion of sea water along the coast which would lead to serious pollution of the water used by both peoples.

However, under the terms of the Oslo agreement, Israel has supplied some 40–50 MCM/yr of additional fresh water exclusively for domestic and urban use to the West Bank communities and some 5 MCM/yr to communities in the Gaza Strip.

1.3.2 Historic Israeli Use of the Mountain Aquifer Water

About 80 years ago, long before the establishment of Israel by the United Nations in 1948, the Jewish farmers in the Jordan Valley, Bet Shan, Jezrael valley, Hadera, Petach Tikva, Yarkon River and other areas, were already utilizing a significant portion of the safe yield of the Mountain Aquifer from the springs, rivers and deep wells: by private farmers, villages and through the Mekorot Water Company and other local organized initiatives. All of these had received official approval by the relevant authorities (Blass 1960).

For example, the British Mandatory Government granted in 1921 to Mr. Pinchas Ruttenberg, a Jewish engineer, an exclusive concession for the use of the water of the Yarkon River – one of the two natural outlets of the Western Aquifer. His company, which eventually became the Israel Electric Company, was also granted an exclusive concession on all the water of the Jordan and Yarmuk rivers in 1923, which led to the organized utilization of those waters for power generation and irrigation up to 1948. Today the Mountain Aquifer is tapped by about 300 wells located to the west of the 'green line', that is, within the recognized international boundaries of Israel. In effect by 1967, prior to Israel's occupation of the West Bank, Israel was utilizing some 80 per cent of the potential of the Western and North Eastern Aquifers within the borders of Israel.

1.3.3 Israeli Exploitation of the Mountain Aquifer in the West Bank

Since the Israeli occupation of the West Bank in 1967, Israel has drilled numerous new wells in the Mountain Aquifer within the area of the West Bank, mainly to supply water to the new Israeli settlements and some to Palestinian communities. Official information on the exact amount of water withdrawn by Israel from within the West Bank aquifer is not available, but unofficial Palestinian estimates indicate that it may be about 30–40 MCM/Yr from the Eastern Aquifer and another 20–35 MCM from the Western and North-Eastern Aquifers for an estimated combined withdrawal of some 50–75 MCM/Yr. The accuracy of these estimates has not been validated from any official sources. The Palestinians claim that any water extraction in the West Bank for Israeli civilian settlements is illegal and in violation of the Geneva Convention concerning the rights and obligations of what is defined as the "belligerent occupier" (El Hindi 1990). Israeli Law Professor, Ayal Benvenisti (1994) supports this interpretation of international water law.

Based partially on some official sources from the Israel Hydrological Service (personal communication from Prof. Amos Bein 2005; Chaklai 2004; Goldberger 1992) and some unofficial estimates (Shuval 1992a, 1992b) it would appear that the estimated potential safe yield of the Mountain Aquifer is about 680–700 MCM/Yr., about 500–550 MCM/Yr of which is derived from the Western and North Eastern Aquifers. Of this, some 350–400 MCM/Yr or 70–80 per cent is now and had been utilized within Israel's borders prior to 1967, with part of its use going back some 80 years. Some 150 MCM/Yr is currently used by the Palestinians, while it is estimated that another 50–75 MCM/Yr may be pumped by Israel from new wells drilled since 1967 within the West Bank for use mainly by the new Israeli civilian settlements there. This estimate has not been validated from official Israeli sources. It is estimated that there may be about another 50–100 MCM/Yr of unutilized water in the Eastern Aquifer which might be tapped by the Palestinians as sweet water through deep wells. Some of these wells, such as those at Herodian, have already been drilled with mixed success. The possibility of additional sources of yet untapped water in the Eastern Aquifer is specifically mentioned in the Oslo B agreement and estimated at 100 MCM/Yr as potential supplemental water supplies for the Palestinians. However the amount of water potentially available from this source is as yet unverified. In addition, Israel delivers 40–50 MCM/yr to West Bank municipalities for domestic and urban use only, in accordance with the Oslo agreement.

The Palestinians pump some 100 MCM/Yr from the Gaza Aquifer, which however, has an estimated long term safe yield of only 60 MCM/Yr and suffers from severe over-pumping and degradation. Much of it is unfit for use as drinking water. The Israeli settlements in Gaza pumped an additional 5 MCM/Yr, or more. These wells reverted to the Palestinians, on the withdrawal of the Israeli settlements from Gaza in the summer of 2005. This set an important precedent of Israel's returning water resources to the Palestinians used previously by settlers on their withdrawal from the area. In addition Israel has offered to sell the water-short Palestinian's in Gaza significant amounts of additional drinking quality water derived from Israel's first major desalination plant in Ashkelon, which was completed at the end of 2005.

The total estimated available water for the Palestinians from the local aquifers in the West Bank and in Gaza, in 2006 is thus estimated at about 250 MCM/Yr. It is estimated that there may be an additional amount of some 50 MCM/Yr in yet undeveloped sources in the Eastern Aquifer. With the potential water increase that might be available to the Palestinians in the West Bank, without reallocation of water by Israel, the total available to the Palestinians would be about 300 MCM/Yr.

1.4 The Palestinian and Israeli Positions and Claims

It is essential to spell out the positions, claims and counter claims as well as the real and perceived fears and concerns of both sides in the dispute over the shared water resources, mainly those concerning the Mountain Aquifer, centered in the West Bank.

1.4.1 Palestinian Positions

The Palestinians position is that while some 80 per cent or more of the flow of the Western and North Eastern sections of the Mountain Aquifer are derived from rainfall over the West Bank areas slated for inclusion in the future Palestinian State, 85 per cent of the water is currently extracted from deep wells and springs mainly within the borders of Israel. The position of the Palestinians is that these waters should be considered shared waters which should be allocated on an equitable basis. Some authors consider them Palestinian water derived from Palestinian land areas that should be allocated for their use. The Palestinians, many of whom are farmers and villagers whose families have been living on these lands for hundreds of years, have a strong attachment to the land and the water that falls as rain over it, nourishes and sustains it and them. They feel keenly that they should not be deprived of the natural resources, such as water, that should go along with the land (Haddad 2005). The Palestinians have strong feelings about the need to recognize their just claims to their 'water rights', particularly in relation to the ground water of the Mountain Aquifers under the lands that will be part of the future Palestinian State. They also have claims to a portion of the water of the Jordan River which they utilized prior to the Israel occupation in 1967 and to more water which would have been allocated to the Palestinians in the West Bank under the proposed Johnston Plan of 1955.

In general, the Palestinians claim the priority rights to complete and total control of the Palestinian water of the mountain aquifer. They reject expensive schemes to desalinate sea water or import water from other nations for Palestinians as proposed by Israel. Such schemes would be under Israeli management and control. They fear that such projects are expensive and will perpetuate Israeli control over their vital water supplies and their life which would deprive them of their independence. The Palestinians hold that if Israel wants to, it could develop such projects as desalination on their own. Israel in return could then forgo claims to the local, easily accessible, Palestinian water sources available under the land areas of the Palestinian State to be established in the West Bank. The Palestinians see the return of their *water rights* together with the return of their land as one of the most important issues in the establishment of their national identity and independence in the Palestinian State to be formed.

1.4.2 Israeli Positions

The basic Israeli position is that it has legitimate historical/prior use riparian water rights to that portion of the Mountain Aquifer's natural water flow currently used within the recognized international borders of Israel, based on the principle of *prior or historic* use according to international water law. Israel rejects the claims that it has 'stolen' the water of the Mountain Aquifer from the Palestinians. Israel points out that major portions of that water have always flowed naturally underground into its territory and eventually into the sea. Meanwhile water systems have been developed by early Jewish residents and by Israel at great expense and fully utilized over a period of time going back some 80 years. These waters are currently used to meet vital human, social and economic needs in Israel. It is Israel's view that depriving them of that water would cause significant and appreciable harm, which is against the principles and spirit of international water law. Israel's official governmental position is that it will not relinquish to the Palestinians any of the natural waters of the Mountain Aquifer or other sources that it is currently using and has used historically. However, Israel has stated that it is prepared to offer the Palestinians significant options for additional water from desalination and other possible new sources of cooperatively developed new water projects. In fact, Israel has already allocated some 50 Million Cubic Meter/year (MCM/yr) of additional water to the Palestinians.

Israelis are concerned that if the Palestinians achieve independence, in all or part of the West Bank, they will, once they gain physical control of the territory, insist on making good on their claim that all of the water of the shared Mountain Aquifer that is derived from rainfall within the West Bank be allocated exclusively for their own use. Israelis are concerned that this will lead to unrestricted and unlimited pumping in the feed areas of the Western and North Eastern Aquifers. This fear is compounded and exacerbated in Israel's eyes by the fact that after the transfer of the Gaza Strip to the administration of the Palestinian Authority some 1000 or more new wells were dug there by Palestinian farmers, resulting in serious uncontrolled over-exploitation and pollution of the limited Gaza aquifer. Also, in the past few years, Palestinians have dug several hundred new, unapproved, wells in the Western Aquifer areas of the West Bank under their control. Israeli water supply managers are concerned that any reduction in Israel's ability to continue to pump from the existing wells whose source is the Mountain Aquifer that it has historically used within Israel, will seriously reduce Israel's ability to manage, control and regulate its water supply needs and cause it appreciable harm.

Several of the authors of chapters in this book and in other publications are highly critical of Israel's management of the shared water resources and have included strong disparaging remarks and serious accusations. Some may be justified and others are incorrect and misleading. While I agree with some of the criticisms of Israel's policy I think that many of the accusations are erroneous, needlessly inflammatory and are not always formulated in proper academic language or in the spirit of open academic discourse. It is thus appropriate to attempt to present here a more balanced approach. To the best of my judgment the Israeli official and unofficial comments and or response to some of the claims and accusations made by Palestinian and other authors in this book are briefly summarized as follows:

a.) Jewish farmers, villages and water companies have legally developed the water resources of both the mountain and coastal aquifers within the current internationally recognized borders of Israel with full approval of both the Turkish and British Mandatory Government authorities going back some 80 years, well before the occupation of the West Bank in 1967. Under the letter and spirit of international water law, this historic or prior use provides Israel with rights for the legal continued use of these waters. These waters which flow naturally into Israel, and are extracted within the borders of Israel were not '*stolen*' from the Palestinians. International water law does not recognize that the upstream country owns the water that flows into a neighboring country. Turkey as the source country, does not own the waters of the Tigris and Euphrates Rivers; and Syria and Iraq have not *stolen* Turkish waters. The statements that Israel *steals* or *mines* water from the *Palestinian Mountain Aquifer*, which is actually a shared aquifer is inflammatory, misleading and incorrect hydrologically since the ground water flows naturally into Israel and the wells are within Israel's boarders.

b.) There were few or no restrictions on the Palestinians farmers and villages in the development of their water resources from these same shared aquifers during the Turkish or Mandatory periods nor during the period of the Jordanian administration of the West Bank from 1948–1967. It is incorrect to blame Israel for this lack of historic water supply development during a time that three outside powers, none of which was Israel, governed Palestine.

c.) Israeli officials reject the claims that its extraction of water from the Jordan River is in violation of international water law. Israel also rejects the accusation that it has totally disregarded the principle of equitable sharing of the Jordan River water. Just the opposite, Israelis claim that under the sponsor-ship of the American negotiator Eric Johnston in 1955–56, Israel negotiated in good faith with Syria, Lebanon, and Jordan for the fair and equitable sharing of the waters of the Jordan River Basin, a portion of which would have been allocated to the West Bank for the Palestinians. A draft agreement for equitable shared use was reached with all the partners but was rejected and torpedoed by the Arab League on political grounds, since they refused to recognize Israel's right to exist and to withdraw any water from the Jordan. This position was against the spirit and basic principles of international water law of equitable sharing between all riparians on joint water resources. Israel then reached an informal agreement with Jordan, sponsored by the United States, for mutual extraction of water from the Jordan Basin. Jordan extracted water for the irrigation of the Jordan Valley and transported a portion outside the basin to Amman, while Israel transported a portion to the Negev. There is nothing in international water law to prevent transfer of water outside the watershed. Israel's sharing of the waters of the Jordan River with Jordan is now formalized in the 1994 peace agreement with Jordan.

d.) Israeli officials reject the claim that by building its National Water Carrier, which was done with the unofficial agreement of Jordan, makes it solely responsible for the drying up of the Lower Jordan River and Dead Sea. In fact Syria and Jordan are also primary extractors of the water of the upper Jordan and Yarmuk Rivers which are the sources of the lower Jordan River and the Dead Sea.

e.) The claim that the Lower Jordan is polluted today is sadly quite correct. However, Israeli officials reject the claim that only wastewater from Israel pollutes the Jordan River. They point out that there are numerous sources of wastewater flow from Jordan and Syria, including the sewage of Amman which pollutes the Jordan River.

f.) Israeli officials and hydrologists reject the claims by some Palestinians that after 1967 Israel's requirements for licensing of new Palestinian wells in the West Bank were punitive and discriminatory. Actually, according to the independent professional estimates of expert hydrologists, the Mountain Aquifer was fully utilized to it maximum safe yield by wells within Israel, well before the Israeli occupation of the West Bank in 1967. Israel did not allow further wells to be dug in Israel without a specific license. The same regulation applied to Palestinians in the West Bank.

g.) The claim that Israel has not recognized Palestinian water rights is incorrect. The Oslo II accord of 1995, specifically mentions the recognition of Palestinian water rights to an equitable portion of the mountain aquifer. In fact based on the Oslo II accord, Israel has increased the Palestinian share of the Mountain Aquifer by some 50–70 million cubic meters per year. However, it was mutually agreed that the exact amounts to be allocated to the Palestinians are to be determined in the framework of the final peace agreement with the Palestinians. During the Israeli-Palestinian peace negotiations under the auspices of President Clinton in 2000, Israel made serious proposals to increase the Palestinian portions of the shared water resources reported to be some 200 million cubic meters per year- almost a doubling of their presently available water resources and providing a significant improvement in the Palestinian quality of life. Sadly, the Palestinians withdrew from those negotiations, which essentially put an end to the possibility of increasing their share of the water resources. The possibility of a peace agreement including a resolution of the water issues seems distant today, after the election of the Hamas government, which totally rejects negotiations, recognition or peace with Israel. However, Israel still holds that in the framework of a peace agreement there is a basis for a significant increase in the Palestinian share of the water resources.

h.) The claim that Israel is responsible for the fact that many Palestinian villages do not have water supply piped to the homes is knowingly misleading and basically incorrect. During the Turkish, British and Jordanian administration of the West Bank very few villages had water supply systems and most of the local villages did not have the required funds to develop them. The Palestinian institutions sadly did not have the organizational initiatives or funds to sponsor building of village water supplies and neglected the existing water supply infrastructure. During the period of the Israel's administration of the West Bank, some one hundred new village water supplies were constructed, infrastructure improvements were made and thousands of families were connected to water in their homes – more than was ever done under the Jordanian administration. However, it is sadly true that there are still many Palestinian villages and homes without proper water supply –this is not Israel's fault.

i.) Some Palestinian authors claim that Israel has dug deep wells near Palestinian shallow wells causing them to dry up. While this may have happened in a few cases, Israel compensated the villages with new sources of external water supplies. However, independent hydrological investigations point out that the deep Israeli wells tap a lower aquifer which is separated in most cases from the shallow aquifer used by Palestinians. Israel officials point out that most of the complaints and accusations were made during the severe draught period of 1998–90, which resulted in many Palestinian shallow wells drying up naturally as a result of the draught. These wells resumed their normal flow after the draught ended. However, the stories and accusations of Israeli malfeasance continue to be spread to this day.

j.) Some Palestinians blame Israel for the serious degradation of the aquifer under Gaza. The water quality there is indeed very poor. However the sad fact is that in 1967, when Israel occupied Gaza, there was already serious over-pumping of the aquifer allowed under the Egyptian administration, which led to the intrusion of sea water and serious pollution of the ground water. Under the Israeli administration, there was an attempt to reduce the over pumping and prevent pollution. However, within months after the administration of Gaza was handed over completely to the Palestinian Authority under the Oslo Accord, hundreds of illegal wells were dug by Palestinian farmers; resulting in even more severe over pumping and ground water pollution. The PA made little or no efforts to curtail the serious pollution of the ground water there.

k.) Some Palestinian authors claim that a major share of the flow of the Jordan River amounting to many hundreds of million cubic meters per year belongs to the Palestinians. It is true that prior to the 1967 occupation of the West Bank by Israel, Palestinian farmers pumped certain amounts of water from the Jordan River and thus can, under international water law, claim certain prior use rights. According to the published study by Palestinian researcher, Jad Isaac of ARIJ the total amount of water pumped by Palestinian farmers from the Jordan prior to 1967 can be estimated at about 30 million cubic meter per year not ten to twenty times that amount. Some Israelis point out that such highly exaggerated, inflated and unreasonable claims cast reflections on the academic credibility of such authors and place a heavy cloud over rational negotiations, making it difficult to achieve a fair and equitable reallocation of the shared water resources.

What can be done to resolve these conflicts in light of the above partial list of the claims, counter claims and fears of the parties which seem at first sight irreconcilable? These issues will be examined in more detail.

1.5 Role of International Water Law

The 1997 United Nations Convention: *Law of the Non-Navigational Uses of International Water Courses* provides the main basis for international water law. Although only a relatively few countries have signed and ratified the convention and it has not as yet been formally activated since this requires the ratification by 35 nations, it is nevertheless considered the guiding spirit of international water law at this time. Many question whether this document applies to ground water but Daibes-Murad (2005) points out that it does apply to a some degree. Although it is in no way binding, international legal experts and negotiators are aware of the fact that its principles hover over negotiation tables and do have a decisive influence. The Convention has promulgated two major and equal guiding principles:

- To assure equitable utilization of the water resources among all riparians on an international water course with priority given to meeting *vital human needs,* particularly for domestic and urban water, above and beyond hydrological, geographic, prior use and geopolitical considerations.
- The obligation not to cause significant or appreciable harm to other riparian states.

The principle of *equitable utilization* of water resources among the riparians on a shared international water course is a deeply embedded principle of international water law drawn from the earlier and widely accepted Helsinki Rules of 1976. It has been reinforced by the recently drafted 'Berlin Rules' of the International Law Association (2004) which have reconfirmed and expanded the *equitable utilization* concept. While Article 13 of the Berlin Rules "Determining an Equitable and Reasonable Use" lists a number of relevant factors that should be considered, Article 14 "Preference among Uses" specifically states: "In determining an equitable and reasonable use, states should first allocate water to satisfy *vital human needs*."

Most authorities in international water law have come to the following conclusions: There is no legal basis in international water law for the claim of some nations that they have sole and exclusive rights over the use of water derived from sources within their territory. The upstream country has rights to the *equitable shared use* of the water *but not to sole and exclusive rights*. The Syrian and Iraqi claims for the continued use of water of the Tigris and Euphrates Rivers that originate in up-stream Turkey are fully accepted under international law. However, the claim that Syria has absolute rights to all the water of the Jordan River emanating in Syria and that Israel, as one of the down-stream users has none, would not be accepted as being in compliance with international water law. Similarly Egypt has fully recognized rights under international law for the continued use of the water of the Nile which originate entirely in up-stream countries.

International water law does recognize the legitimacy of prior or historic use rights but the claim that prior and historic use assures immutable and sole water rights is also not absolute in terms of international water law. Modern concepts of international water law, which emphasize the requirement of *equitable sharing among all the riparians* with priority given to meeting *vital human needs* for domestic and urban water use on a trans-boundary water basin obliges both the upstream source countries and downstream historic users.

Based on modern principles of international water law, both the historic riparian rights of Israel as the downstream user and the rights of the Palestinians as the upstream party on a shared body of water must be considered on the basis of equity and *vital human needs* (Shuval 1992a; Daibes 2005). Both parties to the conflict would be expected, in the first instance, to negotiate directly between themselves to arrive at a settlement based on the principles of 'equitable shared use' rather than to enter a confrontational litigation, expecting some supra-governmental authority to enforce a judgment based on what each side views as their legitimate *water rights*. In the one case of this type based on conflicting claims of *water rights* ever brought before the International Court of Justice, the Court ruled that the dispute should be returned to parties who should resolve it by direct negotiations (Wolf 1997).

There are varying views as to whether or not international water law is mandatory or enforceable, however, there is a general agreement that whether mandatory or not the principles of *equitable shared use* and priority to meet the *vital human needs* of nations and peoples who share international water resources hovers above the negotiation tables and have a strong influence on the negotiations. In the final analysis the Palestinians and the Israelis will have to determine, through direct negotiations between them, what they consider to be fair and just equitable sharing of the common water resources in order to meet vital human needs.

1.6 Minimum Water Requirement as a Basis for Estimating the Legitimate Water Needs of the Parties

In order to determine the legitimate minimum reasonable water requirements of the parties to meet *vital human needs* as called for by international water law, this author has have made an estimate of the baseline vital human water needs of the parties required to assure an acceptable level of health and hygiene, to ensure sustainability and a reasonable standard of living in an arid area. It can be assumed that the partners to the dispute will each require, as a minimum degree of water security to meet vital human needs, access, mainly *from within their territories* to adequate and equitable allocations of good quality drinking water required for human health and welfare. In 1992, Shuval (1992a, 1994) formulated the concept of the *Minimum Water Requirement* (MWR) which is an estimate of a reasonable amount of good quality water to meet the basic *vital human needs* for drinking water and for domestic and urban use in the arid Middle East. Based on these studies, the figure he suggests for the MWR is about 125 m^3/person/ year.

This level of water usage is also the current level of water demand in the domestic/urban sectors in Israel, which assures a good hygienic standard of domestic and urban life and sufficient water to assure a livelihood for *human survival and sustenance* of the population in commerce, trade, and industry (Braverman 1994). It is also the level of domestic/ urban sector water use in several European countries living with acceptable high standards of domestic hygiene, sustainability and economic life. In the United States domestic and urban water demands are greater and average some 180–200 m^3/per/yr. This author has included in his concept of *vital human needs,* as called for by international water law, both water for domestic use as well as drinking quality water for urban use to assure a livelihood required for human survival, excluding agriculture. I have assumed that this level of urban sector water consumption can be maintained for a long time into the future if coupled with sound measures of water conservation. Today, the Palestinian domestic and urban use is at a much lower level at about 35 m^3/per/yr, due both to water shortages and and/or inadequate water supply infrastructure as well as to socio-economic factors. In many cases the Palestinian domestic water use does not meet the minimum for hygienic standards recommended by the World Health Organization of 100 l/per/day (about 37 m^3/per/yr). Braverman (1994) in his report to the World Bank estimated that in the future, as Palestinian socio-economic conditions improve it can be estimated that their water requirements for domestic, urban, commercial and industrial use will be similar to that of Israel or about 100–125 m^3/per/yr. The MWR proposed above should be a goal to be achieved, in time, based on the assumption that all nations in the Jordan River Basin will eventually reach similar socio-economic levels and will require at least that minimum MWR on an egalitarian and socially just basis. A number of Israeli, Palestinian and international water experts have accepted the MWR concept as providing a fair basis for evaluating *vital human needs* and for cooperation between Israelis and Palestinians and of the other riparians in the Jordan River Basin (Assaf/Al Khatib/Kally/Shuval 1993; Braverman 1994). However, official Israeli or Palestinian authorities have, to date, not accepted this proposed MWR formulation.

Water allocations for agriculture, nature, ecology and further urban, industrial development are not included in the MWR estimate, but significant additional quantities of water can become available for these sectors from recycled purified municipal wastewater which is estimated at 65 per cent of the urban water supply (see table 1.1). After the total utilization of all sources of local good quality drinking water from natural sources and recycled wastewater, the further water needs of both Israelis and Palestinians will have to be met by desalination of brackish water or seawater and the development of regional projects for the import of water in an era of peace such as those proposed by Kally (1990).

Since it is difficult if not impossible to plan for all future developments and population growth, it is suggested that the estimated MWR needs of the riparians for a 20 year period be used as the basis for a peace agreement which will provide for rightful reallocations of resources that will assure a reasonable period of water security, economic development, sustainability and social stability. As an illustration it can be assumed that the estimated populations in 20 years (by the year 2025) will be as follows: Israel: 10 million and the Palestinians: 6 million. The true populations may be greater or smaller than these figures depending on many demographic and political factors which are difficult to predict at this stage. These figures are presented as an example of a possible scenario. Based on this assumed population the suggested requirements of the basic vital human water needs – the MWR at 125 m^3/per/yr- to assure water security - mainly from sources within each territory are as shown in table 1.1. It is assumed that 65 per cent of urban water supplies can be treated and recycled for additional use for agricultural, industrial, nature, ecology and urban non-potable reuse and thus provide an increased availability of water from local sources.

Table 1.1: Israeli and Palestinian Needs to Meet Minimum Water Requirements at 125 m^3/per/yr in 2025 for Domestic, Urban, Commercial and Industrial Water Supply

	A	B	C	D
Country	**Population millions**	**MWR MCM/yr Water**	**Recycled MCM/Yr 65 % of B**	**Total (B+C) MCM/Yr Fresh+ Recycled**
Palestinians	6	750	490	1240
Israelis	10	1250	810	2060
Totals	16	2000	1300	3300

Assuming that the Palestinians can ultimately access and utilize from within the West Bank and Gaza some 300 MCM/yr, including the yet unexploited water resources in the Eastern Aquifer, it is apparent that they will be short some 450 MCM/yr to meet their MWR needs of 750 MCM/yr for the year 2025. How can the Palestinian's obtain the needed increase in their share of the limited water resources?

1.7 Increasing the Palestinian Share of Water Resources

1.7.1 Rightful Reallocation of Water Currently Utilized by Israel

Despite the fact that Israel has strong claims of *water rights* under international water law to that portion of the Mountain Aquifer that it has used historically, it will undoubtedly be asked to consider negotiating an agreement on the equitable shared use of the natural flow of that aquifer with the Palestinians in order to reach an accommodation and to help meet their *vital human needs*, in the spirit of international water law, in the framework of the final peace agreement. Israel will be expected to find an appropriate way to meet the strong Palestinian demands and expectations for increased allocations of the natural water of the Mountain Aquifer available within the bounds of the future Palestinian State. At this time Israel officially opposes any such reallocations. Likewise the Palestinians have their case in support of their claims of *water rights* for all the water that falls as rain over the Mountain Aquifer and for a portion of the flow of the Jordan River that was allocated to the Palestinians living in the West Bank under the Johnston plan (Shuval 2002). Both parties should accept the spirit of international water law which calls for *equitable sharing to meet urgent vital human needs* rather than get involved in endless and irreconcilable arguments about whose claims of 'water rights' are stronger.

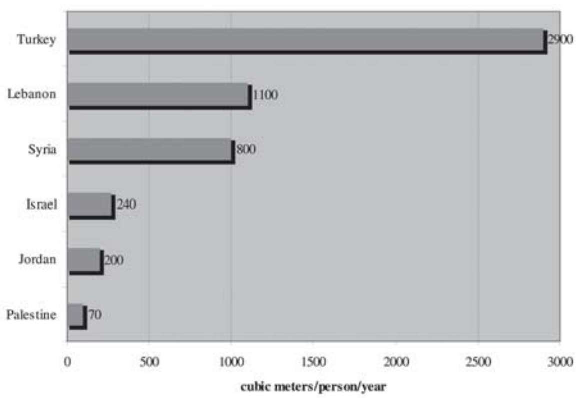
The *rightful reallocation* and sharing of some of Israel's current use of the Mountain Aquifers water resources is one of the possible source for the Palestinians to meet their vital MWR needs for urgent drinking water/domestic/urban sector uses. Israel's present official policy is not to share this water with the Palestinians, but Shuval (1992) argued that it is in Israel's interest to share its water resources, although they are rather limited, with the Palestinians, so that they not only can survive but can thrive economically and socially. Promoting a fair and equitable resolution of the water conflicts between Israel and the Palestinians can provide one of the important and sound cornerstones of a permanent peace agreement. In addition, only an economically and socially strong Palestine can become a good neighbor living in peace side by side with Israel.

However, since this author does not represent the Israeli Government or the official water authorities in any way or manner, he can only suggest in general terms his own personal thoughts and estimates concerning Israel's ability to reallocate a portion of their shared water resources with the Palestinians, who will be in urgent need of more water for their *vital human needs* for the domestic and urban sector as the years go on. Without going into details, it is not unreasonable to estimate, that at best, Israel can reallocate only a part of the Palestinians' needs to meet their essential MWR up to the year 2025. Israel does not have enough water to meet all of its own MWR needs for the year 2025 as well as those of the Palestinians. Since an egalitarian basis for water sharing is assumed, Israel's MWR needs must also be taken into consideration, no less than those of the Palestinians. It is clear that additional external sources will be essential to meet all of the Palestinian MWR needs for 2025.

Nevertheless, this author would recommend to the Israeli authorities that they consider relinquishing some of their current use of the Mountain Aquifer and agree to an increase in the *rightful allocation* of the Palestinians share of the water of the Western and North Eastern Aquifers. In the first instance, Israel should relinquish the total amount of water it is pumping from within the West Bank for Israeli settlements located there since its occupation in 1967. That amount is unofficially estimated at some 75 MCM/Yr, but the exact amount is not known. Israel has a weak case in justifying the claim of prior or historic use of any of that water and its legal right under international water law to continue that use is in question (Benvenisti 1994). For example an important precedent has been set by the Israel authorities on the withdrawal of the Israeli settlements from Gaza. The wells that Israel developed there for the settlements reverted to the Palestinians. It would also be appropriate for Israel to return all of the West Bank wells and the water pumped by them to the Palestinians. In addition to that, this author would recommend that Israel considers forgoing the exploitation of an additional 75 MCM/yr currently pumped from the Western or North Eastern Aquifers, thus increasing the Palestinian share of the Mountain Aquifer by a total of 150 MCM/yr. Israel would have to reduce its own pumping from the Mountain Aquifer proportionately.

Further, Israel should consider reallocating an additional 50 MCM/yr to the Palestinians in the Jordan Valley directly from the water of the Jordan River. This might be seen as a symbolic recognition of the Palestinian prior use of the Jordan River water up to 1967 (ARC 2001) from which they are currently blocked by Israel. Thus, the total increase for the Palestinians from previously utilized or controlled Israeli sources would be 200 MCM/yr or some 45 per cent of the additional estimated amount needed to meet the Palestinian MWR for the year 2025. That additional water allocated for domestic/urban use, in stages as required, would however, go a long way in alleviating the urgent Palestinian needs for more drinking water and water for domestic and urban use for the next 10–15 years at least and until additional water allocations from other neighboring countries, sharing the water of the Jordan River Basin, become available.

Figure 1.2: Potential Fresh Water Resources Available in 2000. Current estimated total water reserve potential from all sources of the Jordan River Basin riparians based on cubic meters/person/year compared to Turkey.



With that proposed rightful reallocation of some 200 MCM/yr of Israel's use of the shared water resources Israel will remain with just about its MWR of 125 m^3/per/yr and cannot be expected to increase it's sharing beyond that point.

1.8 Should Lebanon and Syria Assist Palestinian Vital Human Water Needs?

Figure 1.2 indicates the estimated total water resource potential from all sources of the five Jordan River Basin riparians on the basis of m^3/per/yr for the year 2000. This is compared to Turkey, the water rich contiguous neighbor to the countries on the Jordan River Basin, based on World Bank, other sources (Gleick 1992) and Shuval's (2003) own estimates. These are rough estimates only and may not be topical; however, they do more or less correctly graphically represent the relative availability of water to each of the five riparians. It can be roughly estimated, based on those sources that the population of the riparians in the Jordan River Basin will double over the next 20–30 years and their estimated MWRs to meet vital human needs for domestic and urban use required for a reasonable level of social and economic welfare based on 125 m^3/p/yr will double as well.

As previously stated, unless the Palestinians obtain significant additional water supplies they will face the most severe water shortages by 2025 with only about 35 m^3/per/yr for all uses including agriculture. Both Israel and Jordan will be at or below the MWR red line as well. However, both Syria and Lebanon, while not truly water rich countries, will, by the year 2025, still easily be able to meet their own MWRs and will have considerable amounts of water above those needs. A rough estimate of their excess of water resources above their own MWR needs will be about 7000 MCM/yr for Syria and 3000 MCM/yr for Lebanon for a total of 10,000 MCM/yr (Shuval 2003).

Even if the above rough estimated figures are off to some degree and only half of that amount is available, there is little question that both the Syrians and Lebanese will have much more water available to them per person than the Palestinians by a significant factor. As stated previously the basic overriding principle of international water law is *equitable sharing of water resources among the riparians* on a shared international water course, giving priority to meeting *vital human needs*, in particular of the urgent requirements for drinking water and domestic and urban needs for human health and welfare.

Thus, in approaching the equitable allocation of the water of the Jordan River Basin in the spirit of international water law it is only right, socially just and correct to first evaluate the absolute minimum vital human needs to meet the requirements of social and economic welfare of all riparians and to assure that each one receives a fair and equitable share, at least to meet those *vital human needs*. It then can be argued that those riparians faced with severe water needs should be assisted by those riparians with more plentiful reserves of water resource. From the estimates of the MWR for the year 2025 (table 1.1.) it is clear that the Palestinians will be faced with the most severe water shortages and will not be able to survive without assistance from their neighbors including those on the Jordan River Basin. The only two nations with an estimated major excess of water reserves above and beyond those required to meet their own MWRs will be Syria and Lebanon, the upstream Arab neighbors of the future State of Palestine. In the year 2025 Israel will be just able to meet its own MWR with no more water reserves to spare.

On the assumption that Israel will accept these recommendations and will reallocate to the Palestinians some 200 MCM/yr, this will meet some 45 per cent of the Palestinian needs for the year 2025. If Syria and Lebanon join together in allocating an increased share of the flow of the Jordan and Yarmuk rivers to be supplied directly to the Palestinians to meet the additional 55 per cent of the amounts water that they will require in the year 2025 it will involve an annual allocation of some 250 MCM/yr or less than 1 per cent of their total available water resources and 2.5 per cent of their total estimated excess water resources above that required to meet Syria's and Lebanon's own MWR needs.

Is this an unreasonable demand to assure equitable water sharing and to meet urgent *vital human needs* of the water short Palestinians, a brother Arab nation, who are the least fortunate of the Jordan Basin riparians? Such a reallocation of water to the Palestinians from the upper Jordan River Basin sources could be seen as a symbolic recognition of the water allocation to the Palestinians on the West Bank through the West Ghor Canal proposed by the Johnston Plan of 1955 (Shuval 2000).

Lebanon and Syria can easily be even more generous with the Palestinians and assist them with their water needs beyond the year 2025 in the framework of regional water development projects such as the Al Wachda-Unity Dam project being developed with Jordan or the utilization of water from the Litani and Awali rivers in Lebanon (Kally 1990)

The ideas presented above are personal and may be a truly unconventional approach to the concept of equitable sharing of the water resources in the Jordan River Basin. However, it is in my view entirely within the spirit and principles of international water law that those countries with more plentiful water resources come to the assistance of their less fortunate neighbors on the same international water basin. The basis for a just and lasting peace among the riparians of the Jordan River Basin must be based on accepting the legitimacy of each of the partners and their rights to an equitable share of the water. The reallocation of the water should be based on an objective analysis of the real vital human water needs of each and the ability of those with more plentiful resource potential to assist those in need. Israel cannot do this alone but together with a minimal reallocation of water from Lebanon and Syria all of the most urgent Palestinian water needs up to the year 2025 can be met. Is this a utopian dream?

1.9 Will Israel Agree to a Reallocation of its Current Natural Water Resources?

Since this author does not represent the official Israeli government position in any way, this proposal is the personal view of an academic who has studied the Israeli-Palestinian shared water issues for over fifteen years and has carried out discussions and dialogues on these issues with people on all sides, representing both official and unofficial points of view. The goal in making these proposals is to provide food for thought – some of it unconventional – as well as to stimulate dialogue and debate in the hope of promoting a just and equitable peace agreement between the sides. One may ask – can or will Israel agree to such a reallocation of its natural water resources as proposed above? A recent study by Frank Fisher together with Israeli, Palestinian and Jordanian water experts and economists provides an insightful and persuasive economic approach to this problem (Fisher et al. 2005). These quotes from that study speak for themselves:

> Water is a scarce resource. Scarce resources have value. And the value of water in dispute is bounded above by the replacement cost given by desalination. No matter how much you value water, you cannot rationally value it more than the cost of replacing it. Hence the availability of seawater desalination places an upper bound on what water can be worth on the seacoast. Such desalination costs roughly $US 0.50–0.60/cubic meter at the sea coast. The cost of extracting water from the Mountain Aquifer and supplying it to cities on the seacoast is roughly $0.40/cubic meter Thus it follows that ownership of Mountain aquifer water can never be worth more than about $0.20/cubic meter ($0.60–$0.40). If the amount of Mountain Aquifer water in dispute between the Israelis and Palestinians is 100–200 MCM/yr (million cubic meters per year) than… [it follows] that … 100–200 MCM/yr of Mountain Aquifer water can never by worth more than $20–$40 million per year … the sums involved are trivial … when compared to Israel's gross domestic product of $100 billion per year. The value of the water in dispute is not sufficient to obstruct a peace treaty, nor is it large enough to be worth a war.

In conclusion it must be added that water is one of the few or perhaps the only issue involved in the Israeli-Palestinian conflict where a concession by Israel on an issue in dispute can be fully replaced or compensated for by Israel by the purchase of an alternative. Israel, if it decides to do so, can replace any water reallocated to the Palestinians from the unlimited sources of desalinated sea water at a reasonable price. This is not the case with the disputes over borders, the Holy Places, Jerusalem, refugees or most other key issues.

References

ARC [Austrian Research Centers], 2001: "The ARIJ Report", *in*: Orthofer, R.; Ghanayem, M.; Isaac, J.; Safer, A.; Daoud, R.; Salameh E.; Fattal, B.; Shuval, H.; Wollman, S.; Kupfersberg H. (Eds.): *Developing Sustainable Water Management in the Jordan Valley. Joint Synthesis and Assessment Report* (Seibersdorf, Austria: Austrian Research Centers, August).

Assaf, K.; Al Khatib, N.; Kally,E.; Shuval, H., 1993: *A Proposal for the Development of a Regional Water Master Plan- Prepared by a Joint Israel-Palestinian Team* (Jerusalem: Israel/Palestine Center for Research and Information IPCRI).

Benvenisti E., 1994: "International Law and the Mountain Aquifer", in: Isaac, I.; Shuval, H. (Eds.): *Water and Peace in the Middle East* (Amsterdam: Elsevier): 229–238.

Blass, S., 1960: *Mai-Miriva v'Maas* [Hebrew: Waters of Conflict and Water Development] (Tel Aviv: Massada).

Braverman A., 1994: *Israel Water Study for the World Bank.* R-94-36-1 (Beersheba: Ben Gurion University of the Negev; Tahal Consulting Engineers Ltd, August).

Chaklai, S., 2004: "Report on Water Use in 2004", in: *Agamit- Journal of the Israel Water Commission,* No.170 (Sept-Dec.): 2–3.

Daibes, F., 2006: "A progressive multidisciplinary approach for resolving the Palestine - Israel conflicts over transboundary groundwater: lessons from international law", in: *Abstract Volume 2nd Israel-Palestine International Conference on Water for Life in the Middle East* (Jerusalem: Israel-Palestine Center for Research and Information IPCRI): 19.

Daibes-Murad, F. 2005: *A New Legal Framework for Managing the World's Shared Ground Waters- A case-study from the Middle East* (London-Seattle: IWA Publishing).

Haddad, M., 2005: "Politics And Water Management: A Palestinian Perspective" in: *Abstract Volume 2nd Israel-Palestine International Conference on Water for Life in the Middle East* (Jerusalem: Israel-Palestine Center for Research and Information IPCRI): 22–23.

El-Hindi, J.L., 1990: "Note. The West Bank Aquifer and Conventions Regarding Laws of Belligerent Occupation", in: *Michigan Journal of International Law*, ll: 1400–1423.

Fisher F.; Huber, A.; Amir, I.; Arlosoroff, S.; Eckstein, Z.; Haddadin, M.J.; Hanat, S.G.; Jarrar, A.M.; Toyyousi, A.F..; Shamir, U.; Wesseling, H., 2005: *Liquid Assets - An Economic Approach for Water Management and Conflict Resolution the Middle East and Beyond.*, (Washington DC: Resources for the Future).

Fischhendler, I., 2004: "Legal and institutional adaptation to climate uncertainty: a study of international rivers", in: *Water Policy*, 6: 281–302.

Gleick, P.H. (Ed.), 1993: *Water in a Crisis: A Guide to the World's Fresh Water Resources* (New York: Oxford University Press).

Goldberger, S., 1992: "The potential of natural water sources in Israel-quantities, quality and reliability" [Hebrew], in: *Proceedings of the Continuing Workshop on Israel's Water Resources* (Rehovot: The Center for Research in Agricultural Economics): 4–7.

International Law Association, 2004: "The Berlin Rules", in: *Berlin Conference (2004) Water Resources Law* (International Law Association): 55.

Kally, E., 1990: *Water in Peace* [Hebrew] (Tel Aviv: Sifriat Poalim Publishing House; Tel Aviv University).

Shuval, H., 1992a: "Approaches to Resolving the Water Conflicts Between Israel and Her Neighbors. A Regional Water for Peace Plan", in: *Water International*, 17: 133–143.

Shuval, H. I., 1992b: "Approaches for finding an equitable solution to the water resources problems shared by the Israelis and Palestinians over the use of the mountain aquifer", in: Baskin, G. (Ed.): *Water Conflict or Cooperation - Israel/Palestine Issues in Conflict Issues for Cooperation* (Jerusalem; Israel/ Palestine Center for Research and Information – IPCRI), 1,2 (May): 26–53.

Shuval, H., 1994: "Proposed principles and methodology for the equitable allocation of the water resources shared by the Israelis, Palestinians, Jordanian and Syrians", in: Isaac, J.; Shuval, H. (Eds.): *Water and Peace in the Middle East* (Amsterdam: Elsevier): 481–486.

Shuval, H.I., 1996: "A water for peace plan, Rreaching an accommodation on the Israeli-Palestinian shared use of the mountain aquifer", in: *The Palestine-Israel Journal*, III, 3–5 (Summer Autumn): 75–84.

Shuval, H.I., 2000: "Are the conflicts between Israel and her neighbors over the waters of the Jordan Basin an obstacle to peace? Israel-Syria as a case study", in: *Water, Air, Soil Pollution*, 123: 605–630.

Shuval, H., 2003: "An Equitable Approach To Resolving The Water Conflicts On The Jordan River Basin Under Condition Of Scarcity", in: *Proceedings XI World Congress on Water Resources of IWRA-Madrid October 5–9th* 2003 (not published)

Wolf, A., 1997: "International water conflict resolution-lessons learned from cooperative analysis", in: *International Journal of Water Resource Development*, 13.3: 333–365.

2 Shared Management of Palestinian and Israeli Groundwater Resources: A Critical Analysis

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Abstract

A brief historical background of the status of utilization of Palestinian water resources is made with emphasis on the shared groundwater aquifers between Palestine and Israel. The political process over water resources between Palestine and Israel is outlined pointing out the lessons-learned from negotiations, the negotiation stance taken by both Parties, and the difficulties Palestine has in implementing polices and agreements for the management of shared groundwater resources. Guidelines for a comprehensive framework for the Palestinian/Israeli management of shared groundwater aquifers is presented based on three pillars – political, policies and cooperation. It is concluded that the region of Palestine and Israel is plagued by conflict and thus the political and security situation can only sharpen the critical need to formulate well-defined transboundary policies and mechanisms for cooperation to enhance the resolution of disputes over the sustainable management of shared groundwater aquifers. In reality, current agreements award Israel veto power over the Palestinians' ability to alter the unfavorable 'status quo', because joint management does not apply to Israel's water sector and control on the ground is largely in Israel's hands.

Keywords: Palestinian water resources, Palestinian/Israeli negotiations on water resources, transboundary water resources, shared water management guidelines

2.1 Introduction and Background

Records show that pre-1948 Jewish and Palestinian communities in the region were consuming similar quantities of water for both domestic and agricultural purposes. Since the establishment of the Armistice Line in 1949, Israel commenced restrictions on the development of wells in the area under Jordanian administration and in parallel Israeli exploitation of water resources accelerated and the water consumption gap between the Israelis and the Palestinians started to widen. In 1964 and without recognition of other riparian users needs or rights in the Jordan River Basin, Israel implemented the first 'out of basin' transfer (National Water Carrier System, see figure 2.1) of the Jordan River water to the Negev and southern coastal areas of Israel (Assaf 2004). The diversion of the Jordan River has led to a possible change in the climate of the West Bank and a 50 per cent reduction in the surface area of the Dead Sea which constitutes yet another serious ecological, environmental, and economic problem as the Lower Jordan River is now only a flow of sewage and wastewater from many sources of pollution.

Figure 2.1: Israeli National Water Carrier. **Source:** SUSMAQ (2001). Technical Background on Water Issues for the Final Status Negotiations, Technical Report. Report No. SUSMAQ-NEG #08 V1.0, Sustainable Management of West Bank and Gaza Aquifers Project.

After 1967, and with the annexation of the Golan Heights and the occupation of the West Bank, Israel increased the control over both the Jordan River headwaters and the lower Jordan River. This control was further extended with the invasion of Southern Lebanon in 1978 and the establishment of the 'security zone' – which was returned to Lebanon in May 2000. Further exploitation of the resources of both the upper and lower reaches of the Jordan River continued over this period with total disregard for the other riparians of the Jordan River Basin until the Peace Treaty with Jordan in 1994.

In recent years there have been many talks about constructing a conveyance system between the Red Sea and Dead Sea to solve the problems created by diverting the Jordan River. At the Johannesburg Environmental Summit in 2002, the Jordanian Minister of Water suggested the Red-Dead Sea Canal project (the Peace Canal) with the following objectives: to protect the Dead Sea from disappearing; to desalinate some 850 Mcm/yr of seawater; to generate 550 megawatts/year of electricity, and to develop new tourism and industrial zones.

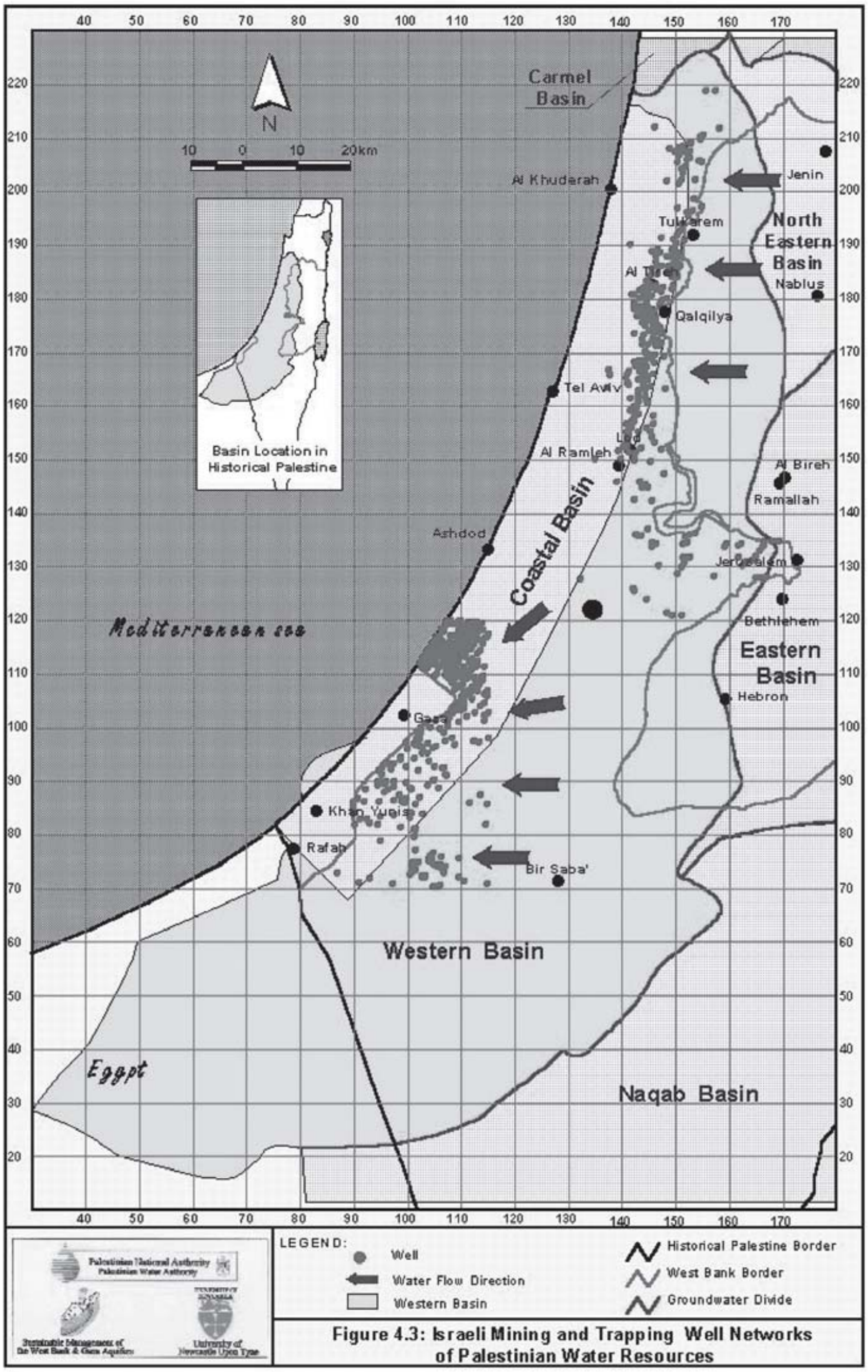
Meanwhile, colonization of the West Bank and the Gaza Strip was carried out by the construction of settlements. These settlements, in addition to utilizing a disproportionate part of the available aquifers, discharged domestic, agricultural and industrial wastes into nearby valleys without treatment, resulting in significant harm to the environment, and creating a major threat to Palestinian water resources

Post-1967 actions were also effected to close many Palestinian wells, to place restrictions on pumping accompanied by restrictive controls by means of licensing, application of fixed operating quotas and refusal of permission to deepen wells. Israel imposed and still imposes facts on the ground to preserve the *status quo* with regard to the allocation of water resources without recognizing Palestinian rights to a greater share of the water resources or compensation for consequences of inequitable allocation in the past. These facts on the ground include (SUSMAQ 2001):

- Mining the West Bank aquifers by dense networks of wells inside the West Bank and alongside the green line (see figure 2.2).
- Drying-up specific Palestinian springs and wells by drilling nearby deep wells for their own use.

Unlike Palestinian wells, Israeli wells tap deeper aquifers and are equipped with more powerful pumps, and in general are more efficient than neighboring Palestinian local wells. Thus, the Israeli wells have two advantages over the Palestinian wells: first, their pumping capacity is higher than the Palestinian wells; second, many are drilled at great depths to utilize the entire thickness of the tapped aquifer. The deep wells drilled by the Israeli authorities in the area have affected the level and quantity of water in the Palestinian wells. The productive capacity of some of the wells has been reduced, and springs have actually dried up. This is due to the trapping of the groundwater by Israeli wells.

Figure 2.2: Israeli Pumping of the West Bank and Gaza Aquifers. **Source:** SUSMAQ (2001b). Technical Background on Water Issues for the Final Status Negotiations, Technical Report. Report No. SUSMAQ-NEG #08 V1.0, Sustainable Management of West Bank and Gaza Aquifers Project.



- Putting obstacles to prevent Palestinians from drilling new wells to meet their future water demands;
- Controlling the utilization zones of the groundwater aquifers in Palestine and solidifying that control by constructing the Separation Wall;

- Intercepting groundwater from reaching the Gaza coastal aquifer (figure 2.2);
- Intercepting surface wadis flowing through Gaza;
- Polluting the groundwater aquifers especially by the wastes of the Israeli settlements.

Progressive desertification has also taken place in the West Bank and Gaza due to the reduction of available grazing area by 50 per cent mainly as a result of the acquisition of land for settlements, military camps and 'nature reserves'. Forestation programs in the West Bank and Gaza that existed during the British Mandate and Jordanian Administration were stopped under the Israeli occupation and a 25 per cent effective deforestation has taken place over 30 years, mainly due to the establishment of the Israeli military camps and settlements.

The entire period from 1967 to the present day was accompanied by the degradation of existing infrastructure and limited development in new infrastructure for water supply, sewerage and solid waste. This resulted in insufficient and unreliable service with poor quality along with large losses in the systems. The Israeli 'operator' also cut off supplies periodically, thereby discriminating unfairly between Palestinians and Israeli settlers when shortages or problems occurred, especially during periods of drought (Assaf 2004).

Consequently, the differential in water consumption between Israel and Palestine has widened from a similar utilization in pre-1948 to more than three times today. The differential in water use between Israeli settlements and Palestinians is even more marked, being in the order of four to six times.

Not until the Declaration of Principles in 1993, ratified by the Oslo II Accord in 1995, did the principles of equitable utilization and the shared management of regional resources between Israel and Palestine get official mention and hopefully these principles will become part of the negotiating agenda in the future. Effectively, Oslo II – as in the Interim Agreement – only permitted a relatively small increase in the utilization of water resources by Palestinians and otherwise agreed (referred to) to a status quo on other abstractions.

Currently, in 2006, the two remaining areas of historical /geographical Palestine have a projected population of 3.6 million, with 2.3 million in the West Bank and 1.3 million in the Gaza Strip. These projections are based on a 1997 census that was undertaken by the Palestinian Central Bureau of Statistics. The overall natural increase or population growth in Palestine is 3.5 per cent, based on 3.2 per cent in the West Bank and 4.0 per cent in the Gaza Strip. The Gaza Strip may be the most densely populated region in the world with over 3,600 persons per square kilometer in 2003. The West Bank has 407 persons per square kilometer. Population increase is the fundamental parameter affecting future water needs. This determines not only municipal demand, but also agricultural demand (to feed the population) and industrial demand (to provide an economy to support the economic development of the population). In Palestine as a whole, more than 50 per cent of the population lives in an urban environment, 28.5 per cent in rural areas, and 15 per cent in camps. In addition to the 3.6 million Palestinians 'in' Palestine, there are over 4.5 million Palestinians living outside, mostly in other Arab countries. There are also another 1.5 million Palestinians living inside Israel, as Israeli citizens.

The aims of this chapter are (1) to assess the status of water resources development and management in Palestine; (2) to highlight the challenges facing the sustainable development and management of the Palestinian water sector. These challenges include all environmental (including technical), socio-economic (including governance, institutional capacity, policy, strategy, and existing legislation), and – most significantly – the political (including water rights issues) challenges; (3) to analyze the Palestinian and Israeli experience of managing shared groundwater aquifers.

2.2 Shared Groundwater Aquifers between Palestine and Israel

The existing water resources of Palestine are derived from four aquifer basins (the Western, Eastern, Northeastern and Coastal) as well as a series of springs that emanate from the groundwater.

The West Bank is a hilly area with variable elevations from 400 m below sea level in the Jordan Valley to 1000 m above the sea level in the hills. The rainfall of the West Bank is strongly seasonal, mainly from October to May. Rainfall is orographic across the West Bank and generally varies from 700 mm/yr in the mountains to 100 mm/yr in the Jordan Valley. The Gaza Strip is located on the extreme edge of a shallow coastal aquifer with a total small area of 365 km^2. The major source of renewable groundwater in the aquifer is rainfall. Rainfall is sporadic across Gaza and generally varies from 400 mm/yr in the north to about 200 mm/yr in the south.

There are two surface catchment areas in Palestine: the western catchment areas that drain to the Mediterranean Sea, and the eastern catchment areas

Table 2.1: Water Resources in Historic Palestine (Mcm/yr) for Reference Years: 1980 – 1999.

Resource	Natural Flow/ Recharge	Total Utilization	Palestinian Water Control			Israeli Water Control		
			Volume	% from Total Utilization	% from Recharge	Volume	% from Total Utilization	% from Recharge
Groundwater	1454	1503	251	17 %	17 %	1252	83 %	86 %
Jordan River	965	870	0	0 %	0 %	870	100 %	90 %
Runoff	215	197	20	10 %	9 %	177	90 %	82 %
Total	2634	2570	271	**11** %	10 %	2299	**89** %	87 %

Figure 2.3: Israeli and Palestinian Utilization of Water Resources in Historic Palestine (Mcm/yr).

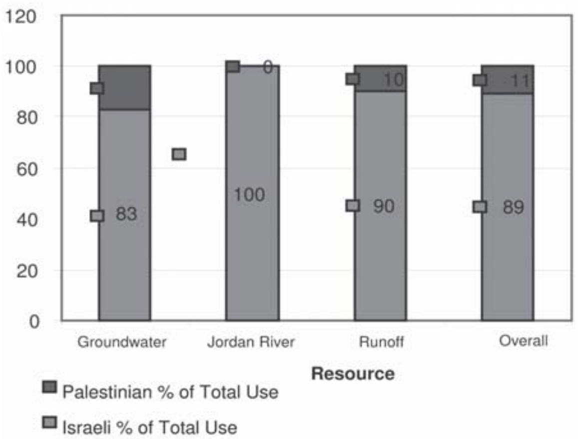
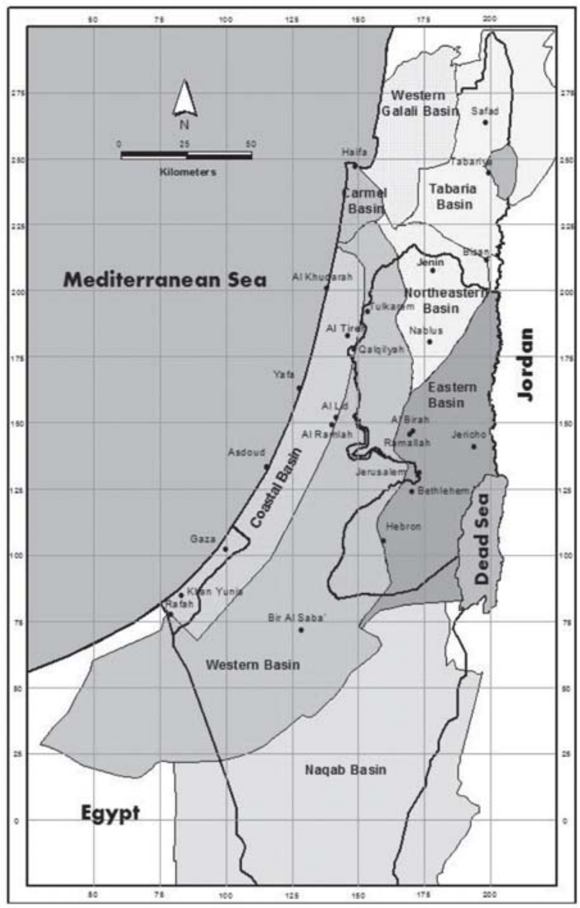


Figure 2.4: Aquifers of Historic Palestine.

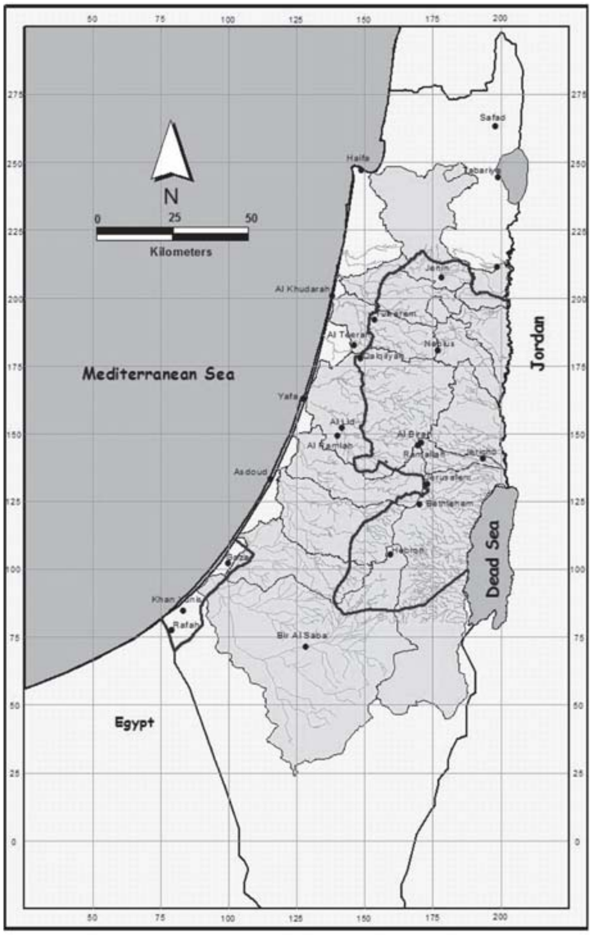


which drain into the Jordan River and the Dead Sea Basins. The total quantity of surface runoff which originates from the Palestinian territories in the Western catchments is 72 Mcm/year with the total surface area being equal to 2,950 km^2 inside the Palesinian territories. The eastern catchments are all presented as part of the Jordan River and Dead Sea Basins. The total catchment area of the eastward draining wadis of the Dead Sea and the Jordan River Basin (including Wadi Araba) is 40,650 km^2 of which Wadi Araba is 11,300 km^2. The total area inside the Palestinian territories is 2,750 km^2 or 6.8 per cent. The total average flow from the West Bank is 17.4 Mcm/year from the eastward draining wadis.

Wadi Gaza is the major wadi (as surface water) in the Gaza Strip that originates in the Negev Desert in a catchment area of 3,500 km^2 and with an estimated average annual flow of 20 to 30 Mcm/year. However, Wadi Gaza at present is diverted by the Israelis towards reservoirs for artificial recharge and irrigation within Israel. This means that nowadays, only a little water out of the high winter flows may reach the Gaza Strip, if any, due to the Israeli practices.

The Jordan River Basin is the most important surface water resource in the region. The total natural flow of the Jordan River, in the absence of extraction, ranges from 1,485 to 1,671 Mcm/yr at the entrance to the Dead Sea. The total area of the Jordan River Basin covered by isohyetes over 300 mm is 14,847 km^2. Of this area, 1,638 km^2 (11 per cent) is within Palestinian territories. Israel is the greatest user of the Jordan River water where its present use is around 59 per

Figure 2.5: Shared and Non-shared Catchments in Historic Palestine*).



* The map also shows the network of wadi runoffs.

cent of the total flow. Israel transfers huge quantities of surface water through the Israeli National Water Carrier from the Upper Jordan to the Negev, where these quantities equal 420 Mcm/yr. At the same time, Palestinians have been denied the use of the Jordan River water due to the Israeli occupation since the 1967 war. In addition, Jordan uses 23 per cent of the Jordan River flow, Syria uses 11 per cent, and Lebanon uses around 0.3 per cent of total natural flow. It must be noted that the Palestinians had used and developed the water resources in the Jordan River Basin pre-1967. Around 150 pumps on the Jordan River had been used for irrigation of lands in the Jordan Valley. According to international water law this fact alone solidifies the rights of Palestinians to use the Jordan River water resources, which were erased by the Israeli occupation.

Based on the above, Palestinian surface water rights are 270 Mcm/year distributed as follows: 181 Mcm/year from the Jordan River, 17.4 Mcm from the Dead Sea Basin, and 72 Mcm/year from the Western Wadis (SUSMAQ 2001). The available water resources in Palestine are shared through transboundary aquifers, the Jordan River and wadi runoff.

An analysis of 1998/1999 data in table 2.1 shows that:

- Shared utilization of aquifers is 86 per cent to 14 per cent in favor of Israel.
- For all sources including the Jordan River and wadi runoff, the overall split in water utilization is 89 per cent (Israel) and 11 per cent (Palestine).
- When viewed in terms of per capita consumption, the ratio of Israeli to Palestinian consumption is roughly 4:1

The three shared groundwater aquifers are the:

- Western Aquifer Basin
- Northeastern Basin
- Coastal Aquifer Basin

Although there exists between 575–740 Mcm of groundwater resources in the Palestinian lands of the West Bank, only around 120 Mcm is available for use to Palestinians. The inequitable utilization of shared groundwater aquifers with Israel (Reference Year period: 1980–1999) led to a huge gap between the Palestinian supply and demand (see figures below). It is important to note that the total utilization (1010 Mcm/yr) exceeded the estimated total average recharge for the three aquifers (679 Mcm/yr according to the Oslo II agreement) by almost 50 per cent. Also, in 1999 Israel pumped 572 Mcm/yr from the Western Aquifer when rainfall was about 480 mm/yr (i.e., recharge in that year was only about 225 Mcm/yr) meaning Israel abstracted 2.5 times its recharge (figure 2.13).

2.3 The Political Process and Existing Agreements

The political process over water resources between Israel and Palestine went through five stages as summarized below.

2.3.1 First Stage

The '*Declaration of Principles*' signed on 13 September 1993 (*Oslo I*) was the first bilateral agreement

Figure 2.6: Schematic Presentation Showing the Extent of Palestinian Aquifers Inside Israel. **Source**: SUSMAQ (2001a). Management Options Report: Water Security and Links with Water Policy in Palestine. Report No. SUSMAQ-MO #14 V1.0, Sustainable Management of West Bank and Gaza Aquifers Project.

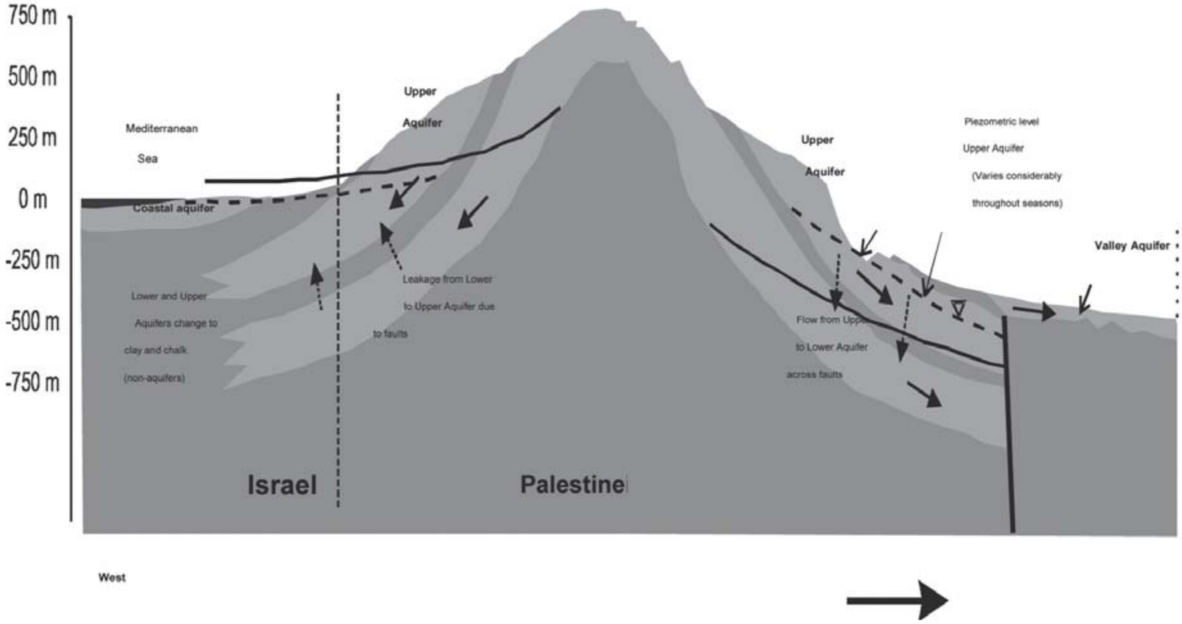


Figure 2.7: West Bank Aquifers. **Source:** SUSMAQ (2001a). Management Options Report: Water Security and Links with Water Policy in Palestine. Report No. SUSMAQ-MO #14 V1.0, Sustainable Management of West Bank and Gaza Aquifers Project.

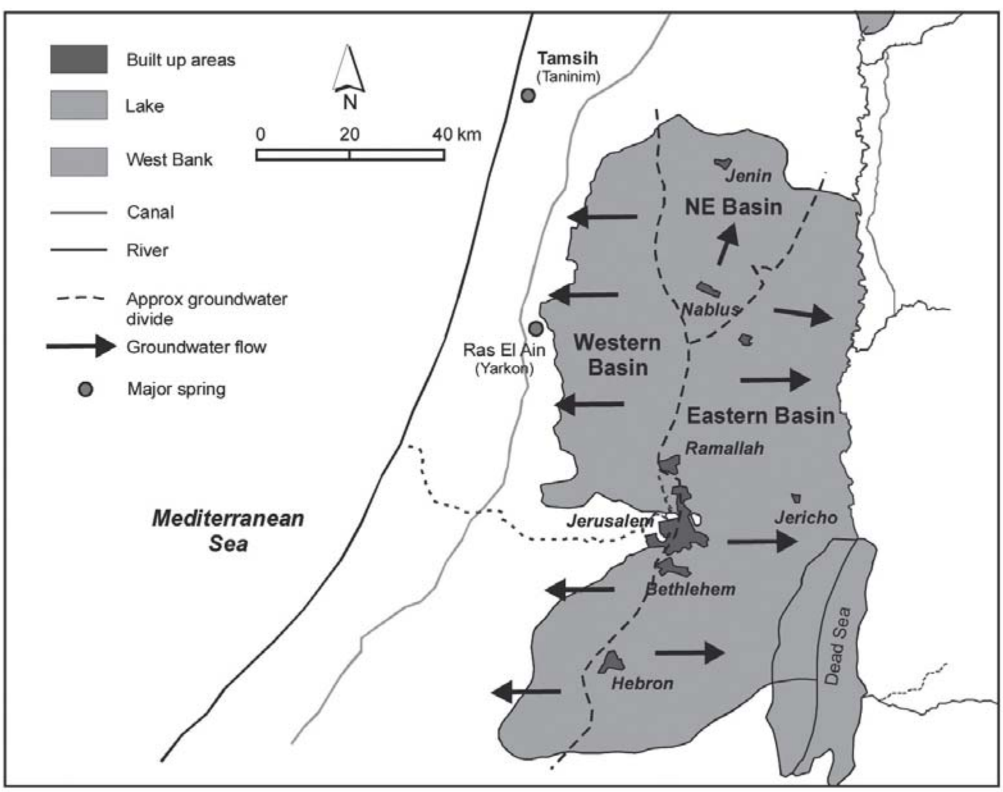


Figure 2.8: A Geological Cross Section Through the Latron Area Showing the Western Aquifer Basin is Ideally Shared Between Palestine and Israel Through Wells and Springs (1998/99). **Source**: SUSMAQ (2001b). Technical Background on Water Issues for the Final Status Negotiations, Technical Report. Report No. SUSMAQ-NEG #08 V1.0, Sustainable Management of West Bank and Gaza Aquifers Project.

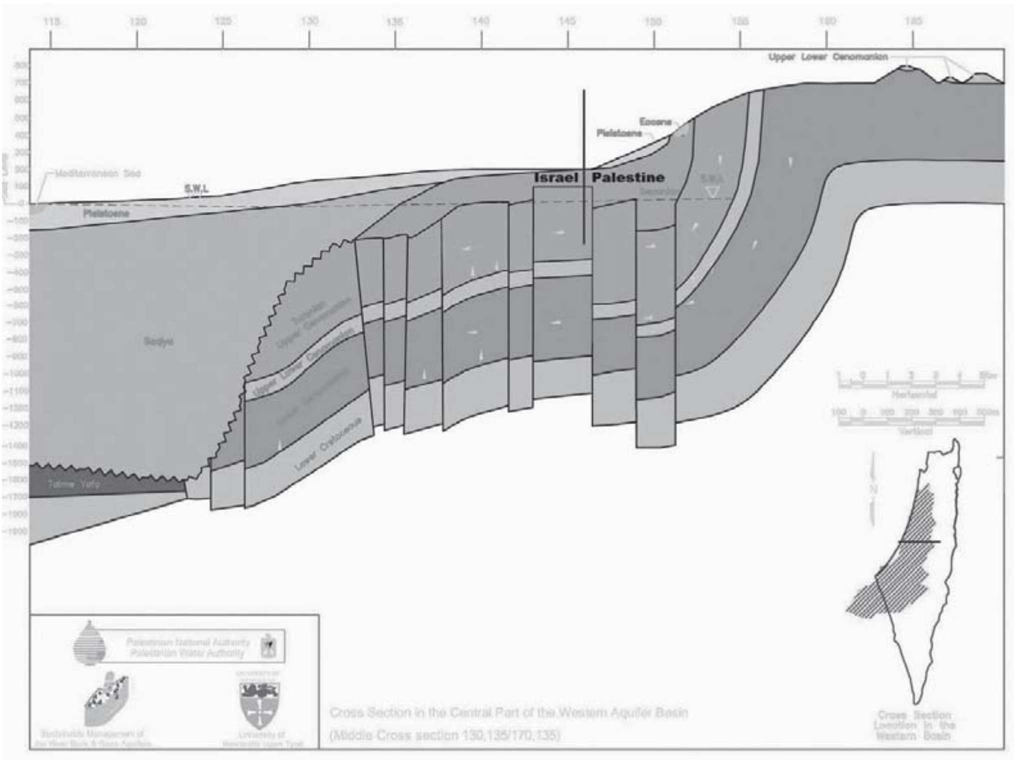
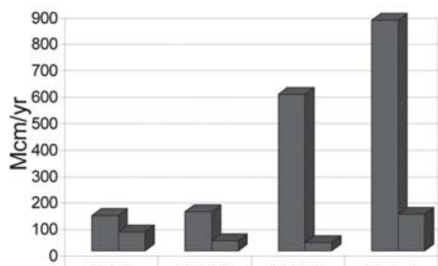


Figure 2.9: Israeli and Palestinian Aquifer Utilization in the West Bank (Mcm/yr) Through Wells and Springs (1998/99).



	EAB	NEAB	WAB	Total
■ Israeli Share	132.9	147.1	591.6	871.6
■ Palestinian Share	71.9	36.9	29.4	138.2

Note: It is important to take notice that the total utilization (1010 Mcm/yr) exceeded the estimated total average recharge for the three aquifers (679 Mcm/yr according to the Oslo II agreement) by almost 50 per cent.

between the Palestinians and the Israelis. According to this agreement, water resource issues would be discussed by the permanent *Palestinian-Israeli Committee for Economic Cooperation*. The parties agreed to prepare plans for water rights and equitable use of water resources. However, the agreement did not identify or establish any explicit water rights for the parties.

Figure 2.10: Palestinian and Israeli Utilization of Aquifers Inside and Outside the West Bank.

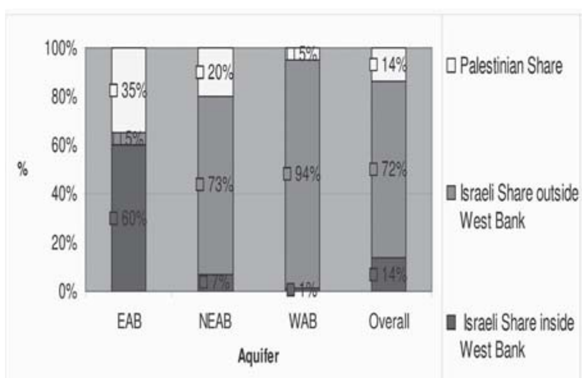
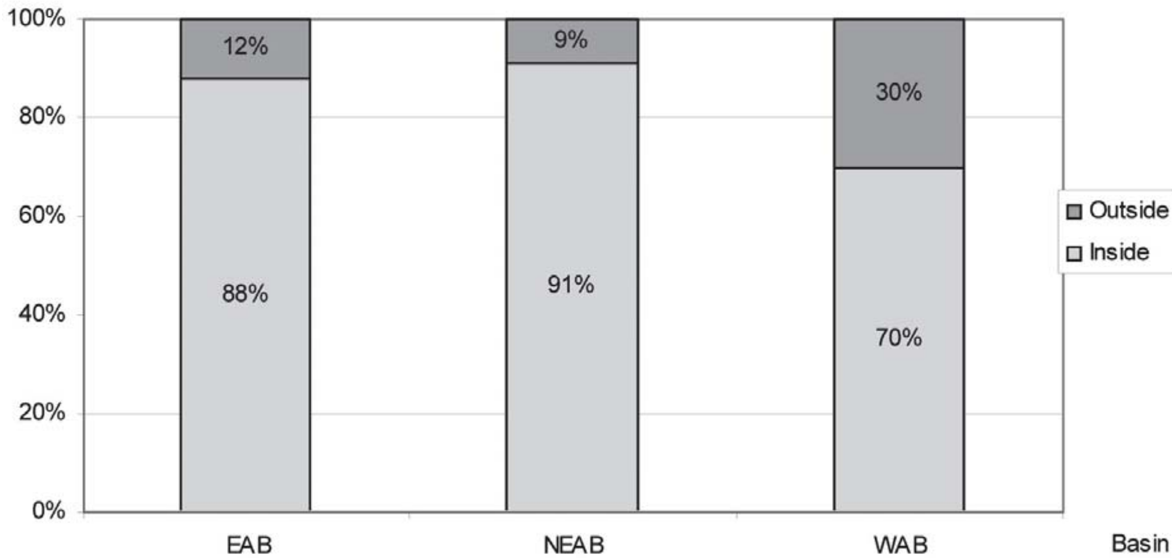
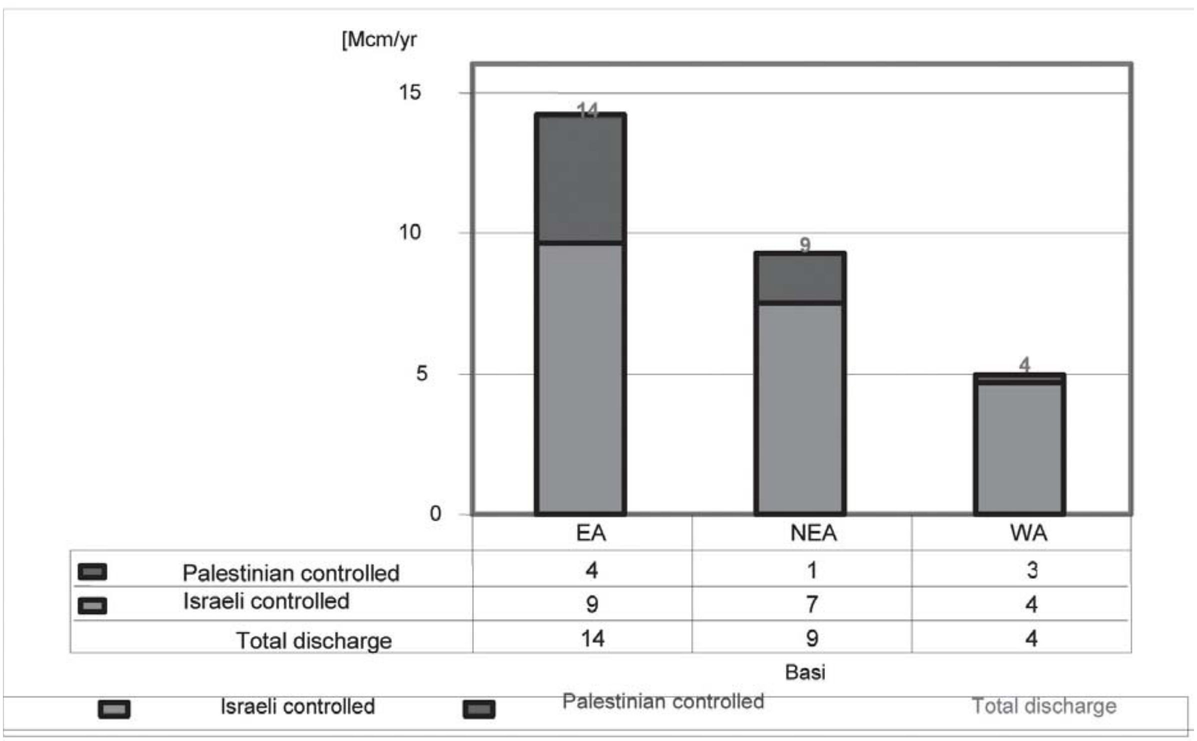


Figure 2.11: Distribution of Outcropping Aquifer Formations Inside and Outside the West Bank.



Note: The 12 per cent outcropping of the EAB inside Israel is insignificant for aquifer utilization.

Figure 2.12: Control of Eastern Aquifer Basin, North Eastern Aquifer Basin and Western Aquifer Basin Springs Inside and Outside the West Bank .



2.3.2 Second Stage

Article 40 of Annex III of the *Oslo II agreement* signed on 18 September 1995 formed the basis for water sector planning and project implementation during the Interim Period (1995–2000) by which at the end a final agreement was supposed to be reached. Article 40 of *Oslo II scenario* specifies that 70–80 Mcm/yr are available for Palestinian utilization from

Figure 2.13: Rainfall and Extraction of Western Aquifer Basin From 1971 – 1999.

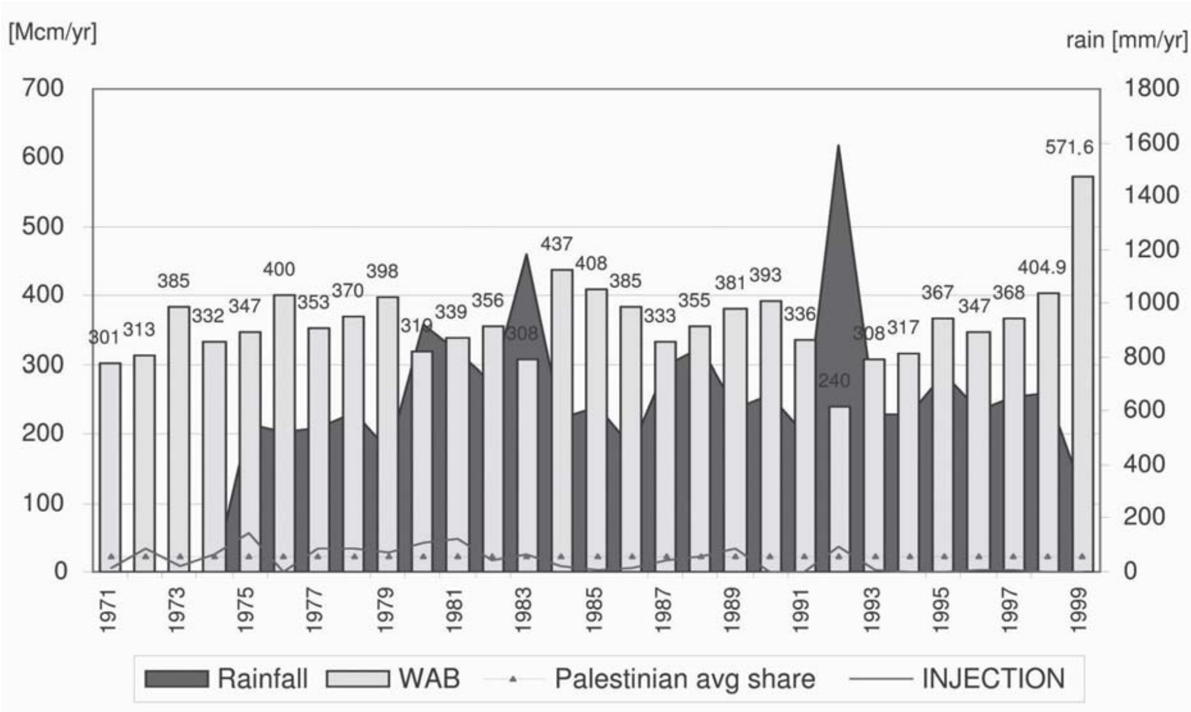


Table 2.2: Israeli and Palestinian per capita water consumption 1999.

Community	Population	Consumption for all purposes (Mcm/yr)	% of Allocation	Consumption (l/c/d)	Ratio of Palestinian to Israeli consumption
Palestinian	2,895,683	252.4	11%	239	1
Israeli Settle-ments	172,200	54.8	2%	872	4
Israeli	5,869,200	2074	87%	968	4
Total		2381.2	100%	2079	

the Eastern Aquifer Basin and other agreed sources, including shared aquifers. However, since 1995, the implemented quantity has been about 30 Mcm/yr only. It is important to note that Article 40 indicates that both the Western and Northeastern aquifer basins are fully or over-exploited by the Israelis with no further access and development potential for Palestinians. Principle one of Article 40 of the Oslo II agreement is the most significant element of the agreement. It states – and for the first time – that 'Israel recognizes Palestinian water rights in the West Bank'. However, Article 40 of the Oslo II agreement came far below the fulfillment of Palestinian water rights and needs. The terms were broad and there was no elaboration on the nature of these rights or the principles governing the rights and obligations of both sides. Since 1995, the implementation of Article 40 has been restricted and extremely slow. Decision making within the *Joint Water Committee* was mostly unilateral and dominated by Israel.

2.3.3 Third Stage (Camp David II rounds in July 2001)

In the *Camp David II* rounds of negotiations, the Israeli side offered to grant additional water quantities to the Palestinians as follows:

- 50 million cubic meters from the Western Aquifer Basin.
- 10 million cubic meters from the Northeastern Aquifer Basin.
- 80 million cubic meters from the Eastern Aquifer Basin.
- 40 Mcm/yr from the Jordan River.

The talks collapsed and the Palestinian water rights were never discussed. In other words, under the Israeli proposal at this time, Israel would control the Palestinian State's water resources.

2.3.4 Fourth Stage: Taba Rounds

These rounds followed *Camp David II* rounds. Discussions continued but with no progress on water.

2.3.5 Fifth Stage: The Road Map

The proposed *Road Map* approach mentions water resources in the Palestine region only once, and in a vague manner, and only within a regional context. The Road Map does not emphasize water as an actual issue for negotiations; it only states in the text of the document the following as one of the Road Map's aims or tasks: "Revival of multilateral engagement on issues including regional water resources, environment, economic development, refugees, and arms control issues." In the *Road Map*, the statements were about regional cooperation to solve the problems of water allocations without any mention of Palestinian water rights. Also, there is no reference at all to international law with regard to water rights.

2.4 Lessons Learned from Palestinian and Israeli Water Negotiations

2.4.1 Israel's Strategic Negotiations Stance

Israel claims always that there is no water left to negotiate about and that the available water resources in historic Palestine do not satisfy 50 per cent of Israel's water needs. Israel does not want to change the status of its past utilization under any possible agreement with the Palestinians and other Arab countries. Israel does not agree to negotiate any solution that will force it to give up any water that it currently controls or utilizes unless Israel guarantees for itself additional water through projects funded by the international community. Israel considers that the interim agreement of Oslo II is final and the Israelis would like 'to talk' not 'to negotiate' about the future Palestinian 'water needs' not 'water rights'. Israel also wants these talks to be through the *Joint Water Committee* (JWC) of the *Oslo II Agreement* only. The Israelis want the JWC to continue as a permanent institution. Israel wants to impose the following on the Palestinians through the JWC measures:

- To force them to reduce agricultural water and to stop drilling additional wells, and
- To force them not to impact the Israeli current utilization of water.

With regard to the water crisis in the Gaza Strip, the Israelis claim that this problem is not their business and the Palestinians must desalinate both brackish and seawater because the Israelis will never agree to provide Gaza with water from Israeli water resources or to bring water to Gaza from the West Bank.

Israel also is constructing the Separation Wall in order to prevent the Palestinians from utilizing the groundwater aquifers behind the Wall and to insure that Palestinians have no access to the Jordan River. In general, Israel tries to avoid international law as a reference to solve the disputes over water with Palestinians and other Arab states. Israel supports regional cooperation to get additional water and establish relations with neighboring countries. Israel believes that water shortages in the region could be satisfied from several proposals:

- Renting agricultural lands in Sudan and establishing shared agricultural projects;
- Purchasing water from Turkey;
- Purchasing water from Egypt.

Israel believes that the Arab Gulf countries should be encouraged to establish cooperation with Israel over desalinization technologies. Through this transfer of technology, Israel would establish cooperative relations in the region.

2.4.2 The Palestinian's Strategic Stance

It is essential to arrive at a clear and mutual understanding about the political and legal aspects of water negotiations that cover Palestinian water rights in terms of quantities, quality, and sovereignty before signing a final agreement with the goal

- To accept international law and UN resolutions; and
- To grant sovereignty to Palestine to utilize and control its water resources.

Each party should develop necessary plans that allow it to develop and utilize its water within its international borders without causing harm to each other *after signing agreements and not before that.* Based on this premise, Palestine considers that all actual, administrative, and legal actions taken by Israel about the water resources within the borders of Palestine cannot in any case impact negatively on the Palestinian water rights which are the subject for the final status negotiations. The Palestinian position is as follows:

- It is essential to arrive at a clear and mutual understanding of the political and legal aspects of water negotiations that cover Palestinian water rights in terms of quantities, quality and sovereignty before signing a final agreement.
- Parties must accept the international law and UN resolutions.
- The sovereignty of Palestine to utilize and control its water resources should be recognized.
- Israel should admit that its current control and utilization of the Palestinian water resources has caused significant harm and loss to the Palestinians and hence Israel must compensate the Palestinians for this past (and continuing) harm and the associated losses.
- All measures agreed to in the interim agreement of Oslo II should remain interim and should not in any case influence Palestinian water rights.
- Palestine is a riparian country in the Jordan River Basin including all its groundwater aquifers. Therefore, the utilization and management of the Jordan River and its Basin should involve the Palestinians as an equal partner and in accordance with international law.

2.4.3 Difficulties in Implementing Policies and Agreements for the Management of Shared Groundwater Aquifers

'Status quo' on the ground: Israel imposes facts on the ground to preserve the *status quo* with regard to the allocation of shared groundwater aquifers without recognizing Palestinian water rights. One example is the mining of the West Bank and Gaza aquifers by dense networks of wells inside the West Bank and alongside the green lines between Israel and the West Bank on the one side and Israel and Gaza on the other side (see figure 2.14).

As mentioned previously, unlike Palestinian wells, Israeli wells tap deeper aquifers. The deep wells drilled by the Israeli authorities in the area have affected water quality and quantity of Palestinian wells. The Israelis have imposed obstacles preventing the Palestinians from drilling new wells to meet their needs in shared groundwater aquifers. No permit has been given in the Western Aquifer Basin since 1967.

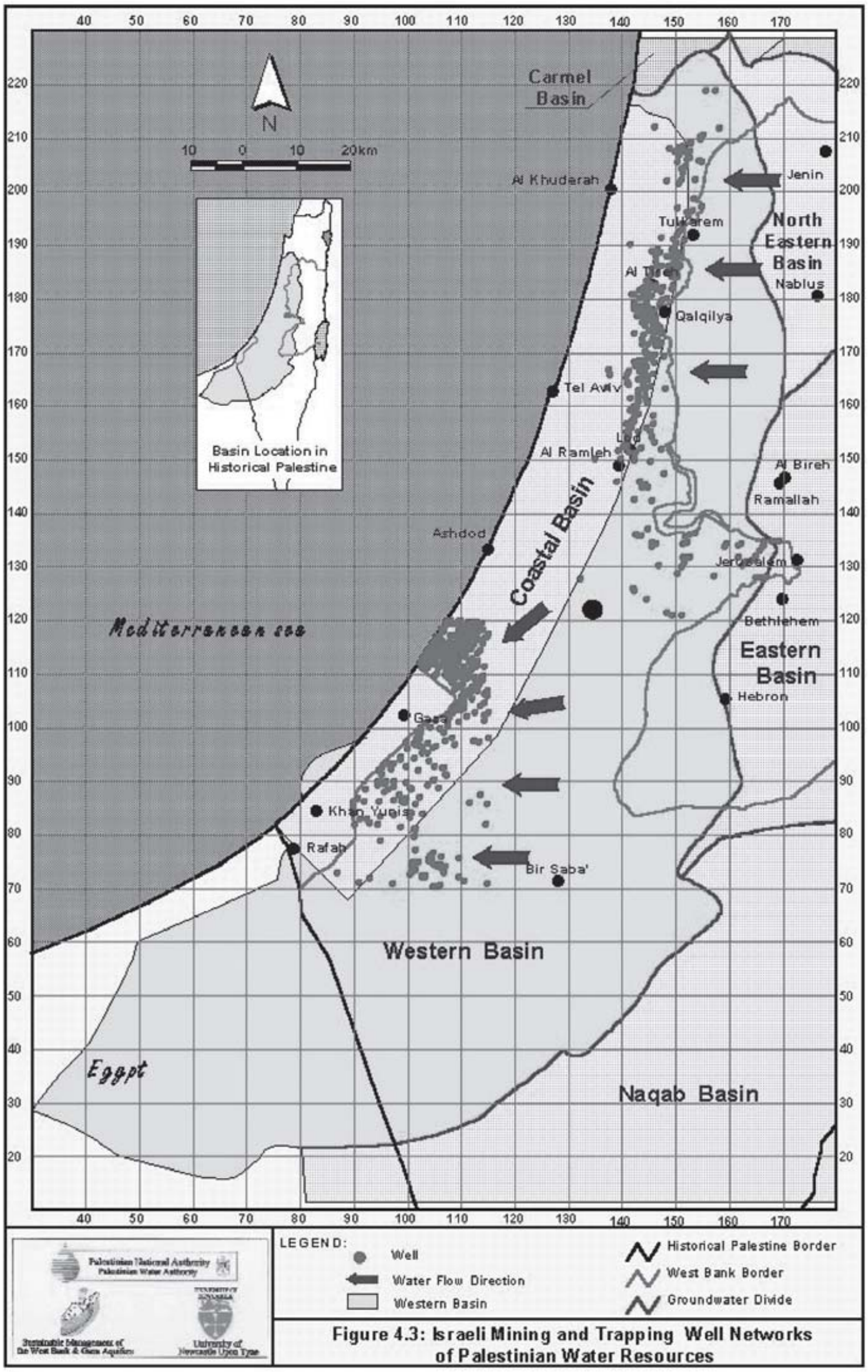
The Israelis control the utilization zones of the shared groundwater aquifers and recently they solidified that control by constructing the Separation Wall. By building the Separation Wall, the Israelis confiscate land, aquifers, springs, and wells. The Israeli authorities have built many parts of the wall, except for the eastern part which is still a proposal.

The Israelis have undertaken the following water-related activities:

- Intercepting groundwater from reaching the Gaza coastal aquifer;
- Intercepting surface wadis flowing to Gaza with the map of Israeli agricultural lands irrigated by wadi water with an annual flow of the wadi = 25–35 Mcm/yr);
- Drilling of Israeli wells around the Gaza Strip;
- Diverting the route of the Jordan River to the Negev;
- Contributing to the shrinking of the Dead Sea (see the chapters by Lipchin; Gavrieli and Bein in this volume);
- Polluting the groundwater aquifers especially by the wastes from the Israeli settlements (see the pollution of Palestinian wadis near Tulkarm);
- Polluting the Palestinian wadis near Shibteen village;
- The shared aquifers have been exposed periodically to the problem of illegal trans-frontier dumping. Debris is dumped on the outcrops of the shared aquifers, which is particularly dangerous because these outcrops are karstified and thus provide easy paths for pollutants to reach water levels;
- Hazardous waste disposal: There is insufficient capacity of infrastructure to manage hazardous wastes safely. The area suffers from inappropriate storage and disposal facilities. It lacks the requisite skills to evaluate risks and monitor controlled dumping. It lacks the capacity to undertake detection, remediation, or possible treatment.
- Forcing water supply systems and their infrastructure in the West Bank to be mixed (mish-mash).
- Enforcing complicated procedures of licensing Palestinian water projects including drilling wells.
- Lack of funding is a major difficulty in the implementation of agreed policies and the enforcement of laws. Lack of funding also impedes vital data collection, the establishment of databases, information sharing and application of contemporary technology.
- The greatest difficulty is general Israeli policy:

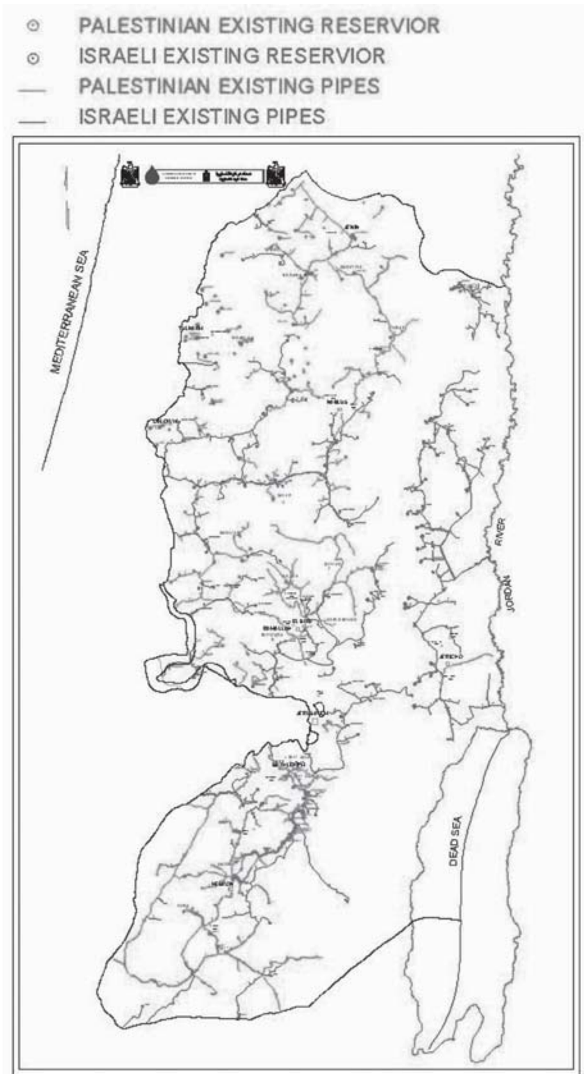
In summary, the entire period since 1967 was accompanied by the degradation of existing infrastructure and limited development in new infrastructure for water supply, sewage and solid waste.

Figure 2.14: Israeli Pumping of the West Bank and Gaza Aquifers. **Source:** SUSMAQ (2001b). Technical Background on Water Issues for the Final Status Negotiations, Technical Report. Report No. SUSMAQ-NEG #08 V1.0, Sustainable Management of West Bank and Gaza Aquifers Project.



This resulted in insufficient and unreliable service (40 per cent of Palestinian communities are unserved) with poor quality and with large losses in the systems (25 per cent–40 per cent). The Israeli 'operator' also cuts off supplies periodically, thereby discriminating unfairly between Palestinians and Israeli settlers when shortages or problems occurred (especially during

Figure 2.15: Palestinian and Israeli water piping networks in the West Bank. **Source:** SUSMAQ (2001b). Technical Background on Water Issues for the Final Status Negotiations, Technical Report. Report No. SUSMAQ-NEG #08 V1.0, Sustainable Management of West Bank and Gaza Aquifers Project.



periods of drought) since water supply networks are mixed.

The general acceptable policy concerning shared aquifers should not be limited to equitable utilization and control but should also include optimal use and ecological protection of shared aquifers as well as the sustainable development of these resources.

2.5 Guidelines for a Comprehensive Framework for the Palestinian/Israeli Management of Shared Groundwater Aquifers

The proposed framework is based on three pillars: a) political, b) policies and c) cooperation.

2.5.1 Political Pillar

The region of Palestine and Israel is subject to recurrent political volatility and insecurity which further hinders communication and cooperation within and beyond the boundaries of these two countries. The shared groundwater aquifers are not only an issue about management, development, and environment – they are essentially a political issue. Political attention can be mobilized through effective dialogue between scientists and decision makers followed by politicians.

The concept of benefit sharing should always be promoted to influence the politicians towards a win-win scenario in shared aquifer management. The concept of re-allocation of use of water between different sectors needs to be promoted so that the politicians can see the entire picture of the region and realize that shared groundwater aquifers and other water resources cannot be managed separately. Recognition is needed by both parties of the water rights and water allocations of one another while accepting permanent sovereignty of each party (Palestine and Israel) over their shared water resources in their lands according to 1967 international borderlines and international law.

2.5.2 Policies Pillar

The policy statement should

- Provide an opportunity for integrated management of shared groundwater aquifers, other shared water resources and water supplies including strategies for the benefit of the riparian countries;
- Provide for the protection of shared groundwater aquifers from pollution through legislation on potential contaminating activities such as:
  - Wastewater and solid waste release;
  - Land use;
  - Agricultural practices;
  - Location of storage facilities for toxic and hazardous materials.

- Establish long-term standards and procedures including permits for well drilling and operation;
- Include long-term plans to monitor and limit drawdowns in shared aquifers as well as abstractions from wells affecting shared aquifers;
- Provide opportunities to strengthen the institutional capacity of shared groundwater aquifers management;
- Promote opportunities for bi-lateral, regional, and international cooperation in research, management, and development of shared groundwater resources;
- Promote measures to update and harmonize water legislation between countries sharing groundwater resources;
- Provide opportunities to mobilize and develop expertise on the legal, institutional and socio-economic aspects of the management of shared groundwater aquifers.

2.5.3 Cooperation Pillar (Including Lessons Learned)

Cooperation between Palestine and Israel over shared groundwater aquifers requires:

- Building confidence and trust between the two Parties and hence help implement unified policies and defuse potential conflict;
- Managing the shared aquifers sustainably;
- Promoting resource protection towards ecological sustainability;
- Recognition of the need for poverty reduction;
- Enhancing bi-lateral economic productivity and development.

Cooperation must be promoted on bi-lateral, regional and international levels that respect the international law concept regarding shared groundwater aquifers. Regional (bi-lateral and multi-lateral) cooperation or agreements must be built on unifying environmental standards and regulations, information and expertise sharing with public involvement.

The cooperation between the Palestinians and Israelis should be based on the items presented in Pillars 1 and 2 in order to serve the interests of both nations towards prosperity, peace, regional safety, reciprocal benefits, and good neighborhoods. The Israelis should acknowledge the Palestinians as an equal partner and a riparian to shared groundwater aquifers. Cooperation should not be limited only to the Palestinian part of the shared groundwater aquifers; the Israeli part and their utilization should also be involved. Any development of shared groundwater aquifers should be based on:

- The socio-economic needs (current and future domestic, agricultural, etc) of both nations based on equity and riparian rights;
- Protection of shared groundwater aquifers;
- Sustainable development of shared groundwater aquifers to face the challenges of water shortages and climate change that affect every aspect of life from ecosystems to human health, food security, human rights and cultural heritage;
- Developing additional water resources (conventional and non-conventional).

The cooperation over the environmental preservation of shared groundwater aquifers should be looked at from the point of view of environmental security which is a core element for promoting peace and stability between Palestine and Israel. In particular, cooperation should

- Develop a clear and practical mechanism to control and monitor the implementation of signed agreements;
- Continue during both peaceful and violent periods with respect to management of shared groundwater aquifers;
- Cover data sharing and information exchange including the establishment of common integrated databases derived from existing and reconciled data;
- Include assessment of risk and uncertainty, especially for periods of consecutive droughts.

2.6 Conclusions

The region of Palestine and Israel is plagued by conflict and thus the political and security situation can only sharpen the critical need to formulate well-defined transboundary policies and mechanisms for cooperation to enhance the resolution of disputes over the sustainable management of shared groundwater aquifers. The failure to maintain close cooperation in preserving the shared groundwater resources will lessen the ability of the two sides to cope with dangers such as pollution, salinity, and a lower water table during droughts.

In reality, current Agreements award Israel veto power over the Palestinians' ability to alter the unfavorable 'status quo', because joint management does not apply to Israel's water sector and control on the ground is largely in Israel's hands. The political arrangement would have to give way to a joint regime that covers common water resources on both sides of the border.

Palestinian sovereignty is a decisive issue because most of the recharge areas of the shared aquifers are within the Palestinian lands. Equitable utilization would be based on the division of the shared water resources in Palestine and Israel as a whole as well as on the basis of water rights and the long-term social and economic needs. However, the current mechanisms of joint management of shared groundwater aquifers between Palestine and Israel fall short of playing a decisive and conclusive role. Thus, capacity building is an important and essential component of effective joint management of shared aquifers:

- First, Parties should acknowledge and understand the transboundary challenges;
- Then foster regional cooperation through policies, institutions, ministries and regional organizations and NGOs;
- Capacity building can also be achieved by improving management skills and environmental technology skills and expertise.

International water law stipulates that joint management ought to be built on mutuality, equality, and respect for sovereignty. A joint management regime requires a definition of the tasks to be undertaken and the structure and composition of a joint management body. Discussions about a joint management regime should factor in other water-related political and economic considerations, notably sovereignty and cost benefit sharing. Achieving peace between nations and states is not only a humanitarian issue, it is a very complex process that has to achieve an accepted balance between the interests and demands of both sides, or otherwise, the situation will be the domination of the oppression on the oppressed.

References

Aliewi, Amjad S, 2005: *Sustainable Development of the Palestinian Water Sector under arid semi–arid conditions*. Proceedings of the Workshop on Arid/Semi-Arid Groundwater Governance and Management, 3–7 April 2005, Cairo, Egypt.

Aliewi, Amjad; Assaf, Karen, 2003: *Assessment of Water Demand Management in Palestine: Identifying the Gaps and the Constraints, Envisioning Challenges and Opportunities*. Second Regional Conference on Water Demand Management and Pollution Control, Sharm Al-Sheikh, Egypt, ESCWA/UNEP/UNESCO/WHO, 14–17 December 2003.

Assaf, Karen, 2000: *The Palestinian Situation: The Need to Legally Define 'Palestinian Water Rights'*. Expert Group Meeting on Legal Aspects of the Management of Shared Water Resources, Sharm El-Sheikh, 8–11 June, ESCWA, CEDARE (Beirut: ESCWA (Economic and Social Commission for Western Asia) / [CEDARE] Centre for Environment and Development for the Arab Region and Europe).

Assaf, Karen, 2004: "Joint Projects and Programs promoting Middle East Cooperation and Knowledge in the Water Sector", in: Shuval, Hillel; Dweik, Hassan (Eds.): *Proceedings of the 2nd Israeli-Palestinian International Conference Water for Life in the Middle East*, Oct 10–14, Antalya, Turkey (Jerusalem. IPCRI): 236–249.

Assaf, Karen, 2004a: "Water as a human right: the understanding of water in Palestine. Global issues papers No. 11"; in: Assaf, K.; Attia, B.; Darwish, A.; Wardam, B.; Klawitter, S., 2004: *Water as a human right: The understanding of water in the Arab countries of the Middle East – A four country analysis*" (Berlin: Heinrich Boll Foundation, September): 185–228.

SUSMAQ [Sustainable Management of the West Bank and Gaza Strip Aquifers], 2001: *Technical Background on Water Issues for the Final Status Negotiations*. Report No. SUSMAQ-NEG #08 V 1.0 (Ramallah: SUSMAQ, August).

SUSMAQ [Sustainable Management of the West Bank and Gaza Strip Aquifers], 2001a: *Management Options Report: Water Security and Links with Water Policy in Palestine*. Report No. SUSMAQ-MO #14 V 1.0 (Ramallah: SUSMAQ, August).

SUSMAQ [Sustainable Management of the West Bank and Gaza Strip Aquifers], 2001b: *Technical Background on Water Issues for the Final Status Negotiations, Illustration Report*. Report No. SUSMAQ-NEG #10 V 1.0 (Ramallah: SUSMAQ, August).

3 Beyond the Watershed: Avoiding the Dangers of Hydro-Centricity and Informing Water Policy

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Abstract

The purpose of this chapter will be to demonstrate that there are a number of economic processes that have the capacity to ameliorate local water scarcity. Arid and semi-arid regions and economies worldwide encountered water scarcity in the past thirty years. Many more will encounter water scarcity in the next three decades. The analysis will review briefly three ameliorating processes – first, the global role of virtual water in water scarce regions, secondly, the impact of socio-economic development on water management options and thirdly, the cultural specificity of water demand management policies. All three processes have the characteristics of being economically invisible and politically silent in the easily politicized management of water. Their impacts, however, are determining with respect to solving local water deficits.

It will be shown that the water, food and trade nexus is not easy to model because of the dynamics of the political economies in the North and the South. Water sector policy-making is subject to evolving discourses, which can easily de-emphasize the underlying environmental and economic fundamentals. The chapter will conclude that invisible and silent virtual water will provide the food water for water scarce regions such as Palestine and Israel. Its invisibility and silence will, however, have the effect of attenuating the pace of water policy reform with respect to water use efficiency and the consideration of the environmental services provided by water. A range of demographic, economic, social and poli-tical theory will be used to frame the discussion.

Keywords: water policy, problem shed solutions, hydro-centricity, soil water, virtual water, socio-economic development

3.1 Introduction

The purpose of the chapter will be to demonstrate that there are a number of economic processes that have the capacity to ameliorate local water scarcity. These economic processes partly take place in the same spatial domain as the processes observed by water scientists. Some of the most important socio-economic ameliorating processes have, however, been shown to operate outside the boundaries of the river basin and the groundwater basin (Allan 2004; Brichieri-Colombi 2004).

Recent experience in the Middle East has been especially important in demonstrating that water scarce regions can access water via global trading systems. To have the secure capacity to operate in this global trading domain those managing water scarce economies have had to adopt new approaches to combining their environmental resources – land and water – with their human, social, manufactured and financial capitals. The extent to which the factors of production have been more effectively combined determines the security of the economy.

Strategic water resource security has been achieved in the Middle East in the second half of the 20th century through economic transformation by investing in the economy generally as well as in a reforming water sector (Allan 2001). In the 21st century the import of water intensive commodities will continue be the main strategy with which to address the 'big water' challenge. Both types of reform are necessary but the water scarce are wise to recognize the potentially dominant role of socio-economic transformation over reforms and efficiency gains in the water sector alone.

3.2 Definitions and Evident and Non-evident Processes

We need a few definitions: 'big water' and 'small water'. Big water is the water needed to produce food for the economy. 90 per cent of the water consumed by society is needed to raise its food and underpin food producing livelihoods. Small water is the 10 per cent of total water needed to provide society's drinking water, domestic water services and to underpin non-agricultural livelihoods. Big water differs from small water in the huge difference in the volumes used and consumed and potentially re-usable. Crop production consumes high proportions of the high volumes of water deployed. Domestic and industrial uses can potentially return most of the water deployed in such processes for treatment and re-use.

There are a number of associated ideas that need to be conceptualized and that could usefully be adopted by the water science community as well as by the diverse epistemic group associated with making and advising on water policy. Big water, that is the water needed for food production, can be *freshwater* or *soil water*. Small water is the 10 per cent of freshwater – *it can only be freshwater* – needed to provide drinking, domestic and municipal water as well as the water needed for non-agricultural livelihoods.

A second important idea concerns the role of soil water. Two political economies with similar populations – Egypt and the United Kingdom – located in very different environments, can be compared. The diagram indicates the significance of their respective water endowments. Egypt has to use almost all its average annual availability of between 55 and 60 billion cubic meters of freshwater in the Nile River. This figure includes re-use. It has negligible soil water. Egypt accesses virtual water to meet its rising water deficit. The UK uses about 15 billion cubic meters of surface and ground waters. Soil water is not negligible in the UK water budget. About 25 billion cubic meters of soil water produce the majority of its food needs and 'virtual water' meet its food-water deficit. In both cases the 'virtual water' calculus is a net figure in that both economies export food commodities as well as importing them.

3.2.1 The MENA Region Experiment

For the past three decades the MENA region has undergone an experiment, which has proved the argument set out so far. When the region entered its water deficit phase as a result of demographic pressures in the early 1970s, the idea that water problems could be solved outside the water sector was inadmissible. Most insiders in the region are still at the beginning of the new millennium – unwilling to recognize the non-water sector factors that have brought about food and water security.

Arid and semi-arid regions and economies worldwide encountered water scarcity in the past thirty years. Semi-arid regions such as the Middle East and North Africa (MENA) have an important place in the history of water management in the last quarter of the 20th century. The responses they have made to water scarcity, and more importantly why they have not made some other rational responses in accord with underlying economic fundamentals, provide important lessons.

These lessons highlight the role of politics in water resource policy-making. Scarcity leads to politicization at the levels of the farm, the community, the nation and the riparian. The nature of politicized water relations is explained by power relations, historic circumstances and the extent to which water scarcity can be ameliorated by evident and non-evident transactions.

The normal human reaction to scarcity is to reduce the scarcity by finding and mobilizing more of the resource within the sovereign territory of the scarce economy. Resource scarcity is commonplace. Most economies are short of a number of strategic natural resources such as oil and minerals. They address such scarcity by importing the scarce resource.

Water is different from other natural resources in that its value per unit is small. At the same time the volumes of water needed to substitute for the local scarcity are very bulky. Importing water in the volumes needed is deterringly expensive, unless the water flows naturally in surface or sub-surface systems and is secured by favorable international customary conventions.

In the 1970s the MENA region as a whole moved out of the phase when it could address its rising water needs by mobilizing more water. The economies of the Gulf as well as those of Jordan, Israel, and Libya had gone into deficit in the 1950s and the 1960s. The timing of the MENA journey into water deficit has proved to be fortuitous for the region. The MENA experiment in handling its strategic water resource deficit occurred at a point in history when the global system was engaged in another experiment. This experiment was the post-1950 subsidized revolution in crop production in North America and Europe. The goal was to secure the farming sectors of these two industrialized regions.

As with most experiments based on subsidies the impacts have been perverse. For the MENA region they have brought the immediate benefits and possible longer term problems. The benefits are political stability and economic security, through the consumption of imported water intensive strategic staples. These commodities were put on the world market at half cost by the US and some European exporters. The longer term problem associated with the reduction of economic and political stress enabled by the import of cheap strategic commodities is that this trade has hidden the underlying fundamentals from consumers, water policy-makers and especially from government leaders. Water sector reforms to re-allocate and manage water resources would have been essential in the absence of the global solution provided by the industrialized North. In the emollient world of cheap imported food staples those managing the importing MENA economies could assume that water policy reforms associated with the high political prices associated with water policy reform could be avoided.

The reason that food production and water have been emphasized thus far is because water for food is the dominant use of water. About 90 per cent of the water needed by an individual is devoted to food production. The remaining ten per cent is needed for drinking, domestic use and the support of non-agricultural livelihoods.

The three departures from conventional approaches to water allocation and management essential to the message of this chapter are the following. The first generally ignored feature, though hydrologically and economically fundamental, is 'soil water'. The second is 'virtual water'. Virtual water is a new concept to the water sector. But the term is merely an example of Ricardo's powerful, two century old, notion of comparative advantage. Wichelns (2004) has added a purist economics definition insisting that virtual water is an example of absolute advantage because it does not have embedded in it optimal production and trading strategies. He recognizes that 'the virtual water metaphor addresses resource endowments, but it does not address production technologies or opportunity costs. Hence, the metaphor is not analogous to the concept of comparative advantage. The metaphor has, however, been helpful in motivating public officials to consider policies that encourage improvements in the use of scarce resources, even if comparative advantages should be evaluated to determine optimal production and trading strategies.'

Prior to human consumptive water-use the natural water resources supported only biological and hydrological systems. All the consumptive use of water by human populations has to be taken from the diverse environmental water resources available to a political economy. Available water includes surface waters, groundwater, soil water and atmospheric water. Surface waters, groundwater and soil water are the waters that the human population use for their economic, social and amenity purposes. Surface waters and groundwaters are taken into account by water scientists and water policy-makers insofar as they can be quantified. Soil water is generally ignored. 'Things do not always appear as they are'.

3.2.2 Soil Water

Soil water is not accounted in national water budgets. The Shiklamanov (2000) research group is an honorable exception in that soil water appears in all its datasets. Nor does soil water figure in an integrated way in the statistics of the international agencies (FAO 2003; FAO Aquastat 2004; World Bank/WRI 2003). Although Renault (2003) at FAO has contributed usefully to the development of the valuation of virtual water, UNESCO has responded to the useful prominence recently given to the concept of virtual water by a number of water research groups (Hoekstra/Hung 2002; Hoekstra 2003; Oki/Sato/Kawamura /Miyake/ Kanae/Musiake 2003; Renault 2003).

This discussion will not emphasize the water services provided by the water in the natural environment. The absence of such discussion does not mean that such water services are regarded as unimportant. There is not space here to address the topic adequately.

3.2.3 Virtual Water

Virtual water has been conceptualized and defined elsewhere (Allan/Olmsted 2003). The concept has also been critiqued and debated (Merret 2002, 2003).

The argument that virtual water should have a place in reviews of global and regional water resources and in strategizing water policies in summary, runs as follows. The water sector and the freshwater within its rivers and ground waters are not a sufficiently comprehensive basis for quantifying, analyzing and optimizing the allocation and management of water resources.

To review water resources and water transferring processes comprehensively it is necessary to see water allocation and management as a global issue and a global challenge. In the global hydro-economic system solving the problems of water scarce regions, non-hydrological systems, such as trade, are as important as the water and water flows within watersheds captured by hydrology. The proportion of the water re-distribution problem successfully addressed by virtual water processes is already impressive and has the potential to be of even greater significance. Hoekstra and Hung (2003: 25) estimate that 695 billion cubic meters of freshwater and soil water entered international trade in virtual form out of the 5400 billion cubic meters water used to produce crops in the 1995–1999 period.

Livestock products are particularly water intensive. A study of the virtual water content of the 1995–1999 trade in livestock products (Chapagain/Hoekstra 2003) calculated the figure to 336 billion cubic meters per year. Most livestock products are raised on soil water. But a proportion of such products are produced from irrigated fodder. By adding the annual global virtual water figures for crop production – 695 billion cubic meters – to the 336 billion cubic meters for livestock products, we get a total global figure of 1031 billion cubic meters. There is some double accounting in this number but the calculation nevertheless does confirm the very important part played by virtual water, mainly derived from soil water that enables sustainable water resources management across the globe.

All the volumes of water discussed above are situated in rising long term trends, although there is a current temporary leveling off in the trade in major grains. The leveling off is the result of improved efficiency as measured by returns to water in both the Northern and the Southern economies (Dyson 1996).

Meanwhile estimates of current global freshwater use in irrigated farming suggest that the total mobilized is about 1430 billion cubic meters per year – that is 26 per cent of the total water used in crop production (Rosegrant/Cai 2002). The same authors suggest that by 2025 the use of irrigation water could rise to 1480 billion cubic meters per year. Clearly the virtual water solution, associated with 13 per cent of global water used in crop production is significant as a problem solving process. The trade in livestock products adds to this global percentage. Virtual water is especially significant in addressing these problems, which local technological solutions cannot address in water scarce regions. Just as important as its volume as a proportion of total water use in crop production and its capacity to solve otherwise un-addressable problems in water scarce regions, is its flexibility. This quality of flexibility will be discussed next.

3.3 Socio-economic Development: A Third Invisible Solution for the Water Scarce

The roles of soil water and of virtual water trading processes have, until recently, been unrecognized. The concepts remain very much part of a minority outsider discourse even in the international epistemic science and policy communities associated with water allocation and management.

The third non-evident process that spectacularly ameliorates water deficits is socio-economic development. The achievement of more *jobs per drop* rather than more *crops per drop* has been key to the successful amelioration of water scarcity except in many economies in sub-Saharan Africa. This ameliorative process is not even on the agenda of most water scientists and water policy-makers in the South.

Socio-economic development associated with the strengthening and diversification of economies has achieved impressive levels of allocative efficiency in association with virtual water related processes. The very desirable allocative efficiencies achieved in the water sector in the past half century have, however, been incidental benefits resulting from the socio-economic development. These water efficiencies gained were not part of water policies. They were *hidden-hand* (after Adam Smith) processes. The hidden hand enabled the perversely hydrocentrically (Brichieri-Colombi 2003) inclined water sector professionals and policy-makers to achieve unintended sustainable economic outcomes.

Job creation in industry, services and the public sector silently and invisibly reallocated water at a scale beleaguered politicians dream of. Job creation associated economic diversification has proved to be a mighty demand management tool. In addition job creation outside agriculture has generated incomes and revenues with which political economies have been able to access virtual water in the global system. Economic transformation achieved in the East Asian economies, and in for example Israel (Allan 2001: 249), demonstrate how economies can achieve water security through economic diversification.

Virtual water transactions and diversified job creation have enabled five decades of relatively conflict free global co-evolutionary transition from water abundance to water scarcity. For the past 25 years potential regional water scarcity has been managed within sustainable regional and global water management regimes through the very effective *threefold synergy* of soil water access, virtual water processes and socio-economic development.

3.4 The Timely Availability of the Flexible Threefold Synergy: Soil Water, Virtual Water and Development

The worsening water scarcity experienced in some regions of the world in the second half of the twentieth century was happily encountered at a fortuitous moment in world economic history. The first good fortune of the water scarce was the availability of a comprehensive global trading system in food. This is not to say that the food trade is new. The system has been operating effectively for millennia. Rome in antiquity was fed by grain and other commodities raised in North Africa. Apparently comparative advantage is not static – as Wichelns (2004) argues in each case it is related to the production systems and the opportunity costs that obtain. By the late twentieth century economies such as Egypt, the main North African food exporter in antiquity, were importing more than half their food. Two thousand years ago Egyptian agricultural exports to Italy were substantial. Semi-arid economies facing water scarcity encountered their scarcities at a moment in history when, fortuitously, the world's temperate regions had become highly industrialized and were producing substantial crop surpluses throughout the second half of the twentieth century.

A second fortuitous, and invisible, non water sector, process assisting the water scarce since the middle of the twentieth century has been the economically perverse agricultural policies of the European Union and in the United States. Their production and export subsidies on wheat for example, ensured that half-cost grain was available on the world market. The pivotal global grain importers, the Middle East, North African and Japanese economies were all well able to purchase imports. They have been significantly advantaged by the EU/US subsidies. Together they accounted for about 150 billion cubic meters of virtual water imports in crops – out of the total annual global volume of 630 billion cubic meters – transacted in the global system in the last five years of the 20th century. These major importers accounted for 23 per cent of the total. The author is at the same time aware of the negative economic impacts of low world prices for grain on those economies, especially those in sub-Saharan Africa, which enjoy no potential comparative advantage except in crop production.

3.4.1 Variable Water Demands: The Threefold Synergy is also Flexible and Responsive

It is argued here that virtual water is, therefore, part of a mighty *threefold synergy* – soil water, virtual water and socio-economic development – that enables communities, nations and river basins to access sufficient water to meet their variable water needs. A further very important feature of the mighty threefold synergy is its unmatched flexibility. Since the 1970s it has enabled the extension of a form of supply management miracle across the globe. The synergy has been capable of meeting varying regional and emergency food/ water demands. Variable demand is normally associated with drought. The threefold synergy can successfully augment demand management policies that in themselves cannot achieve local sustainable water allocation.

The threefold synergy has proved its capacity to respond to systemic trends associated with increased demands associated with regional demographic dynamics – for example in the Middle East. The system has coped with the closure of the Middle East and North African water systems and the resulting increased demands for food imports. It has also coped with the variable demands coming from the former Soviet Union and the Russian Federation. The biggest variable demands have come from China. These demands have occurred despite China's own extraordinary increases in production since 1961. The variable demands for grain imports from China have also been accommodated. That there is a mix of local and international solutions is revealed in the decline in volumes of grain entering international trade in the last five years of the 20th century. Despite the progressive increases in the world's population the volumes of grain traded have been declining since the late 1990s.

3.4.2 The Threefold Synergy and the Environment

Finally, through reducing the pressure on water resources in water scarce regions the threefold synergy has alleviated, or at least it has had the potential to alleviate, progressively higher demands on the freshwater and the soil water in the environment. The availability of the threefold synergy has enabled demands on local surface and ground waters to level off and in some cases to be reduced. This is especially the case in Northern semi-arid economies – for example in Israel. Water has been returned to the environment in Northern semi-arid economies to reinstate, to some extent, the environmental services provided by the natural hydrological system (Allan 2001: 146–148). In the South the availability of virtual water has not yet had the same impact.

The shift towards precautionary and green water policies is not a response to the economic processes that have made them possible. The advocacy of the green movement has been a very important factor in environmentally sensitive water policy-reform in the North. In this Northern discourse the new resource managing circumstances afforded by the threefold synergy has enabled pressure on the water in the environment to be alleviated in Northern political economies.

The green social movement is poorly developed, however, in most Southern political economies. In Southern semi-arid economies the apparent amelioration of scarcity by the threefold synergy can play a negative, rather than a positive role in strategizing the allocation of water vis-à-vis the environment. Old practices and policies can be left in place because to reform them would only be achieved at unacceptably high political prices. Paying such prices can be avoided in the apparent water security provided by the invisible threefold synergy. Water abstraction practices associated with the livelihoods of poor farmers with no alternative job options tend to remain in place, including those, which damage the water environment (Allan/Olmsted 2003).

3.5 Conclusion: Three Fold Synergy and Water Policy in the MENA Region

An understanding of the politics and local history of water policy-making processes is a much better starting point for a water policy reform campaign. This is not a new idea. Marx pointed out the determining role of politics. The historically evolved 'abstract' domain of politics overwhelms the information coming from science and sub-optimal markets in what Marx termed the 'concrete' economic domain (Fine/Saad-Filho 2003). The concrete provides possible conceptual foundations for the (political economy) superstructure, where those with power make allocative decisions. The evidence is, however, that the concrete is only very selectively included in policy-making discourses. Scientists do not draw up policy-making agendas. Nor are they normally much involved in developing politically controversial allocative policy. They can help to raise awareness of how things are. But they normally have to struggle mightily to bring about significant shifts in perception.

One of the reasons that water science and water professionals have limited purchase on policy-making is because there are economic processes outside the water sector and its watersheds, which solve water scarcity problems. The analytical tools of hydrologists, environmental scientists, and hydraulic engineers are not effective in these 'problem sheds' beyond the watersheds of the water sector.

After two or more decades of reorienting their own approaches to managing water, scientists and professionals are still undecided about how to cope with the politics of water policy-making. For centuries, even millennia, water professionals solved the water problems of the societies managed by political elites. They did this without much consideration for the value of environmental services of water or of the economic value of the water inputs to society and agriculture. Recognizing these two issues as new fundamentals were challenging. Conveying their unavoidable importance to water users with few or no alternative livelihood options, and to water policy makers wanting to avoid paying high political prices associated with re-allocative reforms, took the discourse into realms of very painful uncertainty.

Water professionals had little experience of a world where problem solving was social and political rather than technical. In another policy domain, Edward Teller, the nuclear physicist, knew how to influence politics. "He knew that it was more like magic than logic, and in spinning his spells, he was dishonest, wasteful, and at times dangerous. He never saw this as evil or immoral. He once corrected Oppenheimer's famous comments that 'scientists have known sin.' As far as Teller was concerned 'scientists have known power' and what it demands" (Goodchild 2004).

Water scientists and water professionals are still unsure whether they should know power, and remain uncomfortable telling new truths to power. Activists from the green movement have been much more successful in shifting the debate and water policies than the science community and water professionals. The activists are regarded by the water professionals and scientists as 'dishonest', 'spinners of spells' and 'at times dangerous'. But they have influenced the discourse and associated policy reform.

References

Allan, J. A., 2001: *The Middle East Water question: hydropolitics and the global economy* (London: I B Tauris).

Allan, J. A., 2004, "Water resource development and the environment n the 20th century: first the taking, then the putting back", in: Rodda, J. (Ed.): *The Basis of Civilization – Water Science*, IAHS Publication 286, (August): 135–149.

Allan, J. A.; Olmsted, J., 2003: "Trading virtual water, the MENA water deficit and the consequences for water policy reform", in: Lofgren, H. (Ed): *The Middle East water economy* (Washington: IFPRI).

Brichieri-Colombi, J.S.A., 2003: "Food security, irrigation and water stress: logical chain or environmental myth? Occasional Paper 57 (London: King's College London/ SOAS Water ResearchGroup); at: <http:// www.kcl.ac.uk/kis/schools/hums/geog/water/occasionalpapers/home.html#trade>.

Brichieri-Colombi, J. S., 2004: "Hydrocentricity: a limited approach to achieving food and water security", in: *Water International*, 29,3 (September): 318–328.

Chapagain, A. K.; Hoekstra. A. Y., 2003: *Virtual water between nations in relation to trade in livestock and livestock products*. Value of Water Research Report Series No 13. (Delft, The Netherlands: IHE).

Dyson, T. 1996, Population and food: global trends and future prospects, London.

Earle, A., 2001: T*he role of virtual water in food security in Southern Africa*. Occasional Paper 33 (London: King's College London/SOAS Water Research Group); at: <http://www.kcl.ac.uk/kis/schools/hums/geog/water/occasionalpapers/home.html#trade>.

FAO, 2003: *Review of world water resources by country*. Water Report Number 23 (Rome: FAO).

FAO, 2004: *Aquastat database* (Rome: FAO); at: <www.fao.org>.

Fine, B.; Saad-Filho, A., ^{4}2004: *Marx's Capital* (London: Pluto Press).

Goodchild, P, 2004: "Meet the real Dr. Strangelove", in: *The Guardian*, 2 April: 8–9, in: G2 Supplement.

Hoekstra, A.Y.; Hung, P.Q., 2002: *Virtual water trade: a quantification of virtual water flows between nations in relation to international crop trade*. Value of Water Research Report Series No 11 (Delft, The Netherlands: IHE).

Hoekstra, A. Y. (Ed.), 2003: V*irtual water trade: proceedings of the international expert meeting on virtual water trade*. Value of Water Research Report Series No 11 (Delft, The Netherlands: IHE).

Merrett, S., 2002/2003: "Virtual water and Ocean's razor", in: *Water International*, 28,1: 12–16.

Oki, T.; Sato, M.; Kawamura, A.; Miyake, M.; Kanae, S.; Musiake, K., 2003: "Virtual water trade to Japan and the world", in: Hoekstra, A.Y. (Ed.): *Virtual water trade: a quantification of virtual water flows between nations in relation to international crop trade*. Value of Water Research Report Series No 12 (Delft: The Netherlands: IHE): 221–235.

Renault, D., 2003: "Virtual water: principles and virtues", in: Hoekstra, A.Y. (Ed.): *Virtual water trade*. Value of Water Research Report Series No 12 (Delft, The Netherlands: IHE): 77–91.

Rosegrant, M. W.; Cai, X., 2002: "Global water demand and supply projections: Part 2. results and prospects to 2025", in: *Water International*, 27, 2: 170–182.

Shiklamanov, I. A., 2000: "Appraisal and assessment of world water resources", in: *Water International*, 25,1: 11–32.

World Bank/WRI, 2003: *World Resources* 2002–2004*: decisions for the Earth: balance, voice, and power* (New York – Washington: United Nations Development Programme; United Nations Environment Programme, World Bank, World Resources Institute).

Wichelns, D, 2004: "The policy relevance of virtual water can be enhanced by considering comparative advantages", in: *Agricultural Water Management*, 66: 49–63.

4 Politics and Water Management: A Palestinian Perspective

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Abstract

This chapter examines the notion that politics is a significant if not the prime factor that influences on-the-ground realities of water use, sanitation, and water resource development in Palestine. Israeli water politics in the Occupied Palestinian Territory (OPT) were based on the goal of controlling Palestinian land and resources and forcing Palestinians to leave the country. They were characterized by four main steps: to use military overpower and unilateral actions to set and create new on ground realities that constitute the new negotiating basis, to enact laws and military orders that will help strengthen control and oversee what was taken by military force, set policy on the future directions and actions to be taken to fulfill the main objective of controlling Palestinian land and resources and implement through the establishment of institutions that control on ground the forced new reality. Continuing the past and present Israeli approaches will result in serious harm to both people with different proportions and scales. To achieve a long lasting just peace between the two sides based on unified national rights, human values, and mutual living is the solution. A joint Palestinian Israeli water utility operating and serving both people along this line is considered to be a highly feasible option for resolving the water conflict.

Keywords: Water politics, water management, water rights, Palestine, Israel.

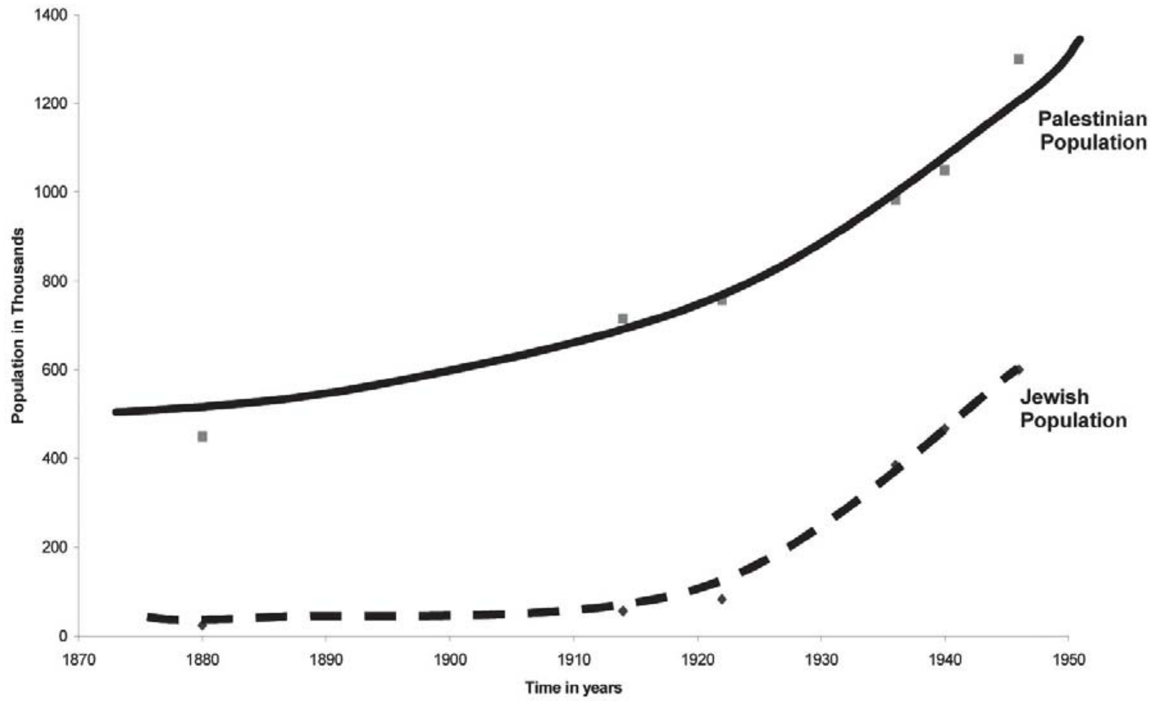
4.1 Introduction

Palestine has scarce rainfall and consequently scarce renewable water resources. Starting with scarce water resources, Palestine is experiencing a fierce competition by Israel and its Jewish colonies over the control of its land and water resources. Water management policies in Palestine since 1949 was contentious and driven by Israeli political competition.

While the current Palestinian water supply is restricted and limited by the Israeli military authorities (not sufficient for immediate and near term needs), Israeli consumers were using Palestinian water at about four times that of average Palestinian water per capita. The enormous economic pressure imposed and enforced by the Israeli military on Palestinians through seizures, closures and controls, and the separation-apartheid wall has affected all aspects of life and economic activity including agriculture. Therefore, water use patterns, land use, and urbanization are being changed in the Palestinian areas under military control. These conditions indicate that significant changes must occur to restore the area and to prevent acute water shortage and economic failure in the Palestinian areas in the near future.

As a result of the prolonged Israeli military occupation of Palestine and its natural resources including water, Palestinians at present have (1) no legal control over their water resources, (2) limited – permitted quotas by Israeli military authorities – water supply much bellow Israeli as well as the WHO standards, and (3) negative economic development forcing people to migrate. This limited water supply to Palestinians includes a small number of groundwater wells for

Figure 4.1: Palestinian and Jewish Population Development (1880 – 1946). **Source**: League of Nations, 1945



municipal use and a number of shallow agricultural wells (with a depth of between 60 and 120 m). The agricultural wells are getting dry with time due to the water withdrawal for Israeli colonies using deep wells (over 500 m deep). The Palestinian water problem is exacerbated by a deterioration of water quality, especially in the Gaza Strip and some areas in the Jordan Valley.

The broader objective of this chapter is to create a better understanding of the water conflict between Palestinians and Israelis and to present a way forward in resolving this conflict for the benefit of both nations.

4.2 Background

4.2.1 Historic Backdrop

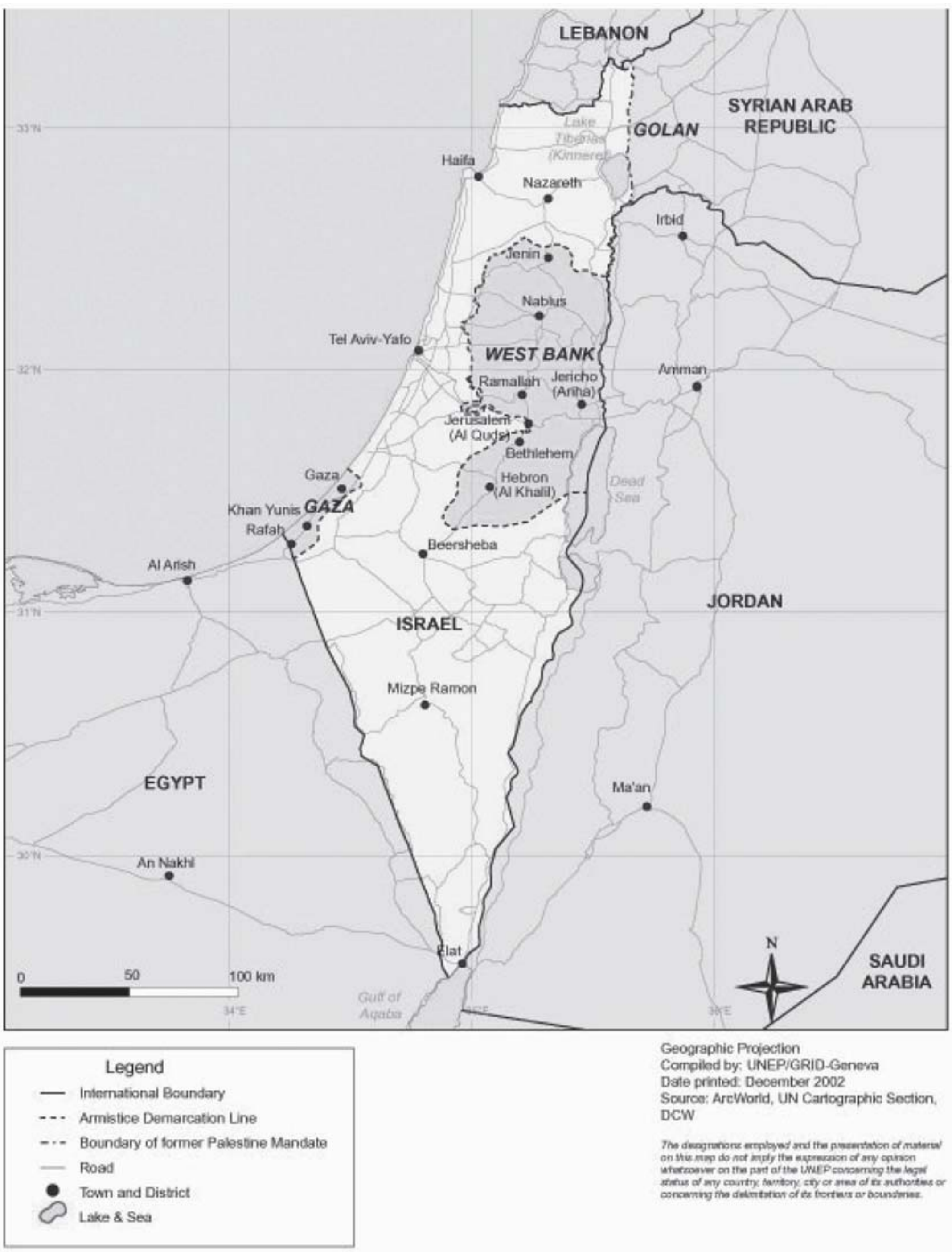
Water is not a new issue in the Palestine question. At the end of the 19^{th} century, there were no Jewish immigrants in Palestine (see figure 4.1). At that time, plans were made by Jewish organizations in Europe to establish a homeland for the dispersed Jews of the world. Cooperation began between the World Zionist Organization and the British government on the Palestinian water issue. As a result of this cooperation, the British Royal Scientific Society in 1873 sent a delegation to Palestine to investigate two issues; the first was the available water resources and the second was the possibility of settling Jews in the southern part of Palestine in Al-Naqab. After its return, the delegation reported in 1875 that water could be brought from the northern parts of Palestine to Al-Naqab and Jews could be settled there (Labbady 1989).

Between 1875 and 1948 several attempts were made by the various Jewish organizations to increase Jewish immigration to historic Palestine and in parallel physical control of the water resources in Palestine and surroundings or by the transfer of water from outside Palestine (Schmida 1984; Dillman 1989; Ali 1964).

In the fall of 1941 the British prime minister Winston Churchill officially announced in the Common Council that the Jewish leaders requested from the British government to have a free hand in all parts of Palestine and in those parts of southern Lebanon which include the Litani river as a price for full Jewish support of Great Britain and of their allies during the second World War (Ali 1964). Concessions were made by the British Authorities in Palestine to exploit some of the water resources for a limited time (Schmida 1984; Dillman 1989).

Many water plans and projects (Dillman 1989; Ali 1964) evolved and were presented. However, the

Figure 4.2: West Bank and Gaza. **Source**: <http://www.grid.unep.ch/product/map/images/palestine_general_mapb.jpg>



riparian parties never discussed and resolved the water problems faced. Palestinians were always in these plans and projects, but they were treated as if they did not exist or had no rights.

4.2.2 Palestine

Palestine as presented in this chapter consists of the West Bank including East Jerusalem and the Gaza Strip. The West Bank and the Gaza Strip are those parts of historic Palestine which were occupied by the

Israeli army during the 1967 war between Israel and Egypt, Syria, and Jordan. The land area of the West Bank is estimated at 5572 km^2 extending about 155 km in length and about 60 km in width. The Gaza Strip, with an area of 367 km^2 is approximately 41 kilometers long and 7 to 9 kilometers in wide (see figure 4.2, Abdel Salam 1990, and Haddad 1998).

4.2.3 Palestinian Population

According to estimates in mid-2003 the Palestinian population totaled 3,634,495 persons, about 2,304,825 lived in the West Bank and 1,329,670 in the Gaza Strip (PCBS 2003, 2004). According to the official list of local authorities compiled by the Palestinian Central Bureau of Statistics (PCBS 2003) and by local governments, there are 686 localities in Palestine of which 54 are urban, 603 are rural, and 29 are refugee camps. These localities were distinguished by the type of authority as 107 municipalities, 11 local councils, 374 village councils or project committees, and 29 directors of refugee camp. An additional 76 rural localities are either not inhibited (forced to leave there villages by the Israeli army because of colonialization or for security reasons) or they joined larger nearby localities.

4.2.4 Palestinian Water Resources

The estimated average annual ground water recharge in Palestine is 698 to 708 mcm/yr (648 mcm/yr in the West Bank and 50 to 60 mcm/yr in the Gaza Strip). The main surface water source in the West Bank is the Jordan River and its tributaries (see figure 4.3). In the Johnston plan of 1955, the Palestinian share in the Jordan River of 257 mcm/yr was considered as part of the Jordanian share of 774 mcm/yr as the West Bank was then under the Jordanian rule. Since the 1967 war to the present, Palestinians have been prohibited by the Israeli army from using the Jordan River water. Palestinian lands and farms located along the western side of the river were confiscated and the area was declared as a restricted military security zone (Haddad 1993). In addition, and since 1967 – with the Israeli military occupation of the West Bank and Gaza Strip – Palestinians were also prohibited from developing the surface water runoff amounted at 72 mcm/yr (Haddad 1993, 1998).

4.3 Israeli Water Politics

During the past century Jewish military groups (before 1948) and Israel (after 1948 until present) skillfully determined, directly and/or indirectly, the amount of water that would be available for Palestinians and who would get what water, for what purpose, from which resource, and when. Israeli water policies in the Palestinian territory were characterized by four main steps: a) unilateral actions, b) enacting laws and military orders, c) setting policy, and d) implementing control.

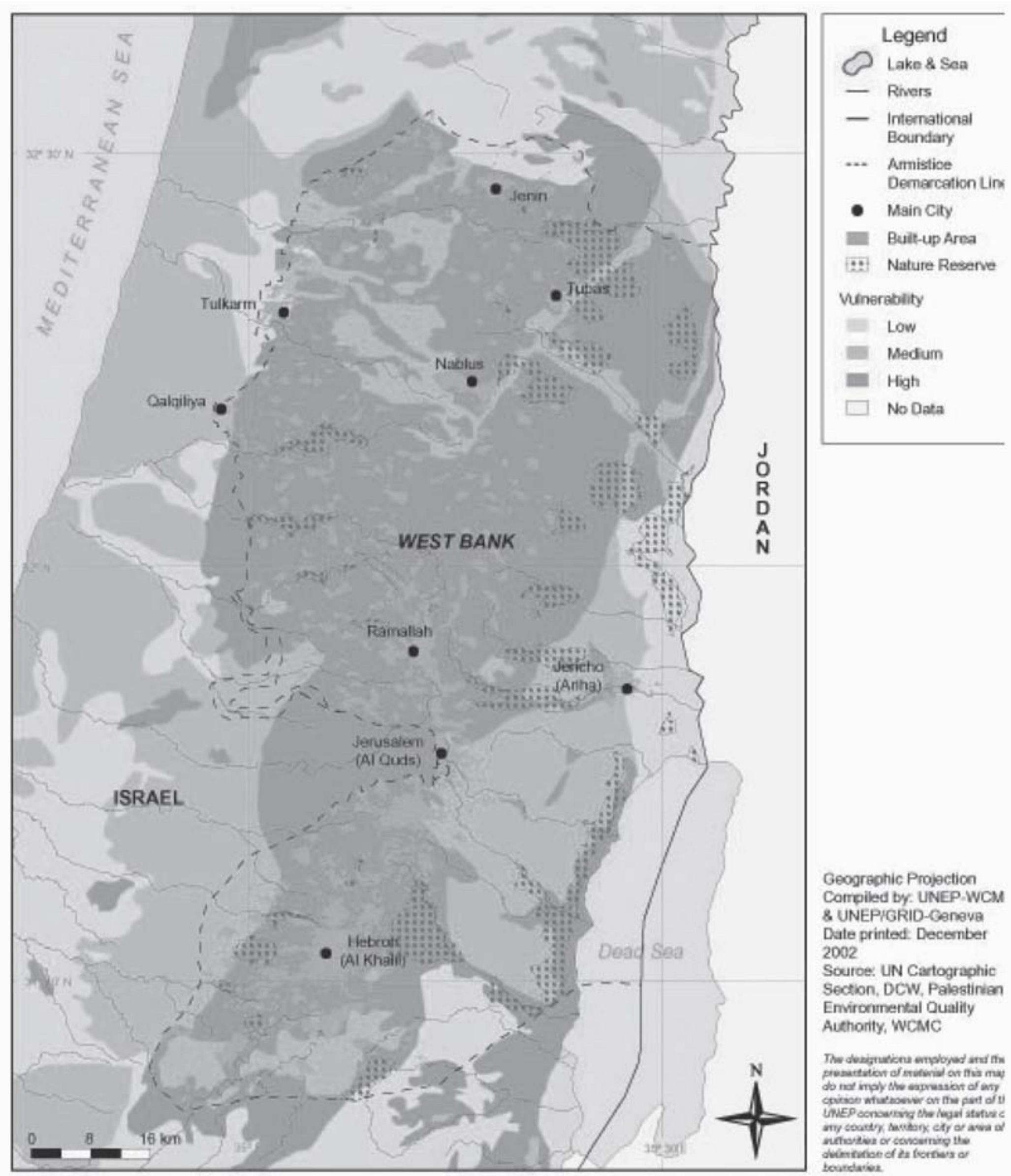
4.3.1 Military Overpower and Unilateral Actions

Since 1948 Israel unilaterally implemented several major water projects using water claimed by others without getting the agreement of other riparians. Israel diverted water from the Jordan River Basin through its national water carrier, dried Hula lake among others. Immediately after the end of the 1967 war, Israel destroyed 140 Palestinian water pumps in the Jordan Valley and made it difficult to obtain permits for new wells. After this destruction, the Israeli army declared the area in the West Bank near the Jordan River a military-security zone and thus prevented many Palestinians to get to their farm land.

4.3.2 Enacting Laws and Military Orders

Following the 1967 war, Israel secured its control over the headwaters of the Jordan River. Before 1967, the Palestinians had 720 groundwater wells for agricultural and domestic purposes. Soon after the occupation, Israel imposed a number of military orders to control Palestinian water resources. On 15 August 1967, the Israeli military commander issued Order No. 92, in which water was considered a strategic resource. This order was followed by numerous other orders aimed at making basic changes in the water laws and regulations in force in the West Bank. Under Military Order No. 158 of 1967, it is not permissible for any person to set up or to assemble or to possess or to operate a water installation unless a license has been obtained from the area commander. This order applies to all wells and irrigation installations. The area commander can refuse to grant any license without the need for justification. These orders were followed by numerous military orders (No. 291, No. 457 of 1972, 484 of 1972, 494 of 1972, 715 of 1977 and 1376 of 1991) to achieve complete control over Palestinian water resources (figure 4.4 and 4.5).

Figure 4.3: Hydrological Vulnerability of Groundwater to Pollution in the West Bank. **Source**: <http://www.grid.unep.ch/product/map/images/palestine_wb_vulnerabilityb.jpg>



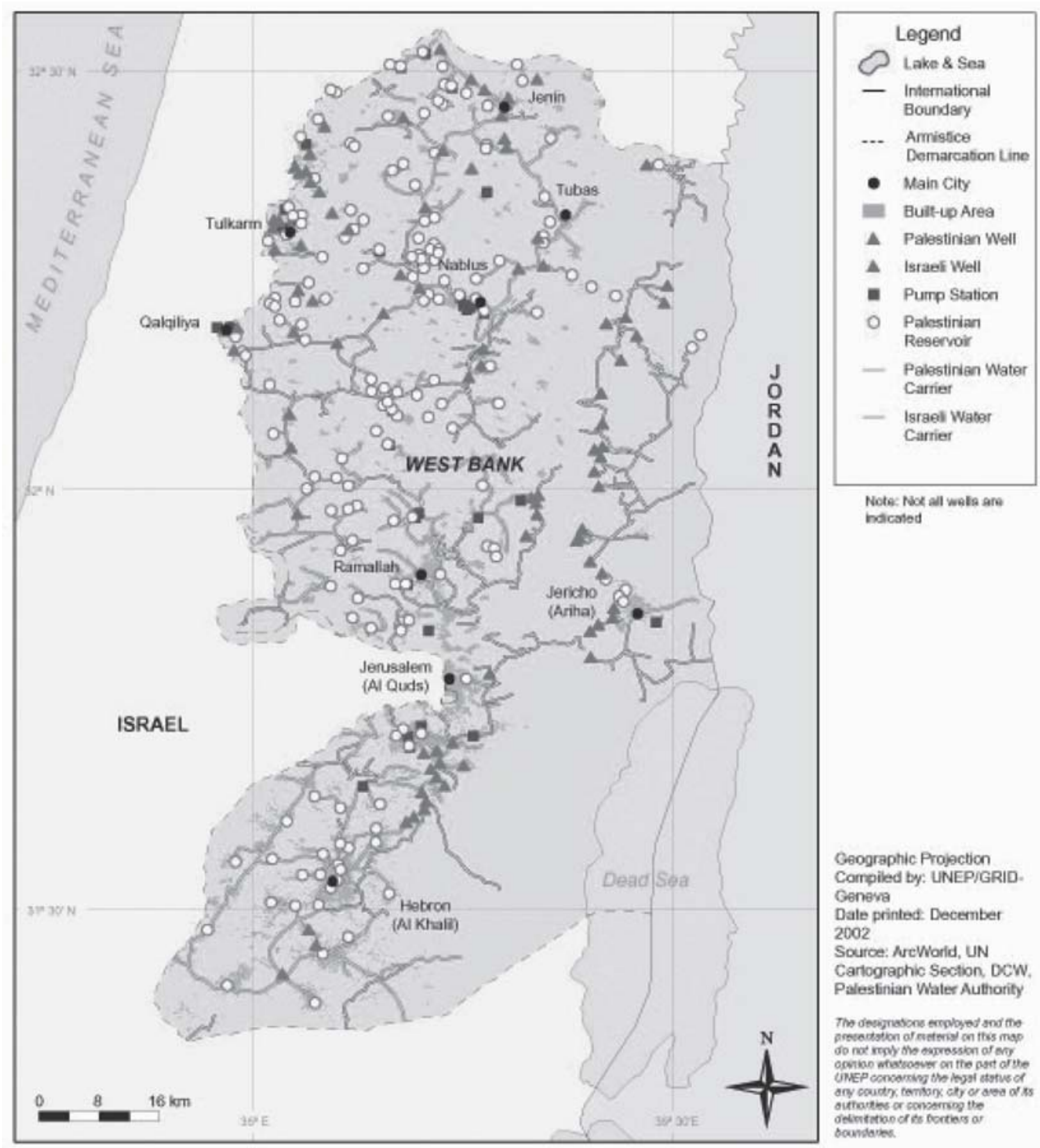
4.3.3 Setting Policy

The Israeli policy in the Occupied Palestinian Territories consists of (1) limiting Palestinian economic development through limiting the water available to Palestinians and (2) closing all doors to a just and real peace with acceptable and implementable political solutions. These policies have left the Palestinians without hope. It has also forced them to leave their land and migrate to neighboring Arabic countries or work as cheap unskilled labor in Israel.

4.3.4 Implementing, Establishing, and Controlling

Palestinian water use was set at a fixed quota by the Israeli civil administration and military authority in the early days of the military occupation of the West Bank and the Gaza Strip. Despite the rapid increase in the Palestinian population and demand for more water, since 1967 Israel has granted Palestinians in the West Bank only very limited permits for new water wells (figure 4.6 and 4.7). All were to be used exclusively for domestic purposes. New water wells for agricultural

Figure 4.4: Water Carriers in the West Bank. Sources: UNEP 2003; <http://www.grid.unep.ch/product/map/images/palestine_wb_carrierb.jpg>.

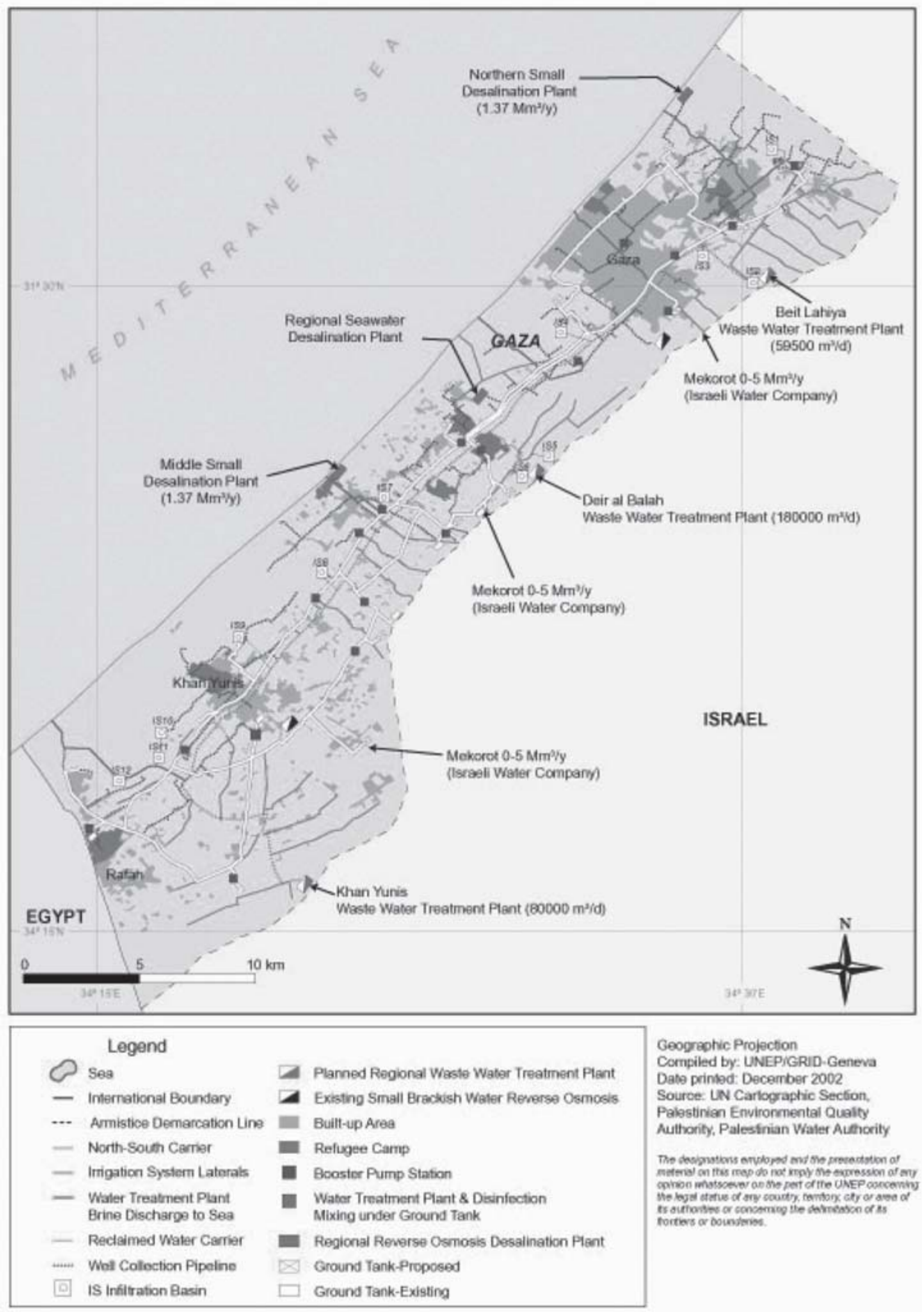


purposes in the West Bank were also restricted granting only three permits.

Israel created the so-called the Israeli Civil Administration, a military – civil organization that had to implement and oversee the implementation of these policies and military orders and laws, which ensured their full control over Palestinian land and resources including water and humans.

Palestinians in the West Bank and Gaza Strip have an intermittent water supply system, namely they get water in the system only twice a week only and then for only 2–3 hours. Water quality has been altered by such a water supply system. Based on Israeli military orders a Palestinian cannot build any type or size of water infrastructure without the written permission of Israeli authorities. If a Palestinian municipality submits such a request to the Israeli authority, their request might take a year to be answered. In contrast all Israeli settlements have continuous – 24 hours per day/seven days a week water supplies of their desired quantity and the quality meets high standards.

Figure 4.5: Water Carriers in Gaza. **Sources**: UNEP 2003; <http://www.grid.unep.ch/product/map/images/palestine_gaza_carrierb.jpg>;

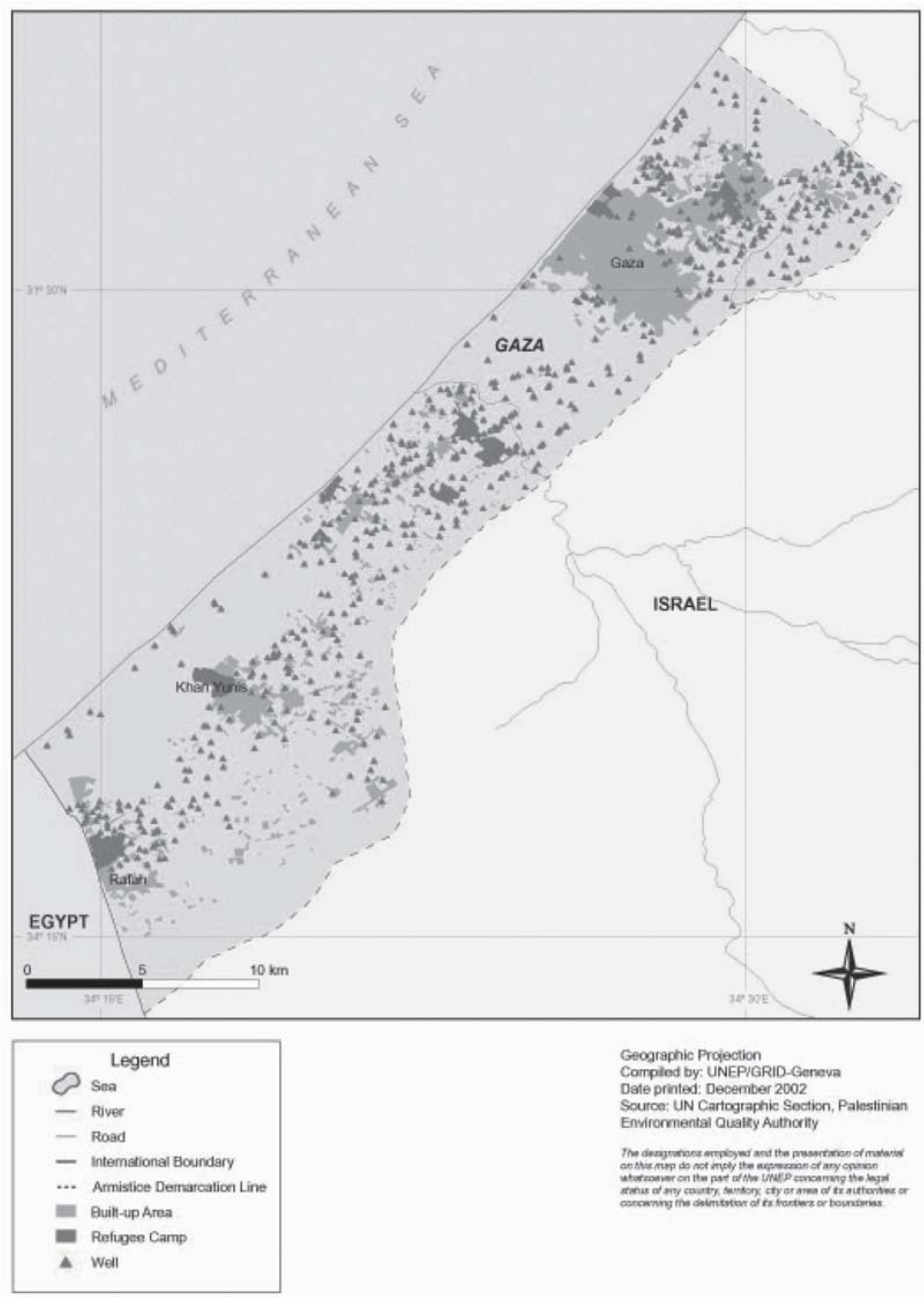


4.4 Key Palestinian-Israeli Water Issues

4.4.1 The Problem

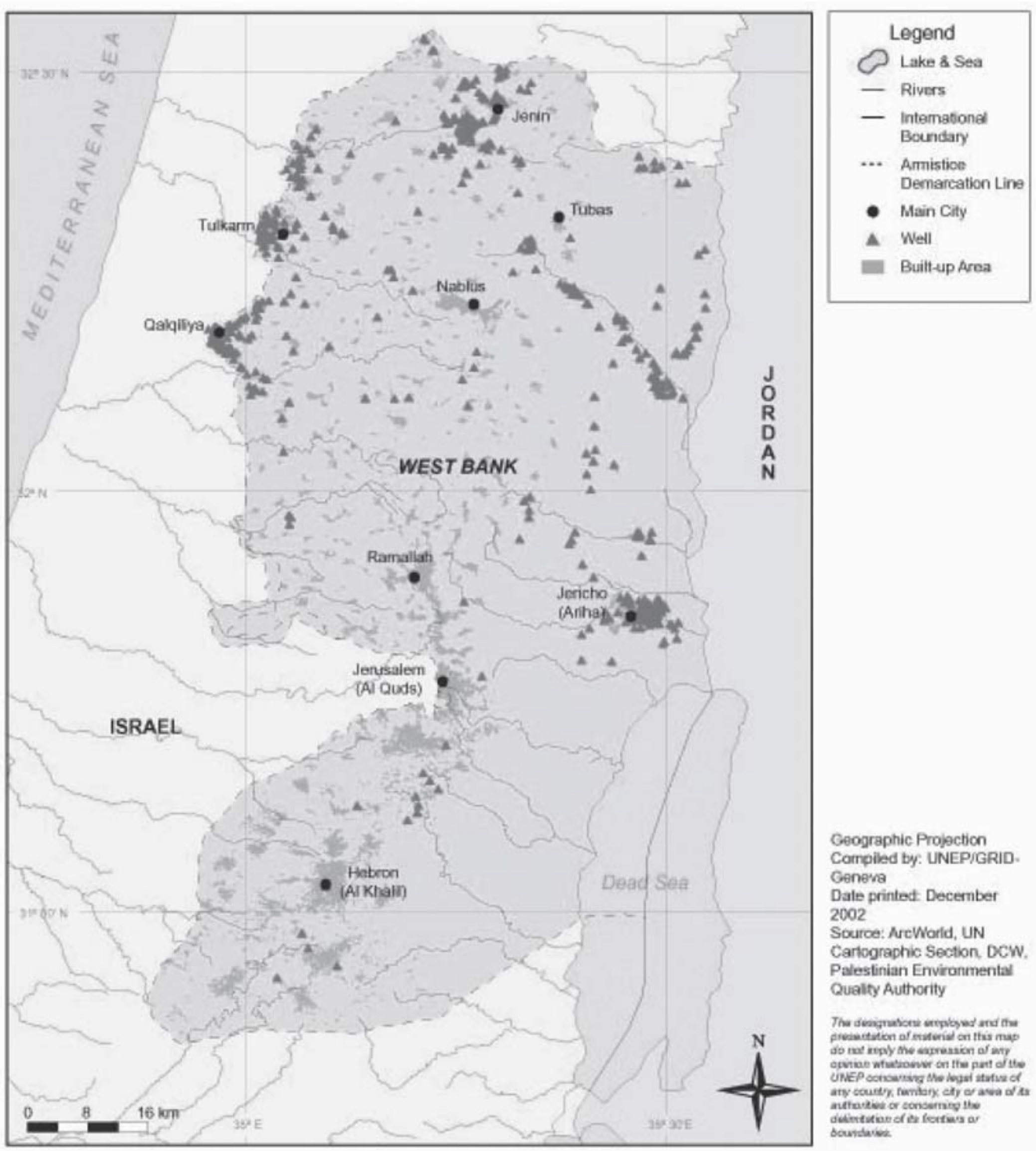
The initial and basic problem between Palestinians and Israelis on water is not water availability, use or supply efficiency, or any other economic or technical problems but the Israeli political competition over Palestinian land and its natural resources and who controls and owns what in historic Palestine. Israel uses military power unilaterally to set water controls, use, access and mobility of Israelis and Palestinians to available water resources in historic Palestine including

Figure 4.6: Well Distribution in Gaza. **Sources**: UNEP 2003, <http://www.grid.unep.ch/product/map/images/palestine_gaza_wellb.jpg>.



the West Bank and Gaza Strip resulting in a growing water demand for Israelis and in limitations and restrictions of water for the Palestinians that has resulted in a difference in water use between Israelis and Palestinians of over four to one. The ongoing and increasing problem is that population and socio-economic growth of both people with time has resulted in a severe water deficit which exceeds available and

Figure 4.7: Well Distribution in the West Bank. Sources: UNEP 2003, <http://www.grid.unep.ch/product/map/images/palestine_wb_wellb.jpg>.



renewable water resources in the disputed area or boundaries.

4.4.2 Palestinian/Israeli Water Negotiation (1993-95)

The PLO was not prepared for detailed negotiation including those on water and it lacked a pre-negotiation a negotiating team, as well as a policy or strategy on water. The only data the PLO possessed were in archival files and reports prepared by various experts. The data in those reports and studies were not verified or validated.

Water negotiations on the transfer of authority on water in the Gaza Strip went smoothly because there was no water interest on the Israeli side in Gaza and the Palestinian side did not raise serious water issues such as (1) the wadi Gaza water blockage beyond the green line by the Israelis amounting to 20-30 mcm/yr, (2) the supply of the Gaza Strip with water from the Palestinian share in the Jordan River Basin from Lake Tiberius through the Israeli National water carrier, and others.

Negotiations between Palestinians and Israelis on the interim transfer of authority for water in the West Bank started in Cairo in mid 1995 and continued for four months with difficulties on defining the terms of reference. These negotiations ended in Taba by an order from top Palestinian political leaders to the head of the negotiating team asking him to sign a preset Israeli drafted water agreement. This agreement appeared in Oslo-B, article 40, annex 3 (Oslo – B 1995). It was not an agreement addressing Palestinian water needs and problems, on the contrary, some of the articles harm the Palestinian cause such as the one talking about future Palestinian water needs estimated at 70–80 mcm. It was intended, as promised by the Israeli side, that this accord would only be valid for the transient interim stage that would end in the year 2000. The water issue at the end of that stage would be settled among the other pending issues such as Jerusalem, borders, refugees, etc.

4.4.3 Water Equity

The Palestinian-Israeli water equity or equal rights to water is not and should not be a political issue. It is a matter of morals and values as well as rights. Supplying water effectively and efficiently to both people using the same human values and criteria is essential for the living together between Palestinians and Israelis irrespective what the final political status between them might be.

4.4.4 Water Rights and Water Needs

If things are normal and mutual trust between Palestinians and Israelis exists, any evolving conflict can be faced and resolved. However, the issue is far beyond trust, neighborhood relations and mutual interest. In Israel the political leadership has different views on the subject matters for example former Prime Minister Sharon was quoted saying: "My view of Judea and Samaria is well known, the absolute necessity of protecting our water in this region is central to our security. It is a non-negotiable item" (Boston Sunday Globe, 1998). In one of his meetings with the Palestinian negotiators, the former Israeli water commissioner Ben-Meir said: "I recognize needs, not rights. We are prepared to connect Arab villages to Israel as well, but I want to retain sovereignty on hand." These statements confirm Palestinian fears of a dry peace and whether Israel genuinely wants peace.

The Israeli position in the bilateral Palestinian-Israeli talks on water is summarized by the idea that the existing uses of water need to be maintained and preserved except for drinking water as well as new alternative water sources that need to be jointly looked at. Accordingly, the Palestinians fear that discussing with the Israelis only water needs and quantities separately from water rights will end by making the Palestinians consumers of or visitors to Israel. In such a case Israel could at any time or instance bring real or artificial cuts, reductions, or monopolizations to those quantities either in price, time or in place. This would limit Palestinian development and existence. Palestinians also fear that accepting such an approach will also end in separating them from their land and their resources including renewable fresh water resources which is the intention of all Israeli activities in the Occupied Palestinian Territories.

4.5 Conflict Resolution and Resolving Mechanisms

Theoretically and subjectively the Palestinian/Israeli conflict in the beginning could be encountered and resolved peacefully using international and UN schemes, orderliness, and methods. This did not materialize on the ground, instead military force, military, economic and political power, superiority and manipulations were used. The Palestinian leaders encouraged high expectations in their people's mind, while most local and some international organizations allowed Israel to grow and strengthen its position. Verbal non-involvement, non-decisive, non-implementable UN resolutions were adopted and had the effect of creating a bigger and wider conflict. The author would like to point to the human suffering and negative consequences associated with abiding with non-decisive resolutions. Military mechanisms will not last forever and there is a high need for real and objective approaches taking both peoples' needs and aspirations for the present and the longer term future into consideration.

4.5.1 Prior Use and Illegal Exploitation

Israel grants itself legitimacy for previous violations of Palestinian water rights by using military force and forcing Palestinians to accept the 'prior use' approach. In addition, Israel rejects to compensate Palestinians for the decades of illegal exploitation of their water resources. Thus, Palestinians are entitled to demand 'affirmative action' to compensate them for past deprivations. Israel accepts neither the legal nor the moral responsibility that an occupying power should accept. Indeed, Israel acts as if the Palestinians were the intruders.

4.5.2 Sovereignty and Water

Palestinians, to be sovereign, need to have supreme and independent political authority, power, and rule over a well defined pieces of land including all its natural resources. Water is primary among these. Water resources are those (1) that lie over and/or under the land territory of the sovereign state, (2) that the state has and can use for its own advantage, (3) supply or fulfill domestic, agricultural, industrial, and other purposes and (4) as reserves for emergencies.

In the Palestinian case neither the definition of the sovereign state nor that of its natural resources is acceptable to the Israeli side. Therefore, Palestinians should seriously seek and put in place needed procedures, checks, and high care when reviewing and analyzing any political proposal or plan, or agreement presented to them, so that Palestinian rights and state sovereignty is not jeopardized and Israeli fears and interests are considered.

4.5.3 Water Supply to Jewish Colonies and Army Camps

The Palestinian side considers the Jewish colonies in the West Bank and the Gaza Strip illegal and therefore requires that Israel should not make any developments in those areas. This includes drilling of new water wells, developing the existing ones or changing the current water extraction.

4.5.4 Water Infrastructure and Contractual Agreements

The Palestinian side insists that all existing water infrastructures and works in the Palestinian Territory is owned by the Palestinian Authority and should be handed over to the Palestinian side. All contractual agreements that the Israeli side signed with any side during the military occupation is considered to be non-binding for the Palestinian side.

4.6 The Way Forward

Continuing the past and present approaches in dealing with the problem previously identified will result in serious harm to both people with different proportions and scales. A long lasting, just peace between both sides must be based on unified national rights, human values, and mutual living. Mutual living between Palestinians and Israelis under the same values and criteria in peace and stability requires reaching (a) a political agreement between the two sides which would tackle and resolve all important and conflicting issues, (b) practical and long term solutions for issues that prevent life and economic growth and development of both people including needed water availability and (c) operational applicable approaches (short and long-term) leading to joint planning, central administration and cooperation in efficient and effective water supply and demand management.

Israelis and Palestinians have to think strategically having in mind that:

- military superiority will not sustain forever and that peace and stability will prevail between the both sides sooner or later;
- a viable Palestinian State is a prerequisite and a part of this future peace and stability;
- a viable state requires sovereignty over its well defined and marked land and natural resources including water;
- bilateral and regional cooperation on water including sharing and developing new water resources, physical and 'virtual water' markets and transfers is also a prerequisite for peace and stability in the region.

It is proposed that a Joint Water Utility (JWU) serving both nations (Palestinians and Israelis alike) with clear objectives and goals and using unified human values could be an answer to most of these issues and would help leading to peace and stability between both conflict parties. Both sides would have to work on issues such as what instruments and mechanisms would support and fund such a JWU, what would the organizational behavior be like, would there be endowments, who would own what, what form would control take, how would employment be handled, what codes would be adopted and what roles would local, national, and international affiliates, parties, and companies play.

Activities and operations of such a JWU would include among others exploitation, development, and preservation of water resources; the legal framework; characteristics of the JWU; current and future water management challenges; impacts on and interaction with local water institutions; creation, administration and operation of the JWU; costs, fees, and taxation, and operational measures. Such measures should constitute a comprehensive and concerted system of joint actions and measures at the national, local level; of international community, the U.S., Europe, and neighboring Arab countries; including capital and technology transfer; maintaining, consolidating, and creating partnership and cooperation links between both governments; and economic development, implementation, monitoring and follow-up of all JWU operations and activities is very essential to the success of the utility. This process should include performance and compliance, consultation and complaint procedures, conflict resolution mechanisms; mechanisms for institutional development with time, risks and risk management, understanding the risks facing the JWU, risk areas and strategies for dealing with them.

4.7 Concluding Remarks

Water is life and the future of Palestine depends on thee availability of water and its quality. Israel has unilaterally controlled Palestinian water resources with military force and means with the result that Palestinians are not controlling any of their national water resources and using water less than one fourth of that portion used by an Israeli.

A continuation of this practice may lead to the continuation and even the acceleration of a divisive, violent, segregated, and inhuman conflict. In searching for an answer to the question of how the water issue between Palestinians and Israelis could be resolved in the future several key elements were presented including human equity, water rights and state sovereignty. The legitimacy of unilateral actions in a militarily occupied country was challenged where the Palestinian land has been colonialized by bringing immigrants from outside. In response to this situation, a compromise was proposed by Palestinians. This compromise consists of establishing a Joint Water Utility (JWU) as part of a future political agreement between Palestinians and Israelis controlling jointly all existing renewable and all future developed water resources simultaneously serving both nations, Palestinians and Israelis alike, with a clear authority, objectives and goals, based on commonly shared human values.

References

Abdel-Salam, A., 1990: "Water in Palestine", in: *The Geographic Studies, Palestine Encyclopedia* (Arabic) vol. 1, Part II (Beirut, Lebanon: Institute for Palestinian Studies): 114–116.

Ali, M., 1964: "Jordan River and the Zionist Conspiracy" (Cairo: National Publishing and Printing House): 54.

Dillman, J., 1989: "Water Rights in the Occupied Territories", in: *Journal of Palestine Studies*, 19, 2 (autum): 46–48.

Haddad, M., 1993: "Disposal Of Wastewater In The Occupied Palestinian Territories" [in Arabic], in: *Shu'un Tanmawiyyeh* , 3,11 (September): 95–103.

Haddad, M., 1998: "Planning Water Supply Under Complex and Changing Political Conditions: Palestine as a Case Study", in: *Water Policy Journal*, 1: 177–192.

Haddad, M., 2005: "Future Water Institutions in Palestine". In: *Water Policy Journal,* 7,2: 181–200.

Labady, A., 1989: "Zionist Ideology and Israel's Water Strategy". Paper Presented at the Seminar on Rural Development in the Occupied Palestinian Territory Amman 25–27 September 1989: 12.

OSLO B, 1995: *Israeli-Palestinian Interim Agreement on the West Bank and Gaza Strip*, Appendix II Annex III, Article 40, Washington DC, 28 December 1995; at: <http://www.miftah.org/>.

PCBS [Palestinian Central Bureau of Statistics], 2003: "Press Conference about the Results of Local Community Survey in the Palestinian Territory" (Ramallah – Palestine: PCBS, September)

PCBS [Palestinian Central Bureau of Statistics], 2004: "Demographic and Social Consequences of the Separation Barrier on the West Bank" (Ramallah – Palestine: PCBS),

Schmida, L., 1984: "Israel's Drive for Water", in: *The Link*, 17, 4 (November): 3.

Sennott **C.,** 1998**.** "Water Rights At Heart Of Arab-Israeli Strife", in: *Boston Sunday Globe*, 18 October 1998.

League of Nations, 1945: *The Mandates System: Origin - Principles - Application*. Series of League of Nations Publications, No. Lon/1945.Vi.A.1 of 30 April 1945; at: <http://domino.un.org/UNISPAL.NSF>.

5 Perceptions of Water in the Middle East: The Role of Religion, Politics and Technology in Concealing the Growing Water Scarcity

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Abstract

While water scarcity is a growing problem in most Middle Eastern countries today, the general public remains largely unaware of this reality and what it can entail for the future. It seems that unless there is tangible scarcity – as in Jordan where users receive only 24 hours of water a week – people will assume there is plenty; one only starts valuing the resource when it can no longer be taken for granted. Even when people are aware that current levels of water consumption are not sustainable, they seldom feel any personal responsibility for the situation or any compulsion to change their behavior patterns; in their eyes this responsibility lies with God or the government.

In this chapter I will identify the reasons behind the lack of public awareness and the indifference that surround issues of water scarcity. To do this, I will draw on material gathered during four years of independent field research in eleven countries in the Middle East, using information and observations from more than 100 interviews with politicians, academics, journalists, water experts, members of local communities and farmers.

I will argue that the reality of scarcity is concealed by religious, political and technological myths. These make it possible for the user to ignore the alarming reality and continue to consume water as though it were an inexhaustible resource. The absence of pricing policies in several Muslim countries, the continued political support for agriculture and water-thirsty crops like wheat, rice and cotton, combined with the false sense of security created by large-scale engineering projects all form part of this mythology of plenty.

The inevitable conclusion is that in addressing the problem of water scarcity in the Middle East, public perception of the problem and attitudes towards water should be considered just as important as solid scientific data regarding water use and abuse. Besides discussing the reasons behind the general undervaluing of water, I will also examine possible solutions, assessing the value of projects that aim to increase public awareness and give users a greater sense of responsibility for the water they consume.

Keywords: water scarcity, Middle East and North Africa, lack of awareness, raising awareness, religion, political ideology and water, modern technology and perceptions of water availability, lack of political transparency, education

5.1 Introduction

Around the world water is becoming an increasingly scarce and valuable resource: 40 per cent of the world's population in 80 countries suffers from serious water shortages, and more than a billion people worldwide do not have access to safe drinking water (UNEP 2002: 69–71). The countries of the Middle East and North Africa (MENA) are among the poorest in the world in terms of water resources. Ten per cent of the world population lives in the region, yet it only has access to two per cent of the world's total freshwater resources (World Bank 1995: 1). Pressure from population growth, the introduction of more modern techniques of water collection and distribution, higher standards of living, and a decrease in the already low rainfall levels all mean that this situation is only deteriorating (ESCWA 2001a: 3). The UN Global Environment Outlook 2002 foresees that 95 per cent of the Middle East will be suffering from severe water shortages by the year 2032 (UNEP 2002: 385–390).

Given the gravity of this situation, it is surprising that the general public in the MENA region remains largely unaware of the impending water crisis and the far-reaching effects it could have at all levels of society. In this chapter I will argue that this lack of public awareness is due to the tenacious presence of religious, political and technological myths which create the illusion of plenty. Constructed upon age-old traditions and beliefs, but also on the convincing rhetoric and imagery of modern-day politicians and engineers, these myths conceal the reality of growing water scarcity. Like the current levels of water consumption in the region, the perpetration of these myths is highly unsustainable; in fact, the longer they are upheld, the sooner the region will be confronted with serious shortages.

It is however difficult to call attention to a problem which has until now remained invisible to most. In many countries water scarcity is not yet tangible on a daily basis. And, sadly, it appears that people will only change their attitudes towards water use once it is 'too late' – when reserves have reached critical levels and water is rationed. Programs to raise awareness of water scarcity therefore seem to be most successful in areas where the crisis is most acute.

The material presented in this chapter is based on four years of research in the MENA region. During this period I visited Morocco, Tunisia, Libya, Egypt, Sudan, Jordan, Israel, the Palestinian Territories, Syria, Lebanon and Turkey. In each of these countries I carried out interviews and field and literature research with the aim of gaining an understanding of local attitudes towards water and perceptions of the growing problem of water scarcity.

Before embarking on this project, I had expected the beliefs, attitudes and traditions surrounding water in the Middle East to be very different from those in the wet northern climates in which I had grown up. I imagined people used the resource more sparingly and valued its presence more highly than we do in The Netherlands where water is only a problem through its abundance.

Yet in most places I found people had exactly the same perception of water as I do: they never really think about it. It is an unquestioned resource that is taken for granted like the air one breathes, and few seem to cherish it to its true value. Only those who experience acute scarcity at a physical level – the Sudanese farmers who send their daughters to fetch water three hours walk away; the Amman housewife who has to run her household on a ration of 24 hours of water a week – seem to fully acknowledge the value of water's presence.

And even those who acknowledge that there is a problem feel little incentive to alter their behavior towards the resource. Instead, water management is left in the hands of God or the government. Due to the heavily centralized system of water distribution in countries like Egypt, Turkey and Israel, the individual user has little control over the resource and therefore feels no responsibility for the water he uses. But also in countries with less centralized systems – Syria, Jordan and Morocco for instance – users feel little compulsion to become actively involved in water management.

Thus in the Jordan Valley, farmers are reluctant to join the newly established water user associations: they simply don't see the point. As water represents only two to five per cent of the cost of running a farm, it is very low on the farmer's list of priorities; many other things are more important. Rémy Courcier, a French agricultural expert working in the Jordan Valley, explained this:

> In the farmer's eyes it is like this: if there is no water, you go and do something else, and if there is water, then why should you have to take responsibility over it, and pay for it and go to boring water user association meetings? Water only becomes important when it stops flowing, when it is polluted and when it is saline. That's when it becomes an issue. And in their eyes, God provides. So you see it is difficult to change attitudes.[1]

5.2 Religion and Ideology: Water as a God-Given Right

While perhaps not the primary cause of water's undervaluation in the MENA, religion and ideology are cer-

1 Interview with Rémy Courcier, regional agricultural expert, Mission Régionale Eau et Agriculture (MREA), Middle East Water Management Project by the French Government, Amman, Jordan, November 2003

tainly the most deep-rooted and tenacious reasons for the lack of awareness surrounding the issue of water scarcity.[2] Because of the strength of religious and ideological beliefs, water is perceived as a gift from God to which one should have an inalienable right. This means that in many predominantly Islamic countries in the region water remains heavily underpriced, which in turns leads to widespread waste of the resource on both domestic and agricultural levels.

In Syria, the domestic user only pays a nominal price for water: in 2001 an inhabitant of Damascus paid just 5 US $ per 1,000 liters of water he consumed (World Bank 2001). In agriculture Syrian farmers have recently started paying a fee for water diverted from government irrigation networks. However, out of the total irrigated area, 59 per cent of the land is irrigated with water from private – and often illegal – wells. The absence of any control over the water that is pumped from these wells has led to a severe decrease in groundwater levels throughout the country.[3]

In Egypt neither municipal users nor farmers pay for the water they use and monthly water bills in Cairo can be as low as US $ 1 (World Bank 2001). Pricing in agriculture remains a taboo, as I realized during several interviews at the Ministry of Water Resources in Cairo, where I received shocked responses when I enquired about the price of water for agricultural use. [4]

In both cases the gross underpricing of water is justified on religious grounds. In his time, the Prophet Mohammed discouraged the selling of water and according to Muslim teaching, water is a gift from God that should be freely available to all. But the Koran also incites believers to use water sparingly and constantly reminds them that it is a gift from Allah that He can withhold if He so pleases.

Yet in practice most users appear to see the resource as a God-given right, instead of a precious gift that should be treasured. In conversations with a wide range of people in the MENA – from government officials to local farmers – I observed a certain resignation and an acceptance of the situation. Thus in the dying Ghuta Oasis near Damascus a disillusioned farmer explained the degradation of the environment and the pollution of the local Barada River as God's punishment for the sins of the believers.[5] At the site of the Hassan Addakhil Dam in Southern Morocco the director of the dam smiled happily as he looked down into the nearly-empty reservoir and commented: "We trust God will send us rain soon." He seemed completely carefree: it was out of his hands.[6] In both cases higher forces are held responsible for situations that are entirely manmade. In a sense this is a way of shirking responsibility: as though the blame can be laid on God's shoulders and His omnipotence can be used as an excuse for the human neglect and destruction of the environment.

In Israel, Zionist ideology has strongly colored public perceptions of water and its availability. Even before the establishment of the State of Israel, the Zionist movement made the quest for water in the Land of Israel its priority. For without sufficient water supplies, the dream of returning to the Jewish homeland could never be fulfilled (Rouyer 2000: 80).

The quest for the development and acquisition of water resources continued to play an important role in the definition of national policy after Israel's independence in 1948. Former prime minister Levi Eshkol described water as "the blood flowing through the arteries of the nation" (Rouyer 2000: 80), and it came to be seen not just as a natural resource but as the instrument of Israel's transformation and prosperity. Water was more than an economic commodity; it was part of an ideology. And as technological capacities increased, water resource development became a symbol of the unlimited power of technology in transforming the land. The Israelis believed that with hard work and the development of sophisticated hydrological projects, there was no limit to the development of the land and its water. Thus ideology and geopolitics took precedence over economic and environmental realities (Rouyer 2000: 80; Tal 2002: 200). Water was only valuable if it could be harnessed for agricultural expansion; climatic considerations such as low and unpredictable rainfall were ignored by politicians of

2 For more details on the role of ideology and religion in shaping public perceptions of water availability, see also de Châtel 2007: chapters 2, 5, 7.

3 Bazza, M.; Ahmad, M.: *A Comparative Assessment of Links Between Irrigation Water Pricing and Irrigation Performance in the Near East*, p. 13, at: <http://www.fao.org/world/regional/rne/morelinks/Irrig/Watpric.pdf.>.

4 In interviews with Engineer Gamil Mahmoud, manager of the Water Policy Advisory Unit, Ministry of Water Resources and Irrigation (MWRI), Cairo, April 2001; Dr Dia Al Din Al Qosy, Senior Advisor to the Minister, MWRI, Cairo, May 2002

5 Interview with Abu Fares, local farmer in the Ghuta Oasis near Damascus, Syria, June 2001

6 Interview with Mr El Fakihi, Regional Director of the Ministry of Equipment, Er Rachidia, Morocco, February 2001

the day, while unsustainable use of the resource was seen as a necessary ill.

The environmental scientist Alon Tal (2002) describes the passion for water that dominated during the early years of the Israeli State as almost a "Shakespearean tragic flaw": on the one hand it led to the development of innovative water development projects on a scale hitherto unknown in the Middle East. On the other hand, it created an unrealistic appetite and blinded decision makers to the long-term implications of stress on a fragile resource. "The argument could be made that they almost loved Israel's water resources to death" (Tal 2002: 200).

While the Zionist movement thought of itself as liberating the Holy Land and restoring it to its former glory, the underlying attitude towards the environment would, over the years, place a growing and unsustainable demand on the country's water resources. Today this attitude has become an inextricable part of Israeli policy. Because agriculture and the water it uses play such a key role in Israel's founding myth, it is difficult to question the policymaking in either domain.

5.3 Water as a Political and Social Issue

The reluctance to price water at its true value is however not only based on pious principles and religious conviction; more often than not the main motivation behind low water fees is the support of the agricultural sector that guzzles between 60 and 90 per cent of water resources throughout the region. The continued support and expansion of the agricultural sector partly stems from a concern over food security. While MENA countries can never be fully self-sufficient, they seek to attain relative food security, ensuring basic food needs are met.

In the Arab countries of the region, there is also another social reason for supporting agriculture, as it effectively limits further urbanization, and supports small-scale subsistence farming in the region. Theib Oweis, a water specialist at the International Centre for Agricultural Research in Dry Areas (ICARDA) near the Syrian town of Aleppo, explains that in these rural societies, the problem of water and its distribution has far-reaching social, political and economic implications. Water can therefore not be considered as an isolated resource.

> There is a strong social dimension. Most people here live in the countryside and have a rural lifestyle. Water has a very special status in their life. This is why many countries in the region aim to maintain an agricultural society: to ensure stable societies. That is also why there are subsidies. It is not just economics that affects the use of water in these countries; you also need to evaluate the other aspects that come into the equation such as environment, society and politics.[7]

The continued support for agriculture as it exists now is unsustainable; at the same time any kind of reform is fraught with difficulties as this traditional agriculture also represents a way of life that has existed for thousands of years in the Middle East. It is thus easier for governments to maintain the status quo, subsidize agriculture and turn a blind eye to the lowering groundwater levels, the depleting aquifers and the huge waste that takes place everywhere.

In Israel the continued support for agriculture is not so much a social necessity as a political choice. Current agricultural and water management policies are still strongly tinted by Zionist ideology and the desire to transform the desert landscape into green pastures. Around 60 per cent of Israel's water supply goes to agriculture (Bar-Shiva 2005). When compared to the other countries in the region, this is still relatively low. However, unlike other MENA countries, in Israel agriculture represents only a small portion of the national income. In 1991 it made up only 3 per cent of the country's GDP, while only 4 per cent of the total workforce was employed in the agricultural sector (Lipchin 2003). Yet it continues to enjoy strong support from the government, most conspicuously through the water pricing system which blatantly favors agriculture over household and industry. Therefore farmers pay much less than users in other sectors and the water they use is heavily subsidized.[8]

Critics of Israel's water pricing and agricultural policies are numerous. They point out that the high subsidies for water used in agriculture create a net loss for the national economy and that water-thirsty crops such as bananas and citrus should be imported. According to Lipchin (2003) any change in this status quo will require the revision of Zionist ideology to

7 In an interview with Dr Theib Oweis, water specialist, International Centre for Agricultural Research in Dry Areas (ICARDA), Aleppo, Syria, June 2001

8 Bar-Shiva/Cohen/Kislev (2005): Israeli farmers pay around 70 per cent of the real cost of the water they use. Household users are charged much higher rates, both by the state water company Mekorot and the municipalities. While farmers paid an average of $ 0.25 per cubic meter in 2005, household users paid at least twice that price at $ 0.61–1.27.

match the reality of Israel's arid environment and scarce water resources.

Lipchin believes that to break through the entrenched views of Zionism, the system needs to be decentralized, allowing for privatization and local-level decision making. In his view this could help reduce the buffer zone that exists between water management and the public perception of water availability. "Because the public is encapsulated in a centralized system over which they have no control, changing ideological values that actually represent the situation on the ground will prove daunting," he says, adding that it is at the same time a necessity if the country is to confront the regional water crisis (Lipchin 2003).

While Israel's current water policy is perhaps irrational and, in the long term certainly unsustainable, it will be difficult to change. This is partly due to the power of the agricultural lobby within Israeli politics, but, on a deeper level, Zionist ideology also plays an important role. While it is perhaps less influential than 25 years ago, its values and the image of Israel it represents are still deeply engrained in the national psyche.

5.4 Greening the Desert: The Promise of Technology

Technology and the impact it has on daily life and the functioning of society at large is an important cause for water's undervaluing. Indeed, modern technology deeply affects the way people think about water and use it. As soon as water starts flowing from a tap, it is taken for granted; people forget that a fluctuating river or an erratic weather system lies at its origins. By making its source invisible, water's existence is divorced from the elements and the seasons, and it becomes paradoxically omnipresent. The user can comfortably assume that it flows from an endless supply.

It is indisputable that the technological advances of the 20th century have enabled the development of MENA economies and improved standards of living. However, on a psychological level – and because many of these projects were hailed by their creators as the answer to all problems – there is now a complacency about water. The Egyptian President Gamal Abdel Nasser spoke of the High Aswan Dam as a "source of everlasting prosperity". Indeed, the High Aswan Dam has transformed the country: not only has it allowed Egypt to intensify its agriculture, it also saved the country from the drought and famine that devastated Ethiopia and Sudan in the 1980s. But on a more abstract level the Aswan High Dam has given the Egyptians a false sense of security over water.

Mohamed Sid Ahmed, a political journalist and commentator in Cairo, comments: "[Since the construction of Aswan High Dam] people are less aware of the value of the water they use. They take it for granted in a way and don't see it as a precious resource. They think they can just press a button and that the water will come."[9]

Two issues are at stake here: in the first place there is the issue of scale. Twentieth-century technology brought large-scale engineering schemes with it. Projects like the High Aswan Dam in Egypt, the Great Manmade River in Libya and the GAP project in Turkey[10] all have one thing in common: their dehumanizing scale. The sheer size of the dam reservoirs and the huge amount of water that is transported through these pipelines simply surpasses the individual imagination. This in turn leads the general public to believe that water supplies are endless.

The second issue is distance. Through the development of modern water distribution systems, the link that used to exist between the individual user and his water is severed. Water now flows from the source through an intricate network to arrive at a user many tens or even hundreds of miles away.

This is the case in Israel where the nationalization of water resources in 1959 and the construction of the National Water Carrier in 1964 has created an extremely efficient and sophisticated system of water distribution. According to Tal, there should have been a transition at this point: after a first stage in which water resources were developed and made accessible across the country, there should have come a second stage during which the limits of the resource were acknowledged and the emphasis would have been placed on conservation and an improvement in efficiency. "The fundamentally ideological approach to water, however, prevented a successful transition to the more mature, sustainable stage" (Tal 2002: 200–201).

The seamless ease with which water is now delivered throughout the country is without a doubt remarkable, but Lipchin believes it is a double-edged knife. For the system's efficiency has also blunted peo-

9 Mohammed Sid Ahmed, political journalist and commentator, in interview, Cairo, April 2001

10 GAP is the Turkish abbreviation for the South-East Anatolian Project, an ambitious and controversial scheme consisting of 22 dams and 19 hydro-electric power plants on the Tigris and Euphrates Rivers in Turkey

ple's sense of awareness of water scarcity. In the eyes of the general public there is endless potential in technological development and neither decision makers, nor the general public, have acknowledged that there are limits to the country's water resources.[11]

Today the solution to scarcity is being sought not in conservation or a change in agricultural policies but in new technology: desalination, a method that promises unlimited supplies. While the schemes can indeed provide a large volume of water, the technology does not address the underlying political and institutional problems. In fact, desalination makes it possible to avoid these issues and maintain a system in which household users pay for the water that is used – and because of the low prices, also wasted – in agriculture.

Thus the promise of large-scale desalination in Israel has the same effect as the High Aswan Dam has had in Egypt: it has created an over-reliance on technology. In the case of Israel it has slowed the discussion on water allocations: not only between the agricultural, industrial and domestic sectors, but also between Israel and the Palestinian Authority. Indeed, in the eyes of some, the fact that Israel can rely on desalination implies that it will in the future no longer have to look at the issue of water supply in a regional context.

Arnon Soffer, a professor of geography at Haifa University, is a protagonist of a "total divorce" between Israel and the Palestinian Authority. He says that because Israel can rely on desalinated water, it no longer needs the water of the Mountain Aquifer. "I am very clear on the steps that should taken. There should be a total separation of all aspects. Also of water. They [the PA] are a third world country and they will pollute the Mountain Aquifer and all the resources they have. So let them have it."[12]

Because Israel can rely on technology to resolve its water problem, it holds the strong position in any water negotiations with the Palestinian Authority. The Palestinians cannot afford modern technologies as desalination. The current political situation and the ongoing conflict between Israel and the Palestinian Authority means that it is very difficult to form an image of the public perception of water among Palestinians.

Where religion, politics and technology conceal the reality of scarcity in many MENA countries, in the Palestinian Territories, water scarcity is a daily reality for many. However, the scarcity here is construed: it is not so much about availability as about access. At the same time, while water scarcity is a serious problem, it is just one of a dozen problems Palestinians have to worry about on a daily basis. The acuity of the political situation – both internal and with Israel – also makes it difficult to carry out research on the popular perceptions of water in the Palestinian Territories.

This review of dangerous modern myths is not a condemnation of modern technology or a nostalgic eulogy of traditional water wheels and hand-dug wells. The point is that modern engineering projects through their impressive scale and grand allure conceal the reality of water scarcity. This reality needs to be urgently acknowledged. For while a new dam can alleviate the immediate effects of water scarcity, it does not change the geographical conditions of the region. It does not transform desert climates to temperate ones or guarantee abundant rainfall levels. It is just one component among many that can help in confronting the problem of water scarcity.

5.5 Raising Awareness and Changing Attitudes towards Water

Around the MENA region there are an increasing number of initiatives – by governments and NGOs; on national and local level – to raise awareness about water scarcity.[13] In Morocco, Egypt, Jordan, Israel and Turkey a variety of programs are being implemented with the aim of educating and involving the user, and ultimately, changing his behavior towards water.

The most obvious way to make people aware of the value of water is by introducing water prices that reflect the true cost of the resource. As mentioned above, there are many political and ideological obstacles preventing this. Still, many predominantly Muslim countries, including Iran, Morocco, Jordan and Tunisia, have started implementing pricing policies in both urban and (local) rural contexts.

But pricing alone is not enough; this policy should be complemented by education programs that involve users in local water management. Instead of shielding the user from reality through the perpetration of deceptive policies, these programs can give them an insight into the gravity of the situation and restore water to its true value. On an agricultural level, such projects are being widely implemented through the creation of

11 Clive Lipchin in interview, Arava Institute for Environmental Studies, Kibbutz Kettura, Israel, March 2004

12 In interview with Arnon Soffer, Department Of Geography, Haifa University, December 2003, Haifa

13 For more details on projects that aim to raise awareness of water scarcity, see also de Châtel 2007: chapters 10, 11

water user associations in which small groups of farmers are given the direct communal responsibility over the water they use.

In Egypt the Irrigation Improvement Project (IIP) aims to rationalize and simplify water use along the Nile's side channels. By replacing the numerous individual hand pumps by a single pump at the head of each channel, water is divided more equally and farmers become more involved in the process of water management. The IIP has been in place since 1997, creating more than 6,000 water user associations throughout the country. The program is seen as a success, also because many farmers who are not yet involved are signing up to it. However, there has been no net reduction of water use and critics question the project's effectiveness.[14]

Professor Mohammed Nasr Allam of Cairo University believes that while user participation and privatization of water management are important, IIP is perhaps not the best way to do it.

> We need to encourage the cooperation of users. The government has a shortage of financing and technical capacities [and] it is important for the government to transfer water management to other sectors. But the IIP program is very slow and its results are not very conclusive in terms of water conservation. It achieves lower cost for the farmer and better production, but no water is really saved.[15]

Thus while Egyptian farmers may today be more involved in the process of water management, their involvement has not yet led to water savings.

On a domestic level, awareness campaigns focus on measures that can help save water in the household. In Jordan, the American donor organization US Aid introduced a program between 2000 and 2005. *Water Efficiency and Public Information for Action* (WEPIA) set itself the ambitious goal of not only raising awareness, but also changing behaviors. The program focused on the dissemination of *Water Saving Devices* (WSDs), small attachments that can be screwed on to taps, showerheads or installed in toilets to reduce the water flow. The project was successful, amending several laws, launching two major media campaigns and designing education programs for everyone from toddlers to university students, women, and even imams. WSDs were also introduced to 60 per cent of the large users including hotels, hospitals and universities. WEPIA's mandate has today been taken over by the water demand management unit within the Ministry of Water Resources. Its challenge is to ensure the durability of WEPIA's work, not only perpetrating its education and media projects, but also making sure that the general public remembers WEPIA's core message: "The Solution is at Your End".[16]

This is the difficulty with many of these programs: as their mandate and financing are limited, their message is all too often forgotten, leaving little tangible results. Durability and sustainability are therefore of key concern.

5.6 Conclusion

> There are too many priorities. You look at the situation and you see only priorities. It is a big challenge: we have to maximize our benefit from the water we have – use it more efficiently. Then we have to prevent pollution and also work with our neighbors. In parallel we have to look to modernize the irrigation system, encourage drainage water reuse and limit the birth rate. It is a great challenge and it is hard to know where to begin.[17]

The Egyptian minister of water resources, Dr Mahmoud Abu Zeid, summed it up; he was talking about Egypt, but, by and large, the same is valid for the whole region. Water is an increasingly scarce resource throughout the Middle East. Many foresee that the severe shortages that will afflict the region in the future will have far-reaching implications for the lives and livelihoods of the population there. Yet this population remains largely unaware of the impending crisis.[18]

The harsh reality of the coming water scarcity is shrouded in religious, political and technological

14 All information on the IIP from visits to the project and interviews with Jan Bron, Team Leader, Water Boards Project, Egypt; Royal Haskoning, The Netherlands, Cairo, Egypt, May 2002; Robert Roostee, Head of the Fayoum Water Management Project headed by Dutch Government, Fayoum Oasis, Egypt, May 2002; Eng. Abdallah Doma, Irrigation Improvement Project (IIP), National Water Research Centre, Cairo/Damanhour, Egypt, May 2002

15 Professor Mohammed Nasr Allam, Professor of Irrigation Engineering, Cairo University; General Manager, Nile Consultants, Cairo, Egypt, May 2002

16 In interview with Dr Hala Dahlan, Senior Technical Specialist, Water Efficiency and Public Information For Action (WEPIA), Amman, Jordan, November 2003; Rania Abdel Khaleq, Director of Water Demand Management Unit, Ministry of Water Resources and Irrigation, Amman, Jordan, November 2003

17 Dr Mahmoud Abu Zeid, Egyptian Minister of Water Resources and Irrigation; President of the World Water Council, Cairo, Egypt, May 2002

myths, which make it possible to ignore reality and continue using water as it has been for centuries. However, the problem is taking on such proportions that it can no longer be resolved on the sidelines of society.

Water is first of all a natural resource, but it is also part of an intricate web of economic, social and political issues from which it cannot be dissociated. It is impossible to consider water in the MENA without considering its users, and their beliefs and attitudes. Because water is not an isolated issue and because its availability influences the life of everyone in the MENA region, the problem of water scarcity should be addressed by society as a whole, not just by policy-makers and engineers. For a part, it is a technical issue that can be resolved through engineering works, better distribution and less waste. But it is also a social issue that is aggravated by unrestrained population growth, pollution and lack of education.

References

Bar-Shiva, Z.; Cohen, N.; Kislev, Y., 2005: "Residential Demand for Water in Israel", at: <http://departments.agri.huji.ac.il/economics/yoav-resid.pdf >.

Châtel, de, F., 2007: *Water Sheikhs and Dam Builders, Stories of People and Water in the Middle East* (Piscataway, N.J.: Transaction Publishers, Rutgers University Press)

ESCWA, 2001: *Current Water Policies and Practices in Selected ESCWA Member Countries* (New York: ESCWA for United Nations).

ESCWA, 2001a: *Development of Freshwater Resources in the Rural Areas of the ESCWA Region using Non-Conventional Techniques* (New York: ESCWA for United Nations).

Faruqui, N.I.; Biswas, A.K.: Bino, M.J. (Eds.), 2001: *Water Management in Islam* (New York: United Nations University Press - Ottawa: IDRC).

Lipchin, C., 2003: "Water, Agriculture and Zionism: Exploring the Interface between Policy and Ideology", Paper Presented at the Third IWHA Conference, Alexandria.

Pearce, F., 1992: The Dammed – Rivers, Dams and the Coming World Water Crisis (London: The Bodley Head).

Rouyer, A. R., 2000: *Turning Water into Politics. The Water Issue in the Palestinian-Israeli Conflict* (Basingstoke London: Macmillan Press)

Tal, A., 2002: *Pollution in a Promised Land* (Berkeley: University of California Press).

UNEP, 2002: *Global Environment Outlook 3, Past, Present and Future Perspectives* (London: Earthscan).

World Bank, 1995: *From Scarcity to Security: Averting a Water Crisis in the Middle East and North Africa*. World Bank Report (Washington, D.C.: World Bank, December).

World Bank; 2001: *Water Pricing in the Municipal Sector* (Washington, D.C.: World Bank, March), at: <http://lnweb18.worldbank.org/mna/mena.nsf?OpenDatabase>.

18 In interviews with Professor Mohammed Nasr Allam, Professor of Irrigation Engineering, Cairo University; General Manager, Nile Consultants, Cairo, Egypt, May 2002; Professor Nadhir Al Ansari, Strategic Environment and Water Resources Research Unit, Al Al-Bayt University, Mafraq, Jordan, November 2003; Boutros Boutros Ghali, Former Egyptian Minister of Foreign Affairs (1977–1991); Former Secretary-General of the United Nations (1992–1996), Paris, France, March 2003

6 The Karstic Flow System in Uja Area – West Bank: An Example of two Separated Flow Systems in the Same Area

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Abstract

Uja spring is the largest spring in the Eastern Basin of the Judea-Samaria Mountains in the West Bank. In the vicinity of the spring outlet there are three production wells (Uja 2,3,4). The Uja spring is characterized by large discharge fluctuations. It was conjectured that the drying of the spring in dry years is the result of pumping in the nearby Uja wells. This conjecture follows the assumption that the spring and the wells are hydrologically connected and are supplied by the same reservoir.

A detailed investigation of the spring discharge, the hydrological setting of the spring, of the wells and the wells water level measurements, shows that the spring and the wells are hydrologically separated. As a result, the pumping from the wells has no influence on the spring discharge.

There is a local, very karstic aquifer, which feeds the spring; the discharge depends on climatic variations (drought or rainy years). In contrast the Uja wells draw water from a deep, separate, aquifer. A similar hydrological situation exists in the En Samiya area, where the Palestinian Authority utilizes water from the En Samiya spring (Upper aquifer) and from the wells (lower aquifer). The important consequences of this analysis on the management strategy of the water supply of the area are concluded in this paper.

Keywords: Aquifer management, hydrology, karst flow, springs, West Bank

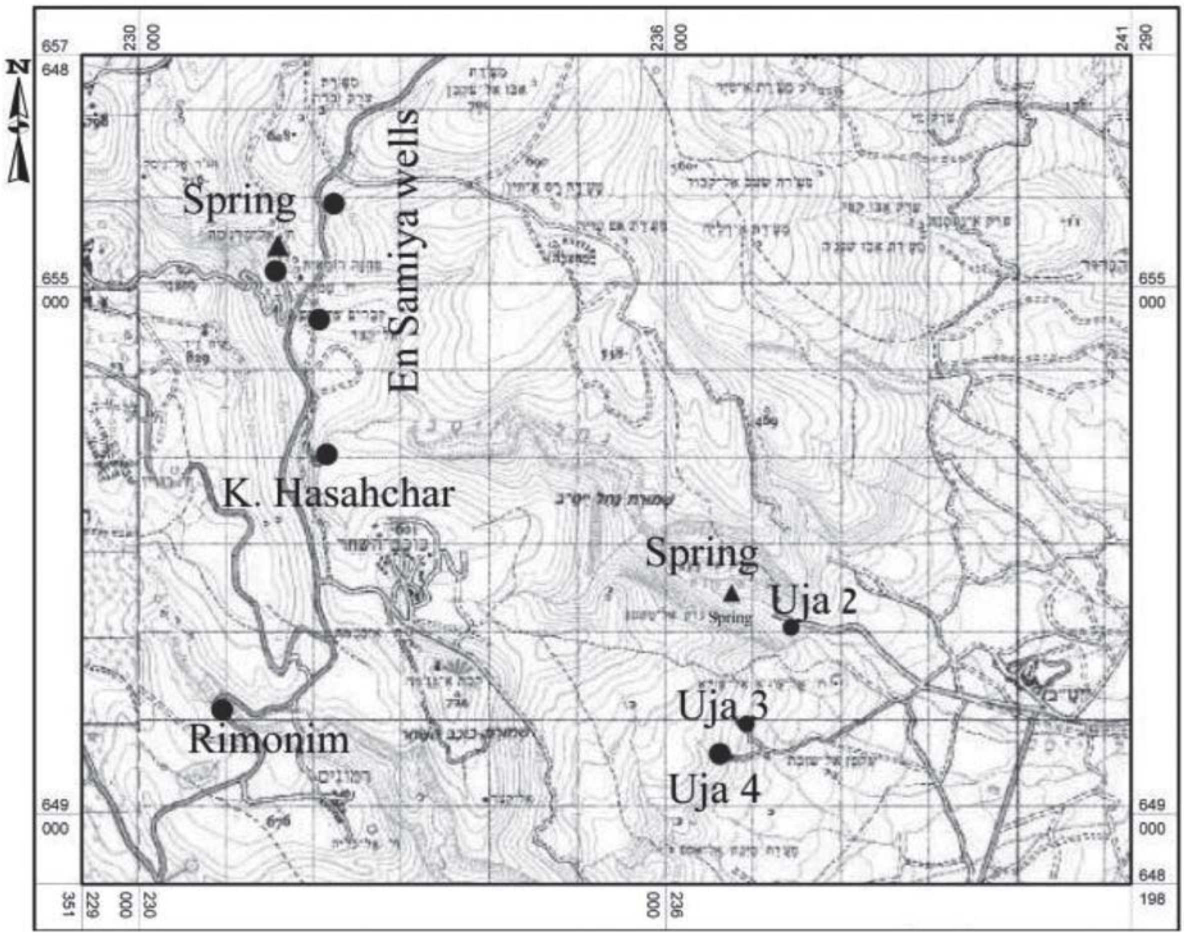
6.1 Hydrogeological Background

The area under study extends geographically from the water divide running along the Ramallah anticlinal axis in the west to the Jordan Valley in the east, and from the Fari'a Wadi in the north, to the Wadi Kelt in the south (figure 6.1).

The stratigraphic profile exposed in the study area varies from the Lower Cretaceous age to young formations of the Holocene age. Ancient formations of Cretaceous age, composed mainly of limestone layers, are exposed in the area of the Ramallah anticlinal axis. The Judea Group layers, constituting the regional aquifer in the area, are exposed to the east of the Lower Cretaceous layers and in the Hebron anticlinal axis. Farther east, near the Jordan Valley and throughout the Judean Desert, the formations of the Mt. Scopus Group are exposed. Young formations of Pleistocene-Holocene age are exposed in the Jordan Valley and on the shores of the Dead Sea as well as in inland wadis and valleys (Guttman 1995, 2000). The area is characterized by intensive fault systems in a general E-W direction. These fault systems form grabens, horsts and step structures. The throw of these faults ranges from some tens of meters to about 100–150 meters.

The area is a semi arid to arid zone, characterized by sharp fluctuations in precipitation. On the high mountains in the west, the average rainfall ranges

Figure 6.1: Location Map of the Case Study. **Source**: Mekorot



from 500 to 700 mm/yr (Jerusalem: 554 mm/yr, and Ramallah: 647 mm/yr). Towards the east and southeast there is a sharp drop in precipitation over a relatively short distance. In the Jordan Valley, the average rainfall ranges from 100 to 150 mm/yr (Jericho: 163 mm/yr). Precipitation decreases to less than 100 mm/yr on the Dead Sea shores.

The Judea Group aquifer, with a thickness of about 800 to 850 m is comprised of several sub-aquifers. According to water level measurements, two sub-aquifers can be identified in most of the study area: the upper aquifer and the lower aquifer. The upper aquifer generally includes the Bina, Veradim and Aminadav formations, and at times the aquiferous horizons in the Bet Meir tongue. The lower aquifer includes the Givat Yearim and Kefira formations and at times the aquiferous horizons in the Soreq Formation (Guttman 2000).

According to the well findings, the hydraulic separation between the two aquifers is primarily in the mid-lower section of the Bet Meir formation, composed of bluish-greenish clay, marl and chalk. The separation is manifested in the difference in water levels in the two sub-aquifers, the level in the upper aquifer being higher than that in the lower aquifer. For example; in the En Samiya and Uja areas there is about 200 m difference between the En Samiya and the En Uja springs on the one hand, and the wells tapping the lower aquifer on the other (Shaliv 1980; Guttman 1979, 1980, 1995, 2000).

6.2 The Uja Spring

The Uja spring is the largest spring in the Eastern Basin of the Judea-Samaria Mountain, West Bank. In the vicinity of the spring outlet there are three production wells (Uja 2,3,4). The Uja spring is characterized by large discharge fluctuations (figure 6.2). For example, in 1993 (a very rainy year) the yearly discharge was about 18.5 MCM. In the drought year of 1999 the yearly discharge was about only 2.4 MCM. In drought years the spring dried up during the summer.

There have been discharge measurements since 1944. These data allow an analysis of the spring behavior and its flow mechanism (figure 6.2). A detailed analysis of the spring discharge shows a quick response to climate changes (that is, a drought period beside very rainy periods). The strong correlation between rainfall (taking Jerusalem station) and the spring fluctuation is shown in figure 6.3. The maximum discharge appears just after the rainiest month. It can be seen that the discharge dies out towards the end of the winter. Most of the time (except in very rainy years like 1992), large storage is not required to maintain a high and steady flow for a long period.

The depletion curves of the spring look very linear with different depletion coefficients (t_0) between rainy years. The linearity of the depletion curve shows that the system has only one flow component and not two flow components that are very typical for carbonatic systems. Possible explanation to it is the existing of a very developed karstic system in the recharge area of the spring and rapid flow of the groundwater towards the spring (Guttman 1980; Rosenthal 1978; Kronfeld/Vogel/Rosenthal 1990).

In average rainy years the depletion coefficient (t_0) is between 130–180 days. In very rainy years (1983, 1993) the depletion coefficient (t_0) is much greater and varies from 540 to 620 days. In contrast to the rainy years, in drought years the depletion coefficient (t_0) is very small, less than 65 days (table 6.1).

Table 6.1: Depletion coefficient and calculated recharge area in several years

Year	Depletion coefficient (t_0) in days	Maximum discharge (cum*1000)	Calculated recharge area (km^2)
1959-1960	180	2951	20
1962	138.7	1993	13
1974-1979	305.1	5480	36
1983	623	10895	44
1984	171.6	2685	18
1985	117.2	1834	12
1987	47.7	642	6.4
1990	65.9	1098	11
1991	21.1	187	1.9
1993	543.3	12293	49
1996	130.6	2727	18
1999	45.8	246	2.5

The differences in the depletion co-efficient means that the size of the recharge area that fed the spring is not constant changing according to the distribution of the rainfall. Due to a very karstic aquifer, it is important to look not only at the yearly rainfall, but also at the monthly rainfall. For example, in 1987 the total amount of rainfall in Jerusalem station was 677.2 mm (higher than the average) but the spring discharge died out very quickly. The calculated depletion coefficient (t_0) was 47.7 days. In 1988, the total rainfall was similar (666.60 mm), but the spring depletion was less than in 1987. In 1988, the minimum discharge (end of summer) was much high than in 1987 (figure 6.2). The reason is the difference in the rainfall distribution during the winter. In 1987, the rainiest month was at the beginning of the winter (November 1986), while in 1988, the rainiest month was on February 1988.

Figure 6.2: The Discharge Behavior of the Uja Spring. **Source**: Israel Hydrology survey (IHS), Military administration-water department

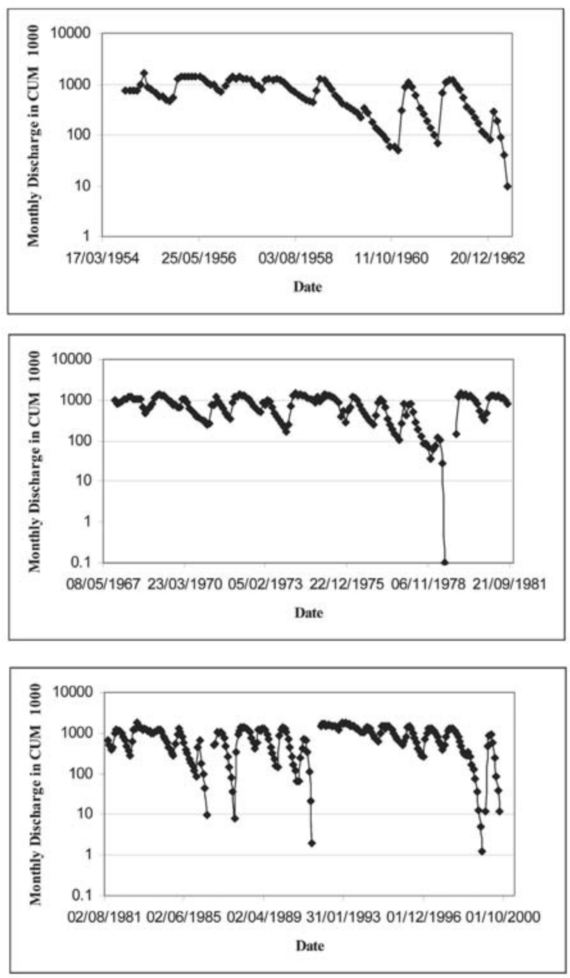
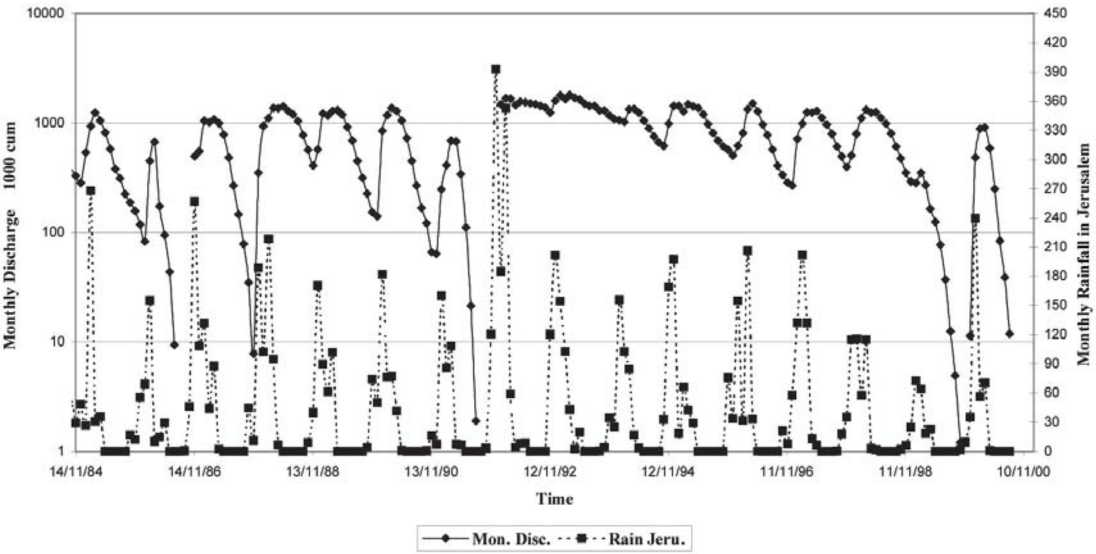


Figure 6.3: Monthly discharge in the spring and the rainfall in Jerusalem station. **Source**: IHS, Mekorot



For the calculation of the minimal recharge area, the actual replenishment rainfall value that was taken for rainy years was 250 mm, for average years value of 150 mm and for drought year value of 100 mm. The results shows that the calculated recharge area that fed the spring varies from 50 km^2 in rainy years to 15–20 km^2 in average years and less than 10 km^2 in drought years (table 6.1) In drought years, like 1999, the size of the recharge area is small, the depletion coefficient is low, therefore the spring is dried up during summer. While in very rainy years, the depletion coefficient is high, the recharge area of the spring is large and the storage is quite big to maintain summer flow.

There is long-term reduction in the summer discharge as seen in the periods like 1974–1976, 1983–1986, 1992–1999 (figure 6.3). This behavior can be explained by the fluctuations in the precipitation (monthly and annually) that are very common to arid zones and its influence on the size of the recharge area. In rainy years, the size of the recharge area is big and the spring discharge is high. It can decrease in average and drought years that might follow the rainy year.

The results show that we are dealing with a very karstic system (spring) that reacts immediately to changes in the monthly and yearly precipitations at his recharge area. The results show that the spring behavior has been constant during the last 60 years on record- many years before the Uja wells started to pump water from the lower aquifer.

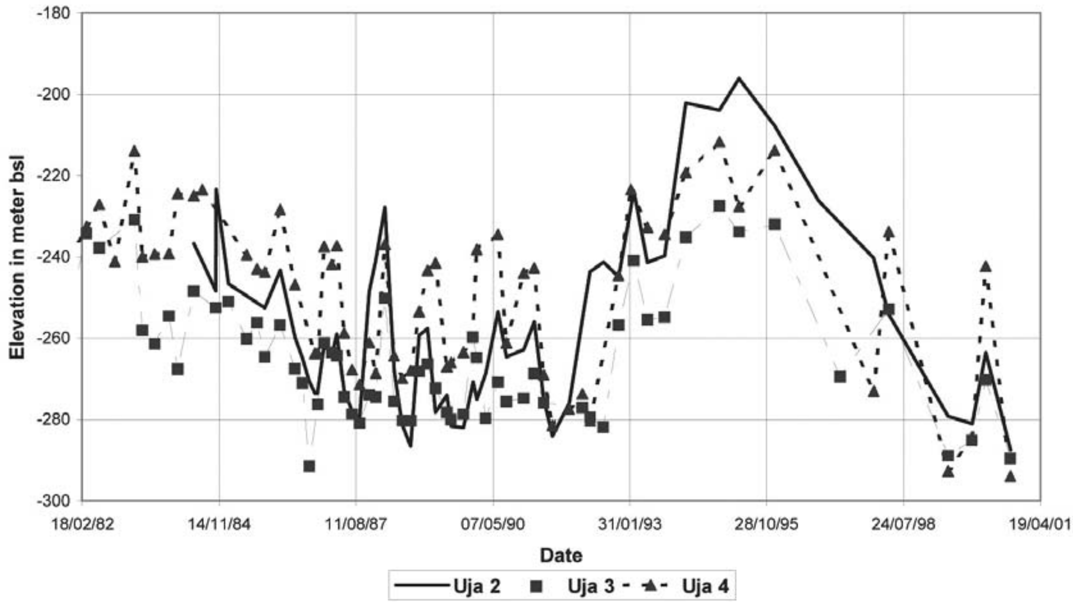
6.3 The Uja Wells

In the vicinity of the spring, there are four wells (Uja wells), which have been drilled into the lower aquifer (figure 6.1). The first well (Uja 1) was drilled in 1964 by the Jordanian authority to a depth of 288 m' and later was deepened by the Israeli authorities to a depth of 536 m'. This well was open in the upper part of the lower aquifer. In 1974, a new well (Uja 2) was drilled to a depth of 615 meter in order to replace the old well. Later, at the beginning of the 1980s, another two wells were drilled a few kilometers south of the spring. Uja 3 was drilled to a depth of 738 meter and Uja 4 to a depth of 650.50 meter. The three wells (Uja 2,3,4) are now open and pump from the lower aquifer of the Judea Group.

The water level in the wells varies between 200 meter below sea level (bsl) to 280 meters bsl (figure 6.4), which is higher than those in the Fazael and Gitit wells to their north, and those in the Jericho wells to their south. Consequently, a local hydrological barrier (water divide) exists in the area. The local water divide creates conditions so that groundwater flow in the area to the north of the Uja wells is toward the Jordan Valley while groundwater flow in the area south of the Uja wells is towards the Dead Sea springs.

The spring outlet is around 20 meters bsl. There is a difference of more than 200 meters between the spring outlet and the water level of the lower aquifer. Such a large difference means a hydraulic separation between the aquifer that feeds the spring and the aquifer form, which the wells are pumping.

Figure 6.4: Water level in Uja wells. **Source**: Mekorot, IHS



The hydraulic separation between the spring and the wells combines with the fact that the spring behavior has remained the same along the last 60 years on record: It has not changed as a result of the pumping from the Uja wells or any other wells located upstream (Kochav Hashachar, Rimonim and En Samiya wells).

6.4 Conclusion

It has been assumed that the spring drying of the Uja spring in drought years is a result of the pumping in the nearby Uja wells. This conjecture follows the assumption that the spring and the wells are hydrologically connected and are supplied by a common reservoir.

A detailed investigation of the spring discharge, the hydrological setting of the spring and of the wells and the wells water level measurements shows that the spring and the wells are hydrologically separated and pumping from the wells does not influence the spring discharge. The main points of the study that led to this conclusion are as follows.

- The outlet of the spring is from the base part of the upper Judea Group aquifer, while the wells are pumping from the lower Judea Group aquifer.
- The spring reacts quickly to rainfall and to climate changes (drought and rainy years). Thus, the maximum discharge occurs about a month after the rainiest month of each year (figure 6.3). Similarly, the depletion starts immediately after the end of the rainy season (except in very rainy years like 1992 and 1993).
- The spring depletion shows a quick drop in discharge, implying that there is no large reservoir that may store water from previous years.
- The behavior of the spring has been the same for the last 60 years on record, long before the wells were pumped. It follows that variations of the spring discharge are related to natural changes only.
- The existence of a hydrological separation between the two systems, spring and wells, is also supported by the difference in the water level of about 200 meters between the two.

The conclusion is that *a local, very karstic aquifer feeds the spring*; the discharge depends on climatic variations (drought or rainy years). In contrast the Uja wells draw water from a deep, separate, aquifer. A similar hydrological situation exists in the En Samiya area, where the Palestinian Authority utilizes water from the En Samiya spring (upper aquifer) and from wells (lower aquifer).

From the management strategy of the water supply in the West Bank, the results of the study show that the policy of drilling deep wells and of pumping from the lower aquifer near the spring outlets was right. No influences between the two sub aquifers have been observed.

References

Guttman, J., 1979: *Jordan Valley – Hydrogeological Conditions in the Cenomanian Aquifer on the Margins of the Jordan Valley* (Tel-Aviv: Tahal Consulting Engineers Ltd.): 01/79/26 [in Hebrew].

Guttman, J., 1980: *Gitit, Kana and Samar Area - Calibration of a Digital Model for Reconstruction of Groundwater Movement in the Lower Aquifer of the Judea Group* (Tel-Aviv: Tahal Consulting Engineers Ltd.): 01/80/96 [in Hebrew].

Guttman, J.; Zuckerman, H., 1995: *Flow Model in the Eastern Basin of the Judea and Samaria Hills* (Tel-Aviv: Tahal Consulting Engineers Ltd): 01/95/66) [in Hebrew].

Guttman, J., 2000: *Hydrogeology of the Eastern Aquifer in the Judea Hills and Jordan Valley*, Final Report. (Tel-Aviv: Mekorot): no. 468.

Kronfeld, J.; Vogel, J.C.; Rosenthal, A., 1990: "Natural Isotopes and Water Stratification in the Judea Group Aquifer (Judean Desert)", in: *Israel Journal on Earth Sciences*, 39: 71–76.

Rosenthal, A., 1978: *Non-Equilibrium of $^{234}U/^{238}U$ Isotopes in the Water of the Judea Group Aquifer on the Eastern Slopes of the Judea and Samaria Hills* [in Hebrew]. M.Sc. thesis (Tel Aviv: Tel Aviv University).

Shaliv, G., 1980: Bet Shean and Eastern Samaria Basins - Updating of Hydrogeological Model (Tel-Aviv: Tahal Consulting Engineers Ltd.): 01/80/51 [in Hebrew].

Part II Trans-boundary Regional Issues: Jordan River and Dead Sea

7 Options for a More Sustainable Water Management in the Lower Jordan Valley

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Abstract[1]

The Lower Jordan Valley is usually regarded as a region with severe water scarcity, but this is not the case. The per capita availability of water is much above the average of the Middle East, but it is regionally unevenly distributed. About 94 per cent of all usable water is used for agriculture; about 2/3 of that has drinking water quality. On the other hand, 44,000 people in the southeast of the valley do not have sufficient local drinking quality water supply to meet the basic domestic demand. Scenario calculations show that a more sustainable water management in the region is possible if water allocation priorities are redefined. The first priority must be given to human and social needs for drinking water, to domestic/urban needs, and to water-efficient income generation activities. Agriculture should be limited to water that is not needed in other sectors. Through such a new management regime, the region could grow to a population of 1 million while in the long run maintaining current levels of agriculture. Water allocation for nature and ecosystems remains a controversial issue. The restoration of a 'more sustainable' water regime of the Jordan River requires cooperation from the four upstream water users (Israel, Jordan, Lebanon, and Syria). The issue that needs to be resolved is if nature and ecosystems are regarded legitimate water users with an inherent natural right, and whether the countries that divert the water from the upper Jordan River system are willing to reallocate water currently used to meet their domestic/urban and agriculture needs or are willing to pay for water from alternative sources.

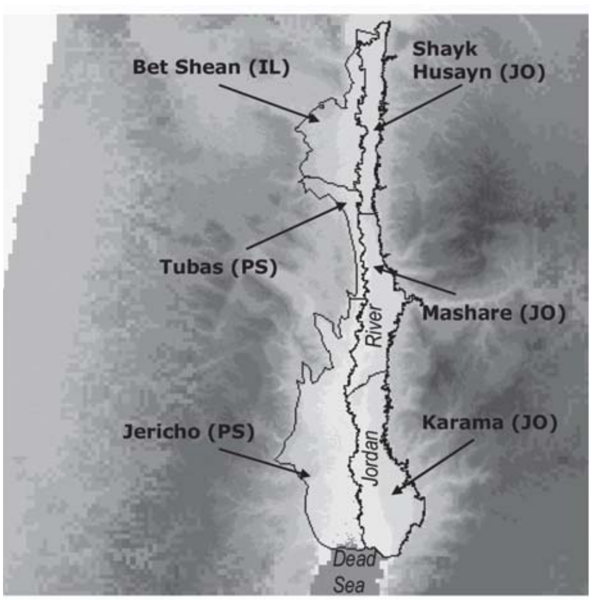
KEYWORDS: water balance; supply; usage; allocation; scenario; usage priority

1 The results presented in this paper come from a joint Austrian, Israeli, Jordanian, and Palestinian cooperative project "*Developing Sustainable Water Management in the Jordan Valley*" that had been partly funded by the INCO-DC Programme of the European Commission through contract ERB.IC18.CT97.0161.

7.1 Introduction

The study area was the valley floor of the Lower Jordan Valley; it stretches from the mouth of the Yarmouk River (south of Lake Tiberias) to the northern shore of the Dead Sea. It includes areas of Jordan (JO), Israel (IL), and of the Israeli occupied territory of the West Bank (Palestine, PS) – the final status of which will eventually be determinedby international law and procedures. The area has a size of about 1,300 km² with a population of about 250,000. The study area was divided into six water regions on both sides of the river: the Bet Shean (IL) and Shayk Husayn (JO) regions in the north, the Tubas (PS) and Mashare (JO) regions in the center, and the Jericho (PS) and Karama (JO) regions in the south of the valley (figure 7.1).

Figure 7.1: Lower Jordan Valley Study Area with the Six Water Regions



7.2 Water Supply and Use

7.2.1 Water Balances

Water supply and usage balances for the base year 2000 were established for all six regions, taking into account local supply (from wells, springs, surface water, and wastewater re-use) as well as water transfers between regions, and water imports and exports. Water supply data are based on official data, and on estimates. Water usage was calculated using data for water consumption sectors such as population data, acreage of different crops, respective average water requirements, and technological efficiencies. The uncertainty associated with the water balances are estimated to be around 10–20 per cent. Methodology details are documented in Orthofer et al. (2001b). All water balances take into consideration five different water quality classes (table 7.1); this is essential to assess the optimal usage for a given water quality mix. Table 7.2 contains aggregate results of the regional water balances.

Table 7.1: Water Quality Categories Used for Regional Water Balances

Quality Code	Quality Description
Q1	Drinking water
Q2	Non-drinking freshwater for unlimited use in agriculture
Q3	Non-drinking freshwater for limited use in agriculture (contaminated and saline freshwater)
WW2	Wastewater for unlimited use in agriculture (pre-treated domestic wastewater)
WW3	Wastewater for limited use in agriculture (contaminated & saline wastewater)

7.3 Water Supply in the Study Area

7.3.1 Overall Water Availability

Total usable water supply is estimated to be about 442 million cubic meters per year (MCM/yr), of which 299 MCM/yr (or 68 per cent) have drinking water quality. 42 MCM/yr of the water supply consists of re-used wastewater. About half of the water supply is 'imported', i.e. brought into the study area from the outside. Water supply from local sources (i.e. from local wells, springs, and surface waters, but without 'imported' water) is 225 MCM/yr, of which 173 MCM/yr (or 77 per cent) have drinking water quality. This translates to a water availability of 1,800 m^3 per capita and year (m^3/cap.yr), and a drinking water availability of 1,200 m^3/cap.yr. If only local supply is considered the water availability is around 1,000 m^3/cap.yr and drinking water availability is about 700 m^3/cap.yr. Contrary to what many people believe the Lower Jordan Valley is not a water-scarce area, particularly if compared to the much lower water availability in the respective countries: 340 m^3/cap.yr in Israel, 93 in Palestine (NRC 1999), and 190 in Jordan (Shatanawi 2001).

Table 7.2: Summary of Water Supply and Usage Balances for the Six Water Regions in the Study Area

		North		Middle		South		Total
		Bet Shean	**Shayk Husayn**	**Tubas**	**Mashare**	**Jericho**	**Karama**	
Base Data								
Population	(cap)	25,000	51,000	4,000	77,000	46,000	44,000	247,000
Area	(km^2)	200	130	70	190	450	290	1330
Mean rainfall	(mm/yr)	300	270	230	160	160	110	190
Natural renewal [1]	(MCM/yr)	12	7	3	6	15	7	49
Water Supply								
Total water supply								
Total supply	(MCM/yr)	141	73	16	72	68	71	442
From local sources [2]	(MCM/yr)	116	10	16	14	68	31	225
Wastewater (WW2/WW3)	(MCM/yr)	0	5		16	0	20	42
Drinking water supply (Q1)								
Total supply	(MCM/yr)	90	68	16	56	68	0	299
From local sources [2]	(MCM/yr)	65	10	16	14	68	0	173
Per-capita water availability								
Total water	(m^3/cap.yr)	5,600	1,400	4,100	900	1,500	1,600	1,800
Drinking water (Q1)	(m^3/cap.yr)	3,600	1,300	4,100	700	1,500	0	1,200
Water Use								
Domestic use								
Drinking water (Q1)	(MCM/yr)	3	5	<	7	2	0	17
Other freshwater (Q2/Q3)	(MCM/yr)	0	0	0	0	0	4	4
Agricultural use (by water quality)								
Drinking water (Q1)	(MCM/yr)	85	62	16	48	64	0	271
Other freshwater (Q2/Q3)	(MCM/yr)	49	0	1	0	0	45	99
Wastewater (WW2/WW3)	(MCM/yr)	0	5	0	15	0	20	40
Agricultural use (by usage sector)								
Irrigated field crops	(MCM/yr)	75	61	17	56	63	56	326
Greenhouses	(MCM/yr)	<	6	1	6	1	8	22
Fisheries	(MCM/yr)	58	0	0	0	0	0	58
Livestock	(MCM/yr)	1	<	<	1	<	1	3
Agricultural use (total)	(MCM/yr)	141	67	17	63	64	65	410
Industrial/tourism use	(MCM/yr)	2	<	0	<	<	<	3

Note: MCM/yr = million cubic meters per year. All numbers are rounded to reflect inherent uncertainties; these may lead to small arithmetic inconsistencies

[1] Estimated as 30 per cent of winter rainfall

[2] Supply from local springs, wells, surface water

7.3.2 Regional and Social Disparities

While the overall valley is a water-rich area, resources are distributed unevenly. The amount and quality of water is much higher in the west than in the east, and higher in the north than in the south. The overall water availability (i.e. including 'imported' water) is 5,600 and 4,100 m^3/cap./yr in the Bet Shean and Tubas regions but only 900 m^3/cap./yr in the Mashare region.

In the eastern part of the River Jordan there is a major water exchange system: drinking water is 'imported' from the Yarmouk basin, transported southwards along the King Abdullah Canal and 'exported' into the Amman urban area. However, only about 1/3 of the 'imported' drinking water ultimately reaches the urban area because much of it is already used in those regions through which the water is transported. Furthermore about 85 MCM/yr of wastewater from greater Amman are imported into the valley and used for agriculture. This system of 'exporting' drinking water to urban areas and re-importing it to the valley for agricultural use is an effective water exchange system for making the best use of the respective water qualities, namely to use drinking water quality to satisfy the urban demand, and to use urban treated wastewater for agricultural irrigation.

The study team has primarily focused on the physical dimension of water accessibility. However, it is clear that in all regions there are inequalities between those who have access to quality water and those who have not. Insofar the 'average' numbers for the water supply in a region as presented in this study conceal the social differences. The discussion of the social dimension is outside the scope of this chapter. There is one particular feature of the Jordan Valley water supply that must be mentioned, namely the unequal water supply within the two Palestinian regions (Tubas and Jericho). In both regions, there are Israeli settlements that have their own and 'exclusive' water supply structures for a relatively small number of people. For instance, in the Jericho region, there is a drinking water supply of 43 MCM/yr for the 44,100 Palestinian residents and of an estimated 35 MCM/yr for 1,600 Israeli settlers. This unequal allocation translates to a drinking quality water availability of about 22,000 m^3/cap.yr for the Israeli settlers and 1,000 m^3/cap./yr for the Palestinans, most of which is used for agriculture.

7.3.3 Water Usage in the Study Area

About 94 per cent of all water (410 MCM/yr) is used for agricultural production (plant irrigation, crop production, fisheries, animal husbandry). Of this, 349 MCM/yr are used for plant irrigation (field crops and greenhouses), 58 MCM/yr for fish farming, and 3 MCM/yr for animal husbandry. Of the 299 MCM/yr of drinking water quality supply, only 22 MCM/yr are used for the sectors which require drinking water quality (namely domestic, public, industry, tourism purposes). 275 MCM/yr (or about 92 per cent) of the available drinking water are used for agriculture.

The patterns of regional water use follow the patterns of regional water supply. In almost all regions, much of the available water (after imports and exports) is used for local agricultural purposes, regardless of the available water quality. In the western part, most available water is drinking water quality but it is mostly used for agricultural purposes. In the Bet Shean region, a substantial amount of lower quality water – from local brackish springs and from the River Jordan – is also used for fish farming. In the eastern part, the amount of drinking water used for agriculture depends on the availability: the more water is available, the more it is used. Water use is particularly high along the water transport facilities which convey water from the Yarmouk basin to Amman (in the Shayk Husayn and the Mashare regions). In the southern Karama region, where no proper drinking water is available, 'Q2' grade water has to be used for the domestic sector.

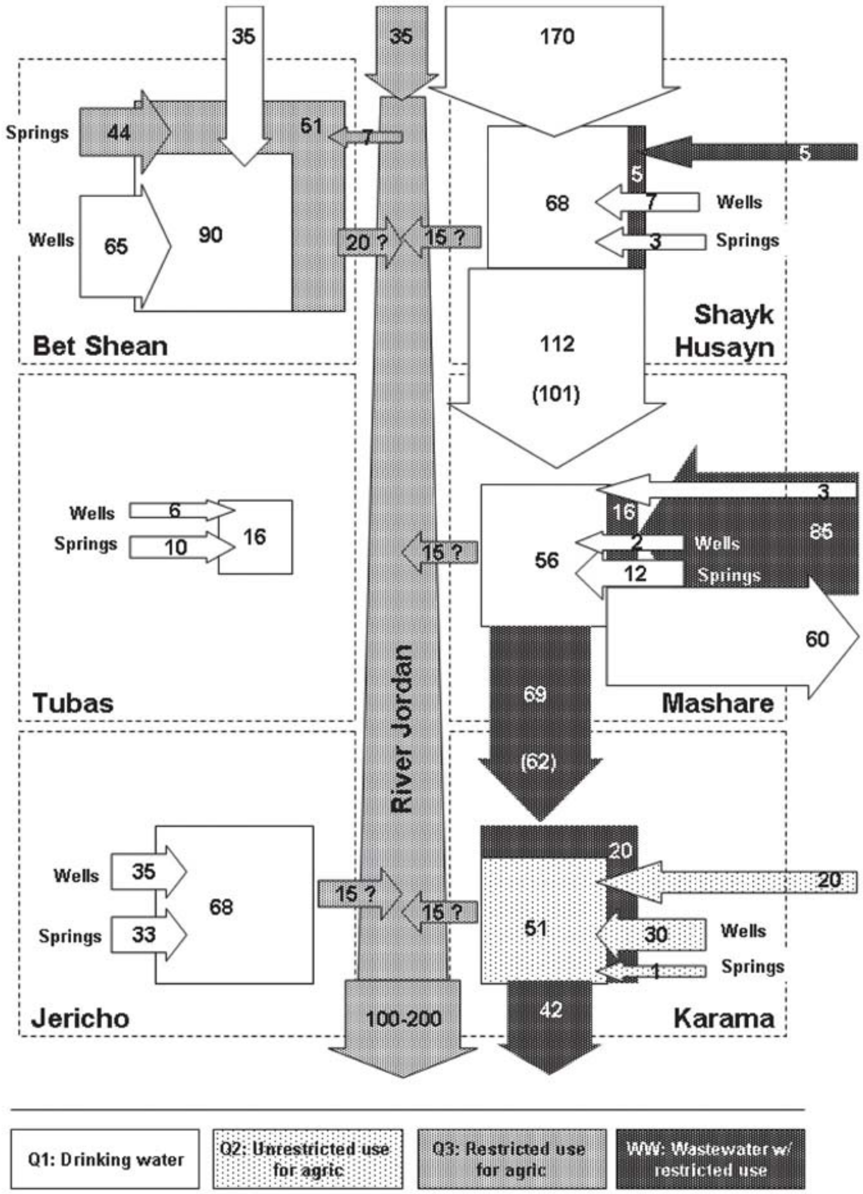
7.4 Options for a 'More Sustainable' Water Management

7.4.1 Sustainability Considerations

'Sustainability' is not a physical criterion that can be calculated or defined. Its original lexical meaning was the status of using a resource in a way that the resource is not depleted or permanently damaged. However, during the past years it had been acknowledged that sustainability not only refers to natural resources but also to the human dimension, i.e. not to damage societies. This means that there is no sustainability as long as the people cannot satisfy their primary needs.

This chapter focuses mainly on the physical dimension of sustainability, but remains fully aware of the high priority of societal and human needs for drinking water. It outlines a water management system that considers the physical sustainability goals without discussing in detail the human sustainability goals.

Figure 7.2: Water Supply System Overview in the 6 Regions of the Study Area (Year 2000)



Note: Rectangles indicate water availability, arrows indicate water supply sources. Shading indicates water quality category. Arrows that start/end outside the region indicate 'imports' or 'exports'. All numbers refer to MCM/yr

7.4.2 Estimating the Amount of Renewable Water Supply

The natural renewal of water through rainfall in the Lower Jordan Valley study area can only be estimated through theoretical considerations. Recommendations in literature range between 17 per cent (NRC 1999) and 20 per cent (Rabi 2000) of annual rainfall. Our team has estimated a renewal rate of about 30 per cent of *winter* rainfall over the area and calculated this using a GIS precipitation model (cf. Orthofer et al. 2001a, Annex E) to be around 49 MCM/yr. This number for 'locally renewable' water is only 10 per cent of the water that is currently used, yet, it is more than double the amount that is currently used for domestic, public, industrial and tourism purposes.

But the study area also has access to water from aquifers that are renewed through rainfall in the highlands around the valley. How much of the renewable supply from these aquifers 'belongs' to the valley?

Traditionally, there was limited withdrawal over the highlands, and much water from the mountain aquifers had been discharged through natural springs in the valley proper. The situation has changed during the past 30 years: many additional wells were established in the highlands that pump water from the aquifers; this affects the natural discharge through springs that pump water from the aquifers. There is limited knowledge about the sustainable yield of the aquifers, but present data indicate that natural recharge could be about 350 MCM/yr for the IL/PS eastern mountain aquifers, and about 900 MCM/yr for the Jordanian mountain aquifer (Kupfersberger 2001). It is not possible to define a sustainable withdrawal from aquifers. Any withdrawal from an aquifer – in addition to natural springs – changes its dynamic equilibrium and reduces the natural outflows to other aquifers and to terrestrial and aquatic ecosystems. It is largely a societal (political) decision on how much compromise with nature is accepted. As a *surrogate* measure for renewable water supply in the study area we propose to use the current 'natural' springflow renewed in the outside (104 MCM/yr) plus the 'locally renewable' input from winter rainfall (49 MCM/yr). Thus our assumption for renewable water supply in the Lower Jordan Valley would be about 153 MCM/yr. This target is about 1/3 of the current total water use. In the long term, this level could be used as a sustainability target for water usage from local sources (wells and springs).

7.4.2.1 Water for Nature

Some 50 years ago the Lower Jordan River carried about 1,300 MCM/yr of quality freshwater to the Dead Sea. The river had sustained natural fauna and flora, and it had maintained equilibrium with adjacent aquifers. At present, the river carries only saline, polluted water and wastewater, about 35 MCM/yr at its inflow into the study area, and about 100–200 MCM/yr at its outflow to the Dead Sea (Al-Weshah 2000; Shavit et al. 2001).

'Physical' sustainability considerations might imply the re-establishment of the natural flow of the River Jordan, which would then restore the river ecosystems, and ensure its cultural value and appearance for future generations. However, the authors found no consensus about this. It is largely a societal question: is there a legitimate 'value' in having the River Jordan flow in a state similar to that at the time of the prophets of the three regional major religions? What is the value of this? Who benefits from it? Who would be willing to pay the price for it? A restoration of the original flow and quality of the Jordan River would require a complete change of current water supply in Jordan and Israel, and it might reduce the availability of water for agriculture in southern Syria. This is certainly not socially, economically and politically feasible in the short or medium term. However, a partial restoration to a minimum flow that satisfies some sustainability criteria should be kept as a long-term goal for a sustainable water management. There are no hard scientific data that would allow setting a minimum flow level of the River Jordan, but some of the authors felt that it is prudent to assume a minimum flow of around 500–600 MCM/yr (or about half the original flow). Such a partial restoration of the ecosystem in the Lower Jordan River is not an issue that can be resolved in the Lower Jordan Valley itself. Any solution would require cooperation from the upstream water users (Israel, Jordan, Syria, and Lebanon) that now divert all Jordan River headwaters for other uses in their areas.

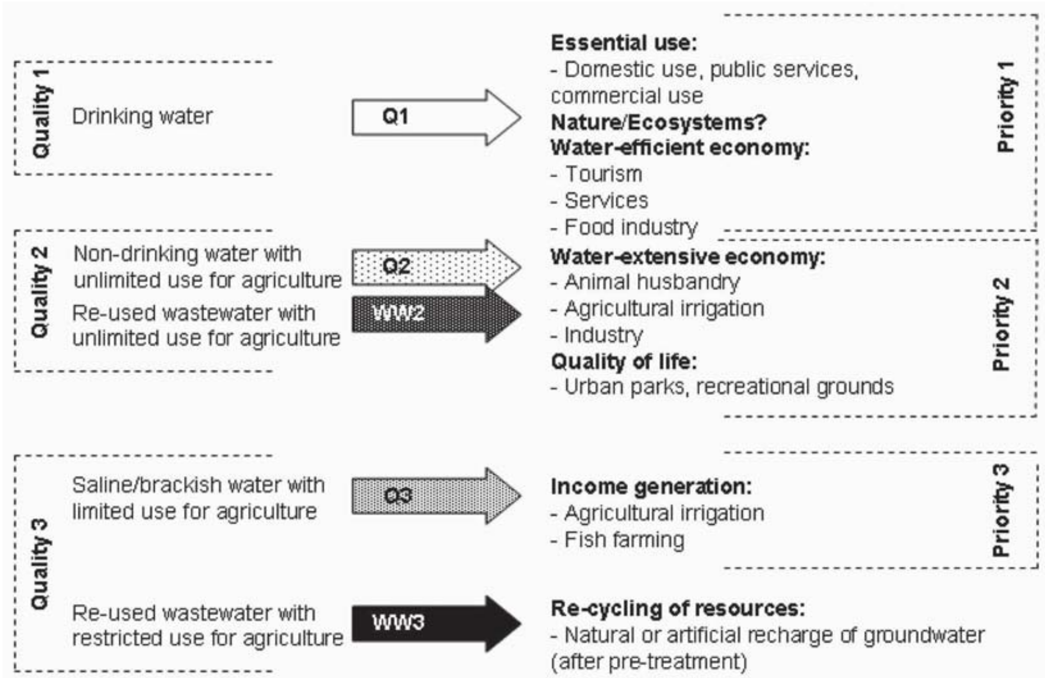
7.4.2.2 Making 'Best Possible Use' of Water Qualities

Simple as it may sound: water is not water. Different water qualities may serve for different usage purposes. The best quality, of course, may be used for any purpose. In many water-rich countries drinking water is used for cooking as well as for car-wash or plant irrigation. In areas with limited water resources water quality is an issue that must play a role for usage management: Population requires a drinking water for food and sanitation. Fish farming may be sustained with brackish water. Agricultural irrigation may even use re-used urban wastewater.

In the Jordan Valley study area, water is used for all purposes with only little regard to water quality. In the overall study area, 275 MCM/yr drinking water are currently used in agriculture while Karama that would need 4 MCM/yr drinking water for the population does not get any water of this quality, and substandard water has to be used for domestic consumption. We propose a cascading use of water qualities: the better quality water should be used only to satisfy the needs of those who need the better quality water (figure 7.3).

Drinking water should be used only for those usages that actually require drinking water: domestic use, public services, food industry, and (perhaps) nature. Drinking water is also required for water-efficient high-income generating activities, such as food industry, services, tourism. Only after all these users have been satisfied, any remaining drinking water

Figure 7.3: Cascading Usage Priorities for Different Water Qualities



would be usable for other usage sectors. The second priority is water needed for water-extensive income generating activities such as irrigated agriculture. This priority also includes usage sectors that increase the quality of life, such as public parks or recreation areas. Irrigated agriculture which has a very low water-efficiency can only be sustained after all other higher priority demand has been met.

7.4.2.3 Wastewater Re-use for Agriculture

In all three countries that share the Lower Jordan Valley the public perception is that agriculture is the basis of human existence and is a high priority water usage sector. In reality, agriculture is a very inefficient way of using water for economic development. Agriculture is also an ultimate sink of water, while the urban and industrial sectors generate considerable amounts of wastewater that can be further used. For example, if 200 MCM/yr drinking water are used for agriculture, it would sustain zero people but 20,000 ha; if the same amount were used only for domestic purposes, it could sustain more than 1.5 million people while still retaining 10,000 ha of irrigated agriculture through re-used domestic wastewater (table 7.3).

The situation in the Jordan Valley shows that – as long as there is a shortage of drinking water for essential human needs – there is no justification to continue using drinking water for irrigated agriculture. Agriculture has an important role for the development of a country's societal coherence and for the development of a national economy. However, the extent of irrigated agriculture in regions of water shortage should be determined by the remaining available water after satisfying the higher priorities, namely the essential domestic needs, the needs of nature, and the needs for a water-efficient economic development. Given the fact that in the Middle East agriculture had always been regarded as the basis of living and had been given a high priority of water usage, the above new allocation priorities will require a "new water paradigm" (Charrier/Curtin 2000).

7.5 'More Sustainable than Today' Water Usage

7.5.1 'More Sustainable' Development Scenario

While there is agreement among the authors on the principle that nature and ecology do have legitimate rights to water allocations there was no consensus as to the level of restoration of the flow to the Jordan River. Most authors support as a realistic sustainability target for the year 2020 that (a) no more than 200 MCM/yr of water should be locally withdrawn from springs, wells and surface water, and (b) the River Jordan should be restored to a minimum flow of 400–

Table 7.3: Relation of Population Number and Possible Irrigated Agriculture from a Given Available Amount of Drinking Water (200 MCM/yr)

Population (cap)	Domestic & public use (MCM/yr)	Additional wastewater re-use for agriculture (MCM/yr)	Total available water for agriculture (MCM/yr)	Potential areas for irrigation (hectares)
0	0	0	200	20,000
100,000	12	+6	195	19,500
200,000	24	+12	190	19,000
500,000	60	+30	170	17,000
1,000,000	120	+60	140	14,000
1,500,000	180	+90	110	11,000

Note: Simplified model with assumptions: average domestic and public use: 120 m^3/cap.yr; typical irrigation requirement in the study area: 10,000 m^3/ha.yr; possible wastewater re-use from domestic/public sector: 50 per cent. All numbers are rounded

600 MCM/yr. Our calculations show that the first target is realistic to achieve. This requires re-directing the usage priorities from agriculture towards more quality of life and a higher economic benefit. At the same time, environment must also be regarded a user of its own right. The underlying assumption for our development scenario is a just and lasting peace among all riparian countries. Sustainable water use is only possible with a cooperative political and social system. In our 'more sustainable' development scenario the Lower Jordan Valley is projected to be a major population center rather than a major agricultural center. Economic growth would be based on services (tourism, commerce, schools and universities, public services, pleasant living environment with high living standards). Any drinking water that is not used in the area would be 'exported' to the populated urban areas outside the study area. Agriculture would gradually be limited to match the remaining water; by 2020 agriculture would not use any more drinking water. Water extraction from wells in the study area would be partly reduced in order to minimize the impacts of overpumping.

The scenario projects that the population will grow from 250,000 in the year 2000 to 1,100,000 in 2020. This reflects the possible development if the valley is to become a suitable area for many Palestinian refugees. Irrigated open agricultural areas would decrease by 30 per cent (or 10,000 ha). At the same time, greenhouse areas would increase by 6,000 ha and thus make up part of the reduction of open irrigated areas. Tourism would grow by about 9 per cent per year. Figure 7.4 shows that with all our assumptions, a more sustainable development is possible.

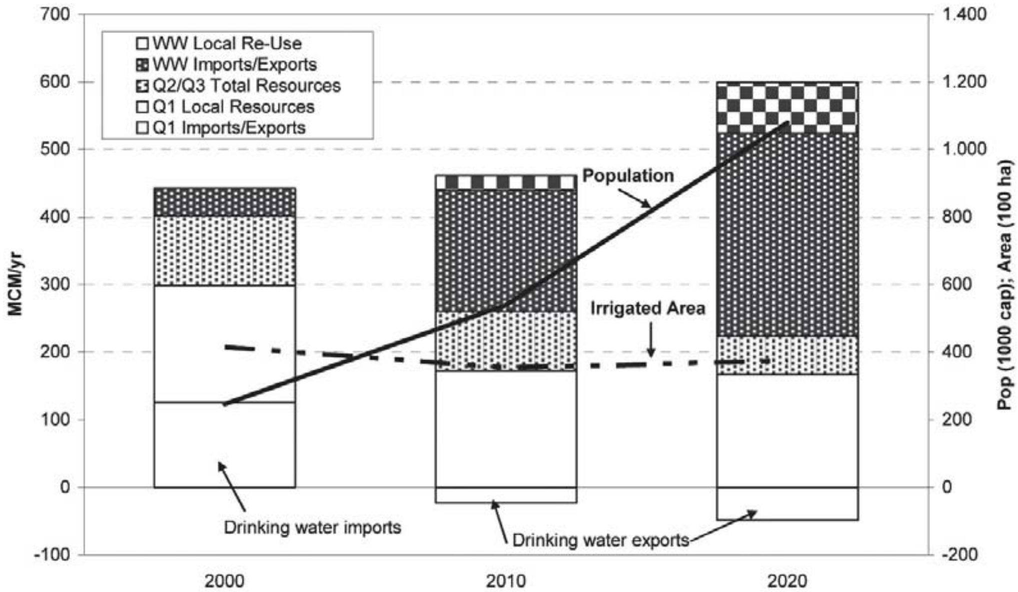
Total water supply would grow by about 25 per cent; mainly because of wastewater 'imported' from the urban regions outside the valley proper, and partly because of local wastewater re-use. The study area that is a net importer of drinking water (Q1) in 2000 would gradually become a net exporter. The extraction of water from wells, springs, and surface water in the study area would decrease by about 20 per cent between 2000 and 2020. Extraction of groundwater from wells, springs and surface water would be reduced by phasing out pumping from brackish wells and by reducing pumpage from drinking water wells. This means that less water would be extracted from the aquifers.

The water balance predicts that by 2020 there would even be a significant surplus of low-grade water that could be used for recharging the depleted shallow groundwater, or (after appropriate treatment) could contribute to a restoration of the flow of the River Jordan.

7.6 Conclusions

In the past, the major element of most 'solutions for the water scarcity' in the Lower Jordan Valley was to increase the supply. Recently, some solutions have also come up with options for reducing demand through a more efficient water technology or through water conservation options. However, these solutions fail to change the overall system of how, and for what societal values, the available water is used. Our analyses and simulations have shown that the Lower Jordan Valley is an area with a high water supply, yet with very variable regional and social availability. Our data confirm the observation that indeed there is no scarcity of the water, but there might be a 'secondary scarcity' (Trottier 1999), namely the capacity to properly

Figure 7.4: Development of Water Supply in a 'More Sustainable' Scenario with Indicators for Agricultural and Urban Demand (Irrigated Areas and Population)



Note: Negative numbers for drinking water (Q1) refer to exports

manage and distribute the available water. Present water management is far from being sustainable. Aquifers are overexploited and water sources are becoming polluted. Most disturbing but hardly noticed, ecosystems have been deprived of their water needs. The River Jordan that has been sustaining nature along its flow through the Lower Jordan Valley has been reduced to a wastewater channel.

Why is this situation so unsustainable although there is sufficient water available? Our results suggest that there are two major physical causes for this situation: first, the almost total abstraction of the flow of the Lower Jordan River by the upstream riparians; and second, the overdevelopment of agriculture in the Lower Jordan Valley (note that the first cause has to do with the second insofar as much of the water from the Upper Jordan River and from the Yarmouk are used for agricultural purposes).

The problem of water sharing between the Upper and the Lower Jordan Valley is a political issue that cannot be dealt with on a rational scientific level. Yet, it is clear that one of the sustainability goals of the Lower Jordan Valley, namely the partial restoration of the Jordan River ecosystem and its natural characteristics, is an issue that cannot be solved in the Lower Jordan Valley but depends totally on the cooperation of the upstream users.

The second cause for non-sustainability – the high use of quality drinking water by agriculture – can be solved to a large extent in the Lower Jordan Valley. Historically, agriculture had always used only a small fraction of the total available water, and thus it had been part of an overall sustainable water management. During the past 50 years, agriculture has become more and more developed, with elaborate large scale farming and irrigation systems, with dairy farms and even fish ponds. At present, about 94 per cent of all available water (and 92 per cent of all drinking water!) are used for agricultural purposes. A similar situation is reported for many countries in arid areas (Gleick 1998). It might be worthwhile to discuss on a general level the justification of agricultural development in arid areas with respect to global sustainable development, but it is outside the scope of the this paper to go into detail on that.

The issue of who controls water allocation in the Lower Jordan Valley is highly charged politically. The riparian governments and scientists have different perceptions of who has 'rights' to water and to what amount. It might be a starting point for consensus building to apply international norms for re-allocation of the regional water resources. All solutions for a more sustainable water management must start from an equitable water allocation for the population.

We have shown that it could be possible to achieve a 'more sustainable' water management system within the next 20 years. Such a management system would be guided by setting priorities on the water use, and by utilizing the available water qualities according to their best use. With the expected population growth in the overall region, drinking water needs to be a priority to satisfy the domestic and urban demand. Remaining drinking water would then be used to make the best economic and societal use that would generate income and promote the quality of life. Agriculture, on the other hand, would be scaled to match the remaining water, mainly re-used urban wastewater.

Such a new role for agriculture is not easy to achieve. The historic public perception of politicians and the population is that agriculture is the basis of the human existence. The economic indicators show that this is not true anymore: in all three countries, agriculture is the sector with the highest water consumption but with a very low contribution to the overall national economy, and a relatively low contribution towards employment. Agriculture is a very inefficient way of using water for economic development. Water can be used far more efficiently, in terms of both income generation and employment opportunities: in business, services, tourism or manufacturing. Such a new water usage system is easy to outline in theory, but difficult to achieve in practice. This new system would require a number of practical changes and efforts, including (a) the establishment of a legal basis and an institutional framework for water management, (b) the introduction of a basin-wide institutional cooperation of the three countries, and (c) the introduction of water prices that reflect cost and value of water. In any case it is necessary that all decision makers in the area plan ahead towards the development of a water-efficient economy and society. It is clear that the different levels of economic development in the three countries require careful consideration for planning. While some countries might be able to advance in the near future on this path towards sustainability, others might need more time to adjust their economies.

It might be worthwhile to apply the concepts of 'virtual water' (Allan 1997) – which means importing most high water-consuming food staples from abroad rather growing them locally – for a more sustainable regional development. The virtual water content of irrigated crops is very high: bananas contain about 2.4 m^3/kg and citrus 0.4 m^3/kg (average data from Israel, Pohoryles 2000). With sufficient, yet limited water resources, the Jordan Valley might be better off producing engineers and teachers rather than bananas, and generating wealth from tourists rather than from oranges.

References

Allan, J. A., 1997: *Virtual Water: A Long Term Solution for Water Short Middle Eastern Economies?* Occasional Paper No 3 (London: University of London, School of Oriental & African Studies (SOAS) Water Issues Group).

Al-Weshah, R. A., 2000: "The Water Balance of the Dead Sea: An Integrated Approach", in: *Hydrological Process*, 14: 145–154.

Charrier, B.; Curtin, F., 2000: "A Vital Paradigm Shift to Maintain Habitability in the Middle East: The Integrated Management of International Watercourses", in: *Water for Peace in the Middle East and Southern Africa* (Geneva: Green Cross International, March).

Gleick, P. H., 1998: *The World's Water. Biennial Report on Fresh Water Resources (*Washington, D.C.: Island Press).

Kupfersberger, H., 2001: *Aspects of Water Management in the Lower Jordan Valley. Preserving the Quality of our Water Resources*. 4th Austrian-Israeli Technical Symposium, Vienna, 23–25 Apr 2001: 183–189.

NRC, 1999: *Water for the Future. The West Bank and Gaza Strip, Israel and Jordan* (Washington D.C.: National Research Council. National Academy Press).

Orthofer, R.; Daoud, R.; Fattal B.; Ghanayem, M.; Isaac, J.; Kupfersberger, H.; Safar, A.; Salameh, E.; Shuval, H.; Wollman, S., 2001a: *Developing Sustainable Water Managemenent in the Jordan Valley*. Final Project Report Project ERBIC 18CT970161 (Brussels: European Commission, DG Research).

Orthofer, R.; Loibl, W.; Wendl, E., 2001b: *A Harmonized Water Data Base for the Jordan Valley*. Seibersdorf Research Report ARC–S-0157 (Seibersdorf, Austria: ARC Seibersdorf Research).

Pohoryles, S., 2000: "Program for Efficient Water Use in Middle East Agriculture", in: *Water for Peace in the Middle East and Southern Africa* (Geneva: Green Cross International, March).

Rabi, A., 2000: "Water: A Means for Confidence-Building and Cooperation in the Jordan River Basin", in: *Water for Peace in the Middle East and Southern Africa* (Geneva: Green Cross International).

Shatanawi, M. R., 2001: *Legal and Institutional Framework for Water Management under Scarce Conditions*. Conference on Integrated Water Resources Management, Nicosia, Cyprus, 11–13 May 2001, Agricultural Research Institute Nicosia. 79–85.

Shavit, U.; Holtzmann, R.; Segal, S.; Venghosh, A.; Faber, E.; Gavrieli, I.; Bullen, T., 2001: "Water Sources and Quality Along the Lower Jordan Valley, Regional Study", in: Shamir, U. (Ed.): *Water Resources Quality: Preserving the Quality of Our Water Resources (*Berlin - Heidelberg - New York: Springer): 127–148.

Trottier, J., 1999: *Hydropolitics in the West Bank and Gaza Strip* (Jerusalem: Palestinian Academic Society for the Study of International Affairs).

8 A Water For Peace Strategy for the Jordan River Basin by Shifting Cropping Patterns

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Abstract

There needs to be a policy shift to water thrifty and salt-tolerant crops in regions of water scarcity, such as that of the countries of the Jordan River Basin (Syria, Lebanon, Jordan, Palestine and Israel) that must be implemented if conflicts over the use of meager water resources in that region is to be overcome. Investigations of the water consumption versus the possible economic returns for many tree crops, field crops, vegetable crops and medicinal plants is evaluated in order to support a water saving for peace policy. To succeed in the implementation of such a policy, the following criteria need to be addressed: These include planning, funding, education, marketing, technical know-how and the will to execute that water conservation policy. When evaluating the crops which are among those most feasible economically, most suitable for the local environment as well as for water conservation, such crops are not being produced enough in the Jordan River Basin countries neither for export nor for local consumption. Since the water used in agriculture represents 70–80 per cent of the overall water use, a shift to water thrifty cropping patterns can minimize conflict over the limited water resources.

Keywords: Almonds, Assaf hybrid sheep, cropping patterns, jojoba, Jordan River Basin, thyme, salt tolerant and water-thrifty crops, water disputes

8.1 Introduction

This chapter deals with the current issue at hand in the Jordan River Basin countries which is the need for the planting and cultivation of crops that meet the criteria of producing economically with minimal water use, or with brackish and purified wastewater without undermining the health standards and the quality of the products produced. The countries of the Jordan River Basin to which this investigation and analysis is directed are Jordan, Lebanon, Palestine, Syria, and Israel.

This chapter is not a survey of the water requirements and productivity under various conditions for all the existing and cultivatable trees, vegetables, medicinal plants, field crops and forage crops which are produced with minimal water requirements in these Middle East countries under the above-mentioned criteria. It simply covers some of these crops which present a good example of the issue at hand. Focus will be on some highly economic tree crops as they represent a more permanent strategy for the implementation of a longer period of water conservation which, if adopted, will be set-up for at least 25 years and may even be effective for several hundred years, as is the case in the cultivation of the drought resistant olive and jojoba trees, as well as almonds and other rain fed productive trees.

8.2 Introducing New Crops into the Jordan River Basin

Data of the National Research Center of the Palestinian Authority in Ramallah on the total water needs of some of the major cultivated crops in the Jordan River basin are presented below in tables 8.1–8.4 (Assaf 1992, 1993, 1996, 1997, 2004).

Table 8.1: Total Water Needs of Some Major Trees Grown in the Jordan River Basin

Tree type	Total water needs cubic meters/ donum	Water Source
Bananas	2,000	Irrigation
Avocados	1,700	Irrigation
Mangos	1,600	Irrigation
Date Palm	1,500	Irrigation
Citrus	1,200	Irrigation
Guava	1,000	Irrigation
Figs	480	Rainfed
Olives	400	Rainfed
Apricots	400	Rainfed
Plums	380	Rainfed
Soft Shell Almonds	380	Rainfed
Hard Shell Almonds	350	Rainfed
Jojoba	300	Rainfed and/or supplemental irrigation
Cactus –prickly pears	150	Rainfed

Table 8.1 privides an estimate of total plant water needs from rainfall to irrigation This total water need of major trees in the Jordan River Basin countries is used for an economic production. The total water needs for a given plant are defined as that water used by the plants from precipitation and irrigation or supplemental irrigation in order to fully produce.[1] Almonds, an important rain fed and well-marketable tree has very low water needs and the new desert-type jojoba trees which can be dry-farmed have the lowest water need among all trees.

The total water needs of certain field and forage crops commonly planted in the Jordan River Basin are given in table 8.2. In the West Bank most recently tobacco – a non-food rain-fed cash crop – has become one of the favorite crops under rain fed conditions due to its high prices and the increase in consumers demand for the simple locally produced and much cheaper, unpacked dry tobacco than the imported manufactured products.

Table 8.2: The Total Water Needs of Field Crops and Forage Crops from Rainfall

Field Crops and Forage Crops	Rainfall Requirement for Economic Production (in total millimeters annually)
Corn	600
Watermelons	550
Melons (cantaloupe)	450
Wheat, Sorghum, Alfalfa	400
Tobacco	400
Chickpeas (Garbanzos)	385
Barley	350
Thyme	350
Vetch	325
Lentils	325
Kirsannih Vetch	325
Cumin, Anise, Blackseed	225

Some of the successfully grown salt-resistant crops that are cultivated on a small scale in the Jordan River Basin region are given in table 8.3.

Tomatoes and melons (cantaloupes) were found in experiments conducted by Pasternick (2002) in Egypt and Israel not only to produce well with saline water, but also the quality of the product was enhanced in that the tomatoes had more solids and became tastier, while the cantaloupe melons become sweeter using drip irrigation with high saline water. Initially, during the emergence period a small amount of water used was either fresh or of very low salinity. Water conservation may also be realized by growing vegetable crops under protective covers, such as in plastic greenhouses, compared to the same vegetables grown and irrigated in open fields. This fact may be evident from the water requirements of several highly consumed crops in table 8.4.

1 As published, the official definition by FAO (2000) for 'crop water requirements' is: The total water needed for evapotranspiration, from planting to harvest for a given crop in a specific climate regime, when adequate soil water is maintained by rainfall and/or irrigation so that it does not limit plant growth and crop yield.

Table 8.3: Water Salinity Levels in the Water Used for Irrigation of Certain Salt Tolerant Crops in the Jordan River Basin

Salt Tolerant Crop	Salinity in Total Dissolved Solids (ppm)
Cactus (Prickly pears)	2,500
Jojoba	2,000
Melons (cantaloupe)	1,500
Tomatoes	1,200
Alfalfa	1,100
Hard Seed Almonds	800
Olives	800
Citrus	500
Bananas	150

Table 8.4: Water Needs of Crops under Drip Irrigation in Greenhouses versus Open Fields, in Cubic Meters per donum

Type of Vegetable	The Water Needs for Vegetables Inside a Greenhouse	The Water Needs for Vegetables In Open Fields
Tomatoes	600	1,000
Cucumbers	850	1,200
Green Beans	750	900
Peppers	600	800
Thyme	300	350

The great difference in the infrastructure cost for providing water to the crops produced in a greenhouse with that in an open field is offset by the greater production inside greenhouses. Following the successful thyme cultivation experiments in 1983, Assaf (1989) pointed to the field potential of propagation and cultivation of thyme in Palestine from cuttings and to the various medicinal benefits from consuming thyme leaves. There is a potential for the production of 2 per cent thyme oil from dry thyme leaves. About half a century ago, Palestinians had a thyme distillation system in Arrabeh-Jenin and used thyme collected from the hilly wilderness of Palestine. In 1946, they produced two tons of thyme oil and exported it to Britain but at present none. However, since the author transferred the technology of producing thyme seedlings from terminal thyme cuttings in the early 1980s, thyme production has become a major field crop in the West Bank and Gaza Strip. Thyme leaves are currently a local commodity and is available both in the common markets and in 2001 some 41 tons were exported to Israel. None was available for export before. The same spread in thyme cultivation has occurred in Jordan to which the author transferred this simple thyme cultivation technology in 1984.

The numbers in tables 8.1, 8.2, 8.3 and 8.4 are presented only for comparative purposes. The actual total volume of water needed each year for a given crop to produce economically depends on many factors besides water. These include: type of soil, the variety type, the climate in the area, time of planting, time and distribution of rain, type of irrigation method, type and amount of fertilizers used, method of cultivation, time of harvest, and evapotranspiration rates in the area. When the above factors are estimated for certain crop water needs, those that are medium were considered, i.e., are neither the extremely harsh/bad factors nor the extremely favorable/good ones..

However, what is economic for the production of a given crop in one year may not be economic another year. For example, tobacco production was not so economic in 2000, but in 2004 when farmers were seeking a cash crop they found that planting and producing tobacco under rain fed conditions has become very profitable. This shift by farmers in the West Bank to tobacco production is due to high taxes of the Palestinian Authority on imports of tobacco marketed by importers and/or produced by the Palestinian tobacco industry. Thus Palestinians have used their own tobacco for making cigarettes even with small inexpensive equipment. The increase in the per cent of smokers has resulted in an increase in cancer, especially lung cancer.

Production often follows the technology transfer. An example of this is the technology used in the spreading the Assaf[2] hybrid sheep by the author in Palestine in 1980. It was soon learned that this highly productive sheep (in meat, milk and number of lambs) requires a lot of feed to produce economically. The rain fed vetch (called 'beeqa' in Arabic) was introduced instead of feed concentrates to serve as a major sheep feed. Again, the shift to produce vetch although it involves labor in harvesting while green as

2 The Assaf hybrid sheep breed introduced to Palestine by the author in 1980 is a cross between East Friesian and local Awassi sheep with backcrosses which resulted in a hybrid sheep named Assaf which is 5/8ths Awassi and 3/8ths East Friesian. A similar successful hybrid sheep was obtained by Assaf simply breeding Keos sheep of Cyprus on the Assaf breed, resulting in a breed we named Keesaf, which is even more productive than the Assaf hybrid sheep.

well as for bailings, the poverty which prevailed during the Palestinian *Intifadah* (uprising against occupation) and the Israeli carnage and road closures in the area caused the shift away from the expensive imports of feed concentrates to the locally produced water-thrifty vetch crop. The dramatic sheep proliferation of the Assaf hybrid sheep from only a few hundred sheep in 1981 to over 20,000 in 1993 needs to be rekindled and supported.

To highlight the impact of the need to shift to the water-thrifty, highly economic tree crops in order to decrease the need for irrigation waters in the Jordan River Basin countries, the potential for almond cultivation in Palestine is discussed below. In investigating the almond crop and its potential in Palestine, a report on *Immigration, Land Settlement and Development in Palestine* was presented by Sir John Simpson in 1930. This report was presented to the Secretary of State for the Colonies to the British Parliament and indicated that in 1927 there were around 30,000 donums of almonds in Palestine with a large crop export. He also reported that almonds were found to give a return per donum six times that of cereal crops and concluded that almonds serve as a useful culture for the development of poor soils in Palestine.

Over seventy years later, in 2002, the Palestinian Central Bureau of Statistics (2001–2002) reported that there were 64,000 donums of land planted by rain fed almonds in all of the Palestinian areas of the West Bank and Gaza Strip of which only about 16 per cent are of the high quality soft shell almonds which require more pest control and more water. The remainder is of the hard shell varieties, which survive and produce in poorer soils and are less affected by drought, insects, diseases, birds and vandalism. Unfortunately they produce less total net meat almonds than the soft shell types per donum.

Almonds which are unlike the long-lived olive trees that survive for several hundreds of years, do not continue to produce well or survive as healthy trees after forty years or less. Most of the almond trees covering 75,000 donums in the West Bank and Gaza Strip which were reported in a food security study (Assaf and Assaf 1985) were at least 20 years old, and in 2004 these trees were over 40 years old and have become even less productive.

It may be concluded that after about 20 years (1985–2002) that there is a trend for a decrease rather than an increase in the almond orchards in Palestine. This, despite the fact that almond nuts have good local and international markets and are sold at over $ 4,000 per ton wholesale, and double that retail, and are desired both by Palestinian and other Arab consumers. Hence, almonds can be one of the important exportable commodities of Palestine, as well as other Jordan River Basin countries. It is astounding why there is not much more planting of this economic water-thrifty tree suitable for this Middle Eastern environment. A simple answer is insecurity in the whole region. For Palestinians, Syrians and Lebanese, Israeli occupation discourages any medium-term investment, such as almond orchards and especially the soft shell kind, which require intensive care.

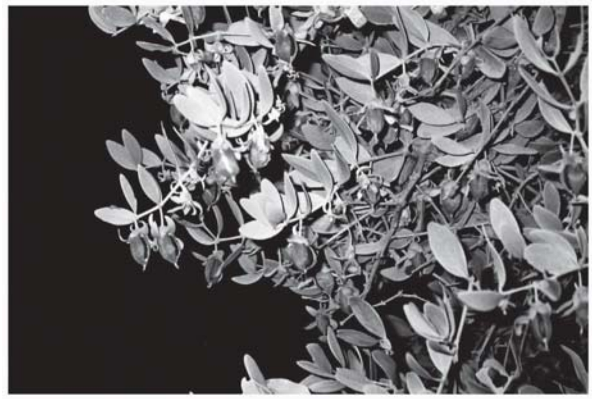
Almonds are not permanent trees living and producing for many years as olives. Almonds need to be renovated by heavy pruning or totally replaced in less than 40 years. In Californian and Israeli almond fields, all are of the soft shell type and are replaced in less than 20 years. Investment in the production of almonds is given here as a good example of a solution for the water deficient Middle East region and for utilizing marginal lands with poor soils. They produce as rain fed tree crops with minimal needs for water and only when possible with some supplemental irrigation. There is justification for large economic assistance and substantial financial investment in almond production in Palestine and the other Jordan River Basin countries since this region imports significantly large quantities of the almonds used in foods or roasted.

A U.S. government trade report (World Horticulture Trade 2001; Almond Board 2004) indicates that Israel and the Palestinian Authority area imported equally in 2003 about 3,000 tons of shelled almonds at a wholesale price of about $ 4,000 per ton, showing the market potential for almonds in the area. In spite of the importance of almond production in the Mediterranean region, the U.S. has become the largest producer of almonds with 2.2 million donums producing over 373,000 tons of shelled almonds in 2002, and exporting 250,000 tons, consuming about 100,000 tons. The countries in the northern Mediterranean such as Spain, Italy and Greece, which each produce on an average 15 to 60,000 tons of almonds, due to heavy local consumption, are also importers of this commodity. Turkey which produces over 70 per cent of the world's hazel nuts, requiring large amounts of water, (which they fortunately have) is not a major producer of almonds. This further illustrates that there is a good market for almonds locally and internationally.

Another important example of shifts in cropping patterns to economic water-thrifty crops that are currently grown in the Jordan River Basin has been in

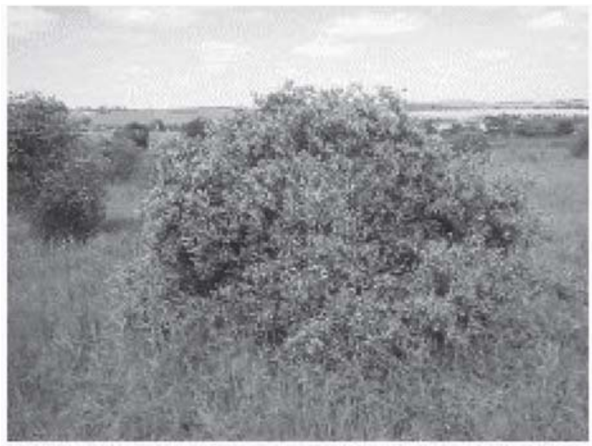
Figure 8.1: Photos of the Jojoba Plant and Plantations in Palestine

Jojoba field near Deir Ghazzaleh - Jenin.



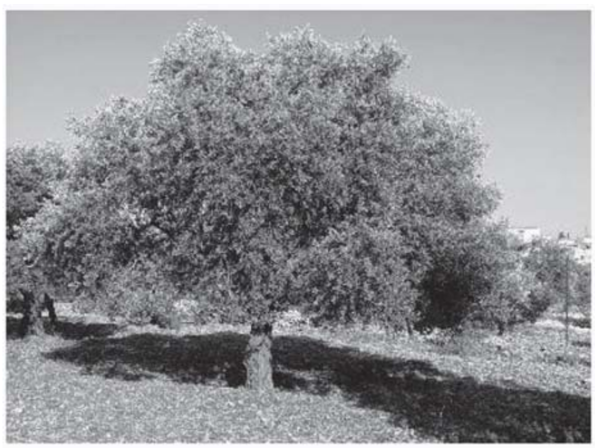
Jojoba seeds (nuts) on a tree in Palestine, August 2004.

Jojoba tree in Palestine, near Arrabeh, Jenin District



Jojoba grown as a bush - in Australia

Jojoba Field in Jordanian Desert near Airport



Olive Tree in Palestine

1982 the introduction and cultivation by this author of the desert type water-thrifty jojoba trees in the West Bank. This was highly successful and currently these trees are producing the high value jojoba oil crop[3] (several times the price of olive oil) in two Jordan River Basin countries, Palestine and Jordan, with 12,000 and 6,000 jojoba trees respectively. Israel has

3 Jojoba oil is used in cosmetics and lubrication and also, as a liquid wax, it can be eaten as a diet oil.

also around 500,000 jojoba trees. As indicated above in table 8.1, the arid jojoba tree produces well with only about 300 mm of water. This includes supplemental irrigation when rainfall is only 150 mm, as is the case in the author's private 70 donum jojoba demonstration farm in the Jordanian desert east of the airport. In this case, another 150 mm is provided by drip irrigation 10 times a year. Jojoba has also been dry-farmed and productive in an area with an average of 300 mm rainfall on a 50 donum plot in Deir Ghazzaleh near the most northern border with Israel. It is also highly productive in the hilly areas of Arrabeh with 400 mm rainfall. The height of most of the 18-year-old jojoba trees in the West Bank exceeds 2.5 meters. Interestingly, the jojoba is also producing fairly well in a small hilly farm plot south of Jerusalem in an arid area with an average rainfall of 280 mm using a horse-pulled plow.

All jojoba plants in Palestine are pruned yearly to the shape of a tree, looking like olives, and thus are different that those grown in Israel, Australia (see photo), Argentina, Mexico and the USA. which are left to grow as bushes. When not pruned, they consume more water, making it difficult to pick and harvest clean organic quality jojoba seeds for pressing oil. Jojoba seeds fall by themselves on the ground in August and are either handpicked as in Palestine and Jordan; or vacuumed up with surrounding contaminants as in Israel, the U.S.A. and in other western countries. Jojoba seeds (nuts) yield about 50 % oil upon pressing.

The introduction of the long-lived, evergreen jojoba trees by this author in 1982 from the USA to the West Bank has been one of the most successful examples for introducing a permanent highly economic water-thrifty rain fed tree crop to the Arab world. It is also an example of the possibilities for success in changing cropping patterns to water-thrifty and salt tolerant crops. The jojoba can grow and produce fairly well using 2500 ppm water with dissolved solids and it has been found growing wild near the seashores in the western parts of the USA.

Last, but most important, is the example of dry-farmed olives, the well-proven long-lived trees withstanding drought for years. In the small area of the West Bank, there are nine million productive olive trees. All are grown under rain fed conditions, among them are trees, several hundred years old, planted by the forefathers of Palestinians during the Roman era and are even called Roman olives. All Jordan River Basin countries (except Israel where farmers irrigate their olive orchards) have olives grown only under rain fed conditions of 380–600 mm rainfall annually.

All these countries, except Israel, are exporters of olive oil to various western countries. They must meet the specifications of the International Olive Oil Council (IOOC 2001) in Madrid, whose reports indicate a great demand worldwide for high quality olive oil. This requires modern laboratories, well-trained and competent chemists, and effective regulations for olive oil grading and specifications in order to be successful in olive oil export. In 1996, this author published a booklet as Head of the newly established Palestinian National Agricultural Research Center detailing specifications, grading and methods of obtaining high quality exportable olive oil. (See also Assaf (1994) on well-suited Nabali Baladi olive (Souri) variety for the arid Jordan River Basin region over a misnamed Improved Nabali variety.)

8.3 Summary and Conclusion

In order to deal with the current and future shortages of water in the Jordan River Basin, successful examples for the cultivation and economic production of certain water-thrifty and salt-tolerant crops were presented. These examples serve as a model for a longer-term water conservation strategy using crops such as almonds to be rain fed or irrigated. They offer a good example to follow in water conservation in the agricultural sector which generally uses over 2/3 of the water resources in the Jordan River Basin. Almond orchard cultivation, as an example, has been practiced in the area for many decades. One report cited almond orchards which have been in existence and productive in Palestine over 90 years ago. Since recent data indicate that there is a good market for almonds in the Jordan River Basin region and worldwide, there is no reason why large investment should not be encouraged in setting-up many well-planned almond orchards under the existing rain fed conditions of the Jordan River Basin countries.

Even though millions of olive trees exist in the Jordan River Basin countries that export olive oil whenever possible, more olive proliferation and an expansion of olive oil production as wells as pickled table olives is recommended. This will be possible if specification, grading procedures are set up and followed for export of the surplus olive oil produced in years of heavy olive production. Olives planted with the meticulous time-consuming terracing in hilly areas in the Jordan River Basin hundreds of years ago are a living proof that traditional water conservation methods and food security can go hand-in-hand for certain water-thrifty crops.

For substantial water conservation, it has been recommended to plant more jojoba trees which are similar to olives but are more drought resistant, which successfully have been introduced to some Jordan River Basin countries. With very low water requirements, jojoba trees produce high value industrial jojoba oil. The success with the jojoba tree encourages entrepreneurs to have an open mind about adopting other plants which could be grown in the region economically with minimal water needs. This could also minimize competition and conflict over scarce regional water resources.

For areas with limited cultivatable land, medicinal plants with their very low water requirements such as thyme have been grown successfully in the Jordan River Basin countries for the last 20 years. Although thyme leaves have been collected for many decades from the mountainous wilderness, this crop has also been successfully grown since the mid-1980s in Palestine, and later on in Jordan, with minimal supplemental irrigation, to satisfy household needs, and for export. For the past 20 years, the small surplus in thyme leaves and jojoba oil have been made possible in Palestine by this author. Other economic medicinal plants were also given as examples for minimal water use in rain fed areas.

Furthermore, animal production, especially sheep, has been a tradition for many years. The new Assaf hybrid sheep, although highly productive in meat and milk, requires a lot of feed. This feed problem has been circumvented and greatly minimized by planting water-thrifty vetch as a rain fed crop

There are many more examples of shifting cropping patterns to water-thrifty economic crops. What is needed is a strategy, planning and funding as well as education and the will to execute such a policy of water conservation and economic development.

References

Almond Board, 2004: *Market News and Information for the Almond Industry* (Modesto, California: The Almond Board of California).

Assaf, S., 1989: "Thyme as a Medicinal Field Crop for the Arab World", Paper and Abstract, Union of Arab Biologists Meeting, Baghdad.

Assaf, S., 1992: *Jojoba as an Industrial Oil-Tree Crop Complementary to Olives for the Support of a Palestinian Economy* (El-Bireh, Palestine: ASIR [The Arab Scientific Institute for Research and Transfer of Technology]).

Assaf, S., 1993: "Dry-farming of Jojoba by Palestinians in the West Bank and Gaza Strip", in: *Jojoba Happenings*, 21,2 (March-April): 4–8.

Assaf, S., 1994: "A Study on the Recent Growing of a Rapidly Propagating Olive Cultivar Mis-Named 'Improved Nabali' and Its Effect on Impeding the West Bank Olive Industry", in: *Acta Horticulturae*, 356; 432–435.

Assaf, S., 1996: *Production and Specifications of High Quality Palestinian Olive Oil* (Ramallah, Palestine: Palestinian National Agriculture Research Center).

Assaf, S., 1997: *Total water needs of water-thrifty crops in Palestine* (Ramallah, Palestine: Palestinian National Agriculture Research Center, The Palestinian Authority).

Assaf, S., 2004: *What is Jojoba and What are its Benefits?* (El-Bireh, Palestine: ASIR [The Arab Scientific Institute for Research and Transfer of Technology]).

Assaf, S.; Assaf, K., 1985: *Food Security of the West Bank and Gaza Strip*. A comprehensive study published by the UN ESCWA/FAO Joint Division and AOAD, the Arab Organization for Agricultural Development, The Arab League (Rome: FAO).

Dyson, T., 1999: *World Food Trends and Prospects to 2025, Proceedings National Academy of Sciences, USA* (Washington, D.C.: NAS Press), 96: 5929–5936.

FAO, 2000: *Information system on water and agriculture, irrigation water use per country in the year* 2000 (Rome: FAO).

IOOC, 2001: The International Olive Oil Council Semi-Annual Reports on Olive Oil Production, Consumption, Specifications and International Trade (Madrid, Spain: IOOC Publications).

Palestinian Central Bureau of Statistics, 2001–2002: *Production of Fruit Trees in Palestine*

Pasternick, D., 2002: *Report on agricultural research* (Beersheva, Israel: Ben Gurion University of the Negev),

Simpson, Sir John, 1930: *Immigration, Land Settlement and Development* (London. UK: The British Parliament Report).

World Horticulture Trade, 2001: *Tree Nut Situation Updates* (Washington, D.C.: U.S. Department of Trade).

9 A Future for the Dead Sea Basin: Water Culture among Israelis, Palestinians and Jordanians

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Abstract

The Dead Sea basin plays a major role for regional economic development (industry, tourism and agriculture) in the Middle East. This potential is threatened by the steady disappearance of the Dead Sea. Since around 1930 the water level of the Dead Sea has fallen by about 25 m, about half of this alone in the last 20 years. The Dead Sea is a transboundary resource shared by Israel, the Palestinian Authority and Jordan. The Dead Sea is the terminal point of the Jordan River watershed and as such, it serves as a barometer for the health of the overall system. Its rapid decline reflects the present water management strategies of the riparian and upstream countries. This includes the different water cultures of the three countries.

Throughout history, the Dead Sea basin has served as a source of refuge and inspiration for followers of Judaism, Christianity and Islam. Today, the religious significance of the Dead Sea is being overshadowed by its rapid disappearance. This may be explained in part by the water cultures of the three countries that influence water policy in the region. Ideology, together with culture and tradition, such as that of Zionism in Israel, has played a central role in water development in the region. In many cases, this has been at the expense of the environment.

Elements pertaining to environmental security and water culture and tradition, whereby a sustainably managed environment provides for social, economic as well as environmental benefits are evident with regards the Dead Sea. The decline for example, undermines its potential as a tourist destination, despite the enormous investment in hotel and resort infrastructures in Israel and in Jordan. The decline also raises ethical issues about the exploitation of water resources by present generations at the expense of this natural heritage to future generations.

This paper provides an analysis of a European Union funded project whose aims are to synthesize and assess existing physical and socio-economic data and to assess options for a better future for the Dead Sea. It will identify the patterns of water supply and use in the region, and the factors that control these patterns, including those of water culture. The underlying assumption is that solutions for a more sustainable development than today scenario will not come from simply providing "more water for more development", but

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from a new land and water management system, indeed ethic, that is sensitive to social, cultural and ecological resources thereby providing security and stability across cultures, economic sectors and nations.

Keywords: water culture, Dead Sea, stakeholder analysis

9.1 Introduction

Both national policy and research focusing on water scarcity in the Middle East take a regional or national perspective, with emphasis in the literature on alternatives to conflict (Postel 1993; Lowi 1993; Gleick 1994; Gleick 1993; Frederick 1996; Flakenmark 1986; Feitelson 2000; Lipchin 1997; Postel and Wolf 2001). Studies have and are being conducted on hydro-economic and hydro-political approaches (Wolf and Lonergan 1995; 1994) or on technological fixes (Hamberg 1995; Gavrieli et al. 2002; Shelef 1995; Segev 1995) as ways of finding solutions to water scarcity in the face of increasing demand. This study explores an as yet little studied, but critical component of the water management system in the region: the influence of water culture on the public's perceptions and attitudes toward water use.

Resource use behavior of local communities is fast becoming realized as integral to the drafting of sustainable resource policy that is advocated at a national level but implemented at a local level. Policies and programs are strengthened when they can account for linkages between local communities and national policy. Increased local participation strengthens resource behaviors that are sustainable by making the policy process more responsive to local concerns. In addition, local ownership, involvement or participation can raise awareness about resource concerns such as that of water scarcity and in so doing make programs more sustainable. A first step in this approach is the assessment of the culture of water that may exist in the region and it's impact on the resource of concern.

Successful employment of preferred policy strategies and technologies will require an understanding of the social environment in which they are to be applied i.e.: the cultural context in which they operate. For example, the social drivers which promote involvement in recycling may vary between households and cultures, and will certainly be different for domestic, commercial and industrial users. In particular, the application of water recycling systems (i.e. the procedure of locating and operating them) within households or communities, can be severely disrupted if some understanding of key factors such as perceived need and benefit and cultural sensitivities towards using recycled water is not acquired (Jeffrey 2000; Jeffrey 2000; Jeffrey & Seaton 1998). Our focus is on the variability in perceptions of, and attitudes towards, water use and the impacts of use on the ecosystem among three water cultures: Israeli, Palestinian and Jordanian, and how this is manifested in the Dead Sea basin..

Understanding the social and cultural dimensions of water use and management are now seen as central to the development of sustainable water management practices (Lipchin 2000; Hellstrom et al. 2000). At a practitioner level, knowledge derived from cross-cultural studies is of increasing relevance to those charged with managing and preserving our natural resources. Indeed, Hoekstra (1998) has suggested that many of the current controversies among water researchers and policy makers can be explained by the existence of different cultural perspectives (Hoekstra 1988). These perspectives differ in their underlying basic values, beliefs and assumptions (perceptions and attitudes). He also points out that many water issues are not only technical problems but are also value laden. Hence, the path toward a solution is more complex than a simple technological "fix".

This is because irrespective of what conclusions the scientific evidence leads to, the impressions and attitudes which the public hold can speedily and effectively bring a halt to any project or scheme (Jeffrey 2000; Jeffrey and Seaton 1998). The issues here are both complex and complicated, having to do with beliefs, attitudes and trust. Furthermore, it is important to expose the public's own agenda for discussing and debating water problems and solutions. By conducting social enquiry at an early stage, we can test how policies and technologies might be received by individuals or groups of individuals. Subsequent feedback into technology or project design (perhaps in terms of appropriate scale, technology or location preferences) can forestall ineffective or inefficient application when the public is an equal partner in the decision making process.

Although the increasingly heterogeneous nature of our societies (at both nation state and regional levels) presents new challenges in managing water resources within a culturally diverse setting, research which can provide guidance to practitioners on such issues is sparse. As Dr. Mahmoud Abu-Zeid, president of the World Water Council has noted:" The cultural and socio-economic values of water are still a very elusive subject" (Abu-Zeid 1998).

Studies of cultural influences on water quality and water use have been carried out since the late 1950's (originally in the USA, but lately in Europe, Central America and Africa). None to this author's knowledge have yet been conducted in the Middle East.

The link between cultural context and attitudes to environmental and technological risk, for example, has been well articulated by Douglas and Wildavsky (1982). A review on the social bases of public concern with environmental quality has been carried out by Van Liere and Dunlap (1980). They examined the explanatory power of several sociodemographic and socioeconomic variables in explaining environmental concern. The results indicate a complex picture where it is not only the young, well-educated and liberal segments of society that display environmental concern (Van Liere and Dunlap 1980). What this and other studies show is that society is more complex than many policy makers care to consider (Jeffrey and Seaton 1998).

In water and natural resource exploitation studies in particular, cultural or ethnic background has been identified as a key indicator of both attitudes and behaviour. In a broad context, Panday (1990) has addressed the cross-cultural psychology of environmental perception and behaviour in an effort to understand how different societies relate to their physical environments (Pandey 1990). The precise influence of cultural variables in individual attitudes towards and interactions with the water environment have been partially investigated by several authors (Murdock et al. 1988; Burmil et al. 1999), highlighting in particular, the multi-faceted role which water plays in arid and semi-arid environments. But studies which look at specific technological applications are few (for a rare exception to this trend see (Fry and Mingledorff 1996)). Ethnicity has been shown to be a predictor of actual water conservation behaviour in the United States (Oliver 1999), with Anglo's responding relatively poorly to voluntary conservation programmes as compared with non-Anglo populations, but equally well to mandatory conservation initiatives. Cultural factors have recently been identified as a key moderator in wastewater reuse for fish farming in Egypt (Mancy et al. 2000).

I argue therefore that projects for sustainability require a holistic and integrated approach that takes into account the overall cultural context in which and by which, water is used. Community measures (income, health, education) and resource measures (quality, quantity, consumption) coupled with the participation and empowerment of local communities (Hoon and Singh 1997) should be the preffered methodological approach in water management.

The aim of this study is to consequently explore how differences *and* commonalties in water culture influence attitudes and perceptions toward water use. The field of study was the Dead Sea basin. The Dead Sea basin is a transboundary resource shared by Israelis, Palestinians and Jordanians.

The study sought to explore the following question: How does one's cultural context correlate with the attitudes and perceptions people hold toward water resources and water use policies in the region in general and in the Dead Sea basin in particular?

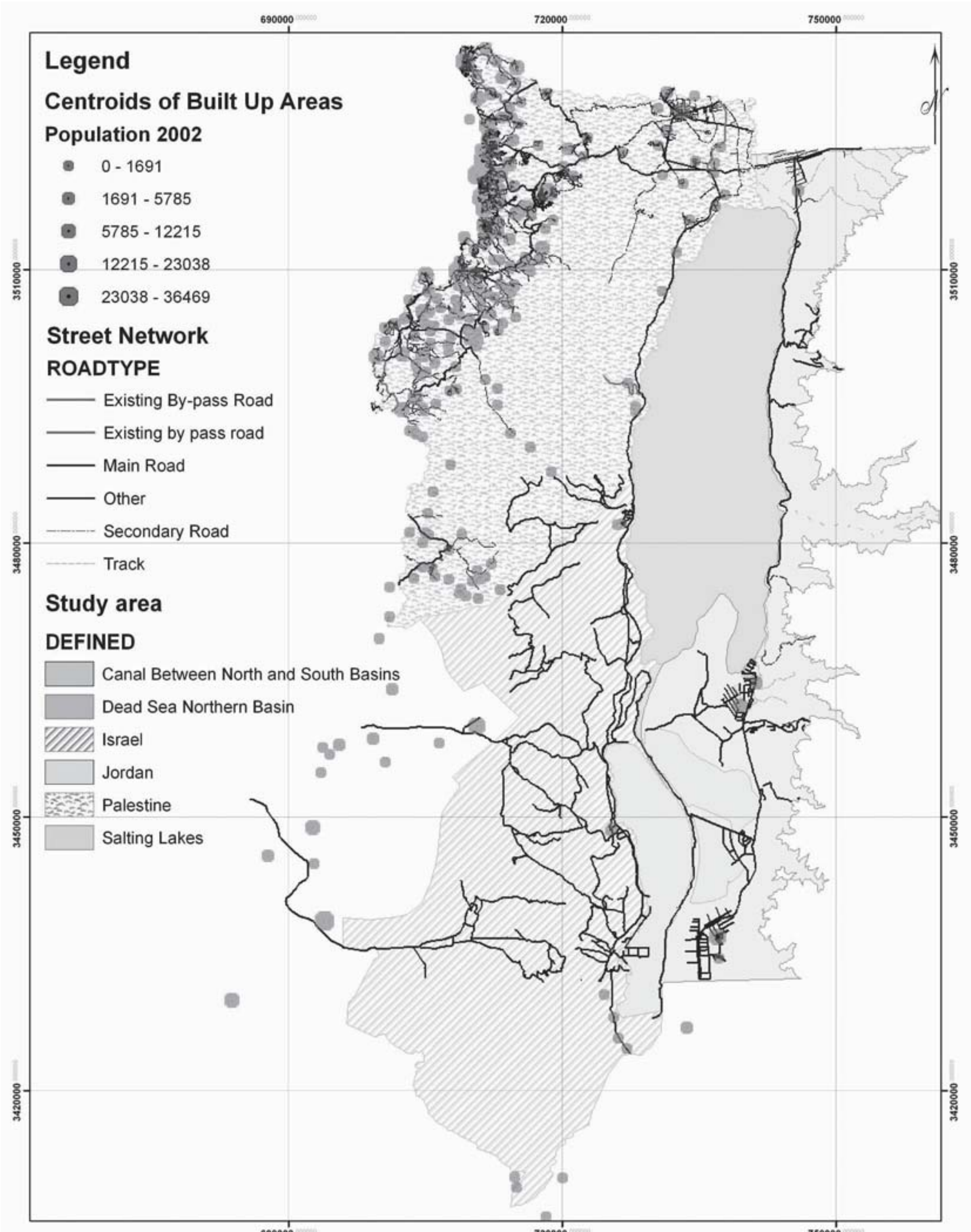
9.2 Study Area

The Dead Sea basin has a size of about 44,000 km² and its watershed is shared by Israel, Jordan and Palestine (figure 9.1).

The basin plays a major role for regional economic development. Current economic activities in the basin are industrial (mineral extraction and water bottling), tourism and agriculture. The Dead Sea's mineral composition and the unique climate provide treatment for skin diseases, especially for psoriasis and atopic dermatitis (Schempp 2000). The health and cultural features plus the unique landscape have made the area attractive for tourism. Besides the regional relevance, the basin has a global importance. Since 1998 there have been efforts to promote the Dead Sea basin as a UNESCO Man and Biosphere Reserve and a World Heritage site (Abu-Faris et al. 1999) because it is a both a unique habitat for wildlife (particularly important around springs and wadis (e.g. Ain Fashkha, Ain Gedi, Wadi Mujib) and a global cultural heritage site with some of the world's oldest human settlements (e.g. the city of Jericho and the mountain fortress of Masada).

The Dead Sea is the terminal lake of the Jordan Rift Valley. Its surface is currently about 417 m below sea level which makes it the lowest point on earth. With a salinity of about 3,000 mg/l it is also the most saline water body in the world (Gertmann 1999). Rainfall is limited to winter months; it varies from about 500 mm/yr in the north-western highlands to less than 100 mm/yr in the valley floor (Al-Weshah 2000). Perennial storage in surface and underground

Figure 9.1: The Dead Sea watershed. **Source**: Dead Sea Project, www.deadseaproject.org.



water reservoirs is limited and vulnerable to pollution and depletion. Potential evapotranspiration in the valley floor is about 2,000 mm/yr, and actual evaporation from the Dead Sea surface is about 1,300–1,600 mm/yr (Stanhill 1984). The temperature is about 40 °C in summer and 15 °C in winter (Assaf et al. 1998). At the east and west there are steep escarpments, while in the north and south, the valley stretches gently upward along the Jordan River and along the Wadi Araba, respectively.

The historical Dead Sea consisted of two basins: the deep northern basin (which is now the only remaining Dead Sea proper), and the shallow southern basin from which the Dead Sea has retreated since 1978. The two basins are divided by the Lisan Peninsula.

Figure 9.2: Decline of Dead Sea water level 1976-2003 (Data from Israeli Hydrological Service)

The land cover is mostly open with little vegetation. Sensitive areas include the Lisan peninsula area, marshlands and wetlands at the northern and southern ends of the Dead Sea, the Wadi Mujib, the Ain Gedi oasis, and the Dead Sea itself (Fariz 2002). Lack of natural freshwater, expansion of human settlements, and inappropriate land use has affected these areas (Gebetsroither et al. 2004).

Waste waters from local domestic, agricultural, industrial and tourist activities flow directly into the Dead Sea. Raw sewage flows into the Dead Sea from Jerusalem-Bethlehem urban areas via the Wadi Nar (Kidron valley). Water shortage and land degradation are a problem all over the basin and these are likely to exacerbate with population growth (Rishmawi and Hrimat 1999).

The most visible and most disturbing degradation is the decline of the Dead Sea water level and volume. Since around 1930 the water level of the Dead Sea has fallen by about 25 m, about half of this alone in the last 20 years (Anati. D.A. & Shasha 1989; Assaf et al. 1998). In the past few years the rate of decline was 80–100 cm per year. The last available data from mid-2003 indicate a water level of -417 m (figure 9.2). As a result of this decline, in the last 20 years the Dead Sea surface area has shrunk by about 30 %, and its north-south extent has shrunk from over 75 to 55 km (Anati. D.A. and Shasha 1989). Since 1978, the Dead Sea has completely retreated from the southern basin, which presently consists only of artificial evaporation ponds used by the mineral extraction industry.

The reasons for this decline are well-known. First and foremost, the decline is a direct consequence of the declining freshwater input: this includes decreasing discharge from the River Jordan, increasing water use from natural springs and side wadis, and extensive use of aquifers that provide secondary water input (Klein 1985). Of all these factors, the River Jordan probably plays the biggest role (Lipchin 1997). It may be said that the Dead Sea's steady disappearance is a direct result of the water management strategies of the River Jordan riparians (Tal 2001). While 100 years ago the River Jordan's discharge into the Dead Sea was about 1,200–1,300 million cubic meters per year (MCM/yr) of freshwater, it has been reduced to about 900 MCM/yr by the 1940's and now is not more than 100–200 MCM/yr of saline and polluted water (Orthofer 2001; 1994; Al-Weshah 2000; Orthofer et al. 2001; Rabi 1997 ; Shavit 2001). The main reason for this decline is that water from the Upper Jordan River as well as water from the Lower Jordan River tributaries (e.g. Yarmouk, Zarqa) has been

Figure 9.3: A series of sinkholes on the exposed shoreline on the western shore of the northern basin of the Dead Sea (Photo: Clive Lipchin).

blocked and diverted for urban and agricultural uses inside and outside the watershed by the basin riparians.

On top of the reduced freshwater input, more than 200 MCM/yr water are pumped out of the Dead Sea into evaporation ponds in the shallow southern basin. It is estimated that the salt industries contribute 25 to 30 % of the present total evaporation rates (Wardam 2000).

It is not clear whether the Dead Sea water level has now come to equilibrium between the reduced surface and a reduced evaporation, or if it will continue to decline. As a result of the lowering of the water level, the adjacent aquifers are seriously affected (Yechieli 1996). Sinkholes have opened up along the shoreline, caused by lowered water tables and groundwater over-exploitation (Baer et al. 2002; Bowman et al. 2000). These sinkholes are a serious threat to infrastructure around the basin and have essentially halted future development plans such as the building of new hotels (figure 9.3). Furthermore, the decline of the Dead Sea also affects the freshwater springs on its shores (e.g. Ain Fashkha and Ain Turiba) that support a unique biodiversity (Friends of the Earth Middle East 2000; EcoPeace 1998). The decline of the water level has also had a serious effect on tourism due to the disappearance of the shoreline close to the hotels.

Without some form of intervention, the current trend is expected to continue with potential disastrous effects for the future. The growing population in all three countries will increase the pressure for the freshwater that currently remains unused. The possible re-settlement of returning Palestinian refugees will also increase demand in Palestine. Palestinians demand as part of a regional water agreement that more water should be allowed to the Lower Jordan River and that this additional water should be usable for the Palestinian population. This, of course, means that the Dead Sea would not benefit. The declining Dead Sea undermines the potential as a tourist destination, despite the enormous investment in hotel and resort infrastructures in Israel and in Jordan. Over the next few years, there are plans for further tourism and industrial development including the construction of over 50,000 new hotel rooms (Meunier 1999). For the fledgling Palestinian economy, the present state of the Dead Sea suggests that Palestinians may never have the opportunity to develop what should have been one of their more attractive tourist locations that could provide critical employment to a growing workforce.

In all three countries, development policies have disregarded impacts on the environment, indigenous people and small farmers. Essential water needs for nature were neglected; policies lacked incentives to promote local forms of environmental security and equitable access to natural goods and services. Water is increasingly allocated to the urban sector and to large-scale agriculture at the expense of the needs and rights of the rural and indigenous people. Consequently, the rural poor and indigenous are overexploiting land resources to sustain their livelihoods.

Furthermore, the decline of the Dead Sea raises ethical issues regarding the exploitation of present generations of water resources at the expense of the natural heritage in the future. Many would argue that it represents an intolerable violation of the rights of future generations.

Nonetheless there is concern in the region about the threat of a disappearing Dead Sea (Coussin 2001; EcoPeace 1998), but very little progress. Most options for solving the environmental and economical problems focus on the provision of "new water from outside", particularly through the building of a canal that will connect the Red Sea with the Dead Sea ("Red-Dead Conveyance Project") (Gavrieli et al. 2002). This is a classical technological "fix" solution indicative of a centralized management structure with little public involvement. Both Israeli and Jordanian governments support this type of option (recently, the Israeli government has shown less enthusiasm as it explores desalination plants on the Mediterranean coast). This 240 km conduit is expected to replenish the missing inflow from the Jordan River through brine discharge from desalination, use the gravity pressure for desalination through reverse osmosis for drinking water, and for production of electricity. Costs are estimated to be around 3 billion dollars (Pearce 1995). Financing for the project may come from the World Bank. Among the questions which remain unclear are the environmental impacts of the canal, e.g. the chemical changes of the water and the economic viability of the project.

This study seeks to go beyond the centralized and technological approach to saving the Dead Sea by approaching the problem from a more holistic and inclusive perspective. It seeks to find out from the public (residents of the Dead Sea basin) where they stand on the issues. What are their needs and priorities? What is important to them and what alternatives are they willing to support? The study also seeks to understand how one's social context influences one's perceptions and attitudes towards the declining water levels of the Dead Sea basin. In other words, how does a society's water culture shape how a society approaches an issue such as that of the disappearing Dead Sea. In responding to the crisis in the Dead Sea basin one needs to examine the historical context of how each riparian's water culture evolved and in what direction it is headed in the future. This socio-cultural approach is valuable to policy makers in providing clues on what types of interventions and programs may elicit society's acceptance or rejection.

9.3 Water Culture in the Dead Sea Basin

9.3.1 Water Culture in Israel

With at least 60 % of water going to agriculture in Israel, its unique role in local Israeli culture and heritage must be understood and the practical manifestations integrated into an assessment of water culture in Israel. Agriculture has historically enjoyed a privileged place among Israeli decision-makers. Explanations for this were somewhat self-evident during the 1950s and 1960s when agriculture provided some 30 % of the country's GNP and most of the top political leadership had either immediate or historical connections with agricultural communities (Hillel 1994).

Zionism, the nationalistic ideology of the Jewish people always elevated agricultural pursuits, encouraging "pioneer" immigrants to establish new settlements. A variety of philosophers, most notably A.D. Gordon, espoused a Tolstoyic perception that only through work connected to the land and soil could personal redemption be achieved (Tal 2002). Among agriculture's additional merits that were traditionally cited are: its contribution to "food security," as a means of self-sufficiency, its role in stymieing land claims by Arabs (in particular Bedouins), establishing territorial claims in the periphery of the country and in the past, socialising new immigrants and reducing unemployment.

This ideological and cultural bias provides some explanation for present water policies, which today are frequently inconsistent with economic and environmental considerations (Lipchin 2003). To begin with, the economic contribution of agriculture to Israel's economic profile has fallen to 3 % of GNP and 2 % of overall employment. Crop subsidies nevertheless remain high for certain crops. Large-scale water diversions for agriculture have also left a hydrological legacy of dry streams and depleted aquifers (Lipchin 2003 and Zaslavsky 2002). None more so is the National Water Carrier that diverts water from the Sea of Galilee in the northern part of the Jordan river watershed to the south of the country for irrigation. This large scale diversion scheme plays an important role in reducing the flow of water in the lower Jordan and hence the amount of water that can reach the Dead Sea.

Part of the reason can of course be attributed to the political elites who continue to dominate governmental decision-makers. Senior politicians and government officials are disproportionately affiliated with the agricultural sector, affecting their decisions about water allocation, pricing and distribution. The political patronage of Israel's top leadership to agricultural interests continues and they remain protected in recent years regardless of party affiliation. For example, past Prime Minister Ehud Barak, a "leftist" politician, was raised on an agricultural kibbutz, while recent Prime Minister Ariel Sharon, head of a "right-wing" party makes his home on a ranch in the Negev. Recently, a plan by the Israel Treasury to raise water prices by 70 % for the agricultural sector was tabled after intervention from the Minister of Agriculture.

While the general public is increasingly urban in its domicile (over 90 % of the population in Israel live in moderate to large cities) Zionist's veneration of ruralist living remains a critical factor in the water culture of the national psyche. This is true from an ideological perspective, with farming still considered among the more admirable (albeit barely profitable) professions. Youth movements, a critical socialisation factor for large segments of upper-middle class Israeli youth, still spend considerable time in summer work camps in agricultural communities.

Agriculture also holds a place in the national aesthetic psyche. A recent study by Fleisher et. al. (2001) from the Hebrew University in Jerusalem based on a "willingness to pay" survey suggests that the value for passive use (among tourists) for agricultural production in Israel's Jezreel valley and Israel's Huleh valley exceed the actual production amounts. This is not inconsistent with similar preferences in England, which has protected its bucolic countryside with legislation to subsidise rural landscapes. Quite simply, Israelis like farms, and farmers have convinced decision-makers (and to a certain extent the public at large) that the resulting prodigious water consumption is justified (Lipchin 2003).

Hence, it can be argued that there are dominating "ideological and cultural" factors that explain the country's ongoing commitment to agriculture and that by association, water is just too valuable to flow freely in the country's rivers and streams. By this logic, the price now being paid by the Dead Sea is due to the veneration of water for agriculture among all other needs. Within this context however, the agricultural sector has increasingly come to understand that fresh water is a scarce resource that will be largely replaced by treated wastewater and desalination. At the same time, the growing of certain crops may become prohibitively expensive or impossible due to the salinity levels in effluents and available brackish waters (Schwartz 2001). The transition to drip irrigation for many crops from the 1970s onward has allowed many Israelis farmers to maintain productivity even as actual allocations were cut periodically.

Reductions in allocations of water to agriculture were primarily enacted in the face of droughts but also reflected a growing domestic demand for water. The adaptability of Israel's agricultural sectors and the relatively consistent fluctuations in allocations over the past decade confirm that while agriculture's general support is fairly unquestioned, the actual quantity of water consumed is open to change and influence of additional factors. In fact, recent data show that water consumption in agriculture is declining.

Table 9.1: Potable water consumption by purpose in percentages. **Source**: Israel Central Bureau of Statistics, 2004

	1983	1993	2003
Agriculture	71	64	56
Domestic	23	29	38
Industry	6	7	6
Total	100	100	100

Not only the actual magnitude but also the form of the agricultural community's water portfolio can be considered a dynamic factor. Past experience suggests that it is a nimble sector that has frequently changed its crop profiles in order to exploit market opportunities or to respond to the agronomic constraints posed by different water qualities. This same flexibility can be seen in its utilisation of wastewater, which as already mentioned provides it with a growing percentage of its hydrologic needs (table 9.2). Cultural resistance to wastewater, that has been an obstacle to its utilisation in certain Arab societies, constitutes less of a barrier among Israeli communities. Although the use of wastewater for domestic purposes has been shown to be unpopular (Lipchin 2003). The amount of fresh water (potable) being consumed by agriculture is declining somewhat, although the savings of fresh water in agriculture are being rapidly consumed by the growing domestic sector.

From an empirical perspective, the primary factors that can be associated with any reduction in agricultural productivity, and hence water, involve land con-

Table 9.2: Water production in agriculture by type in percentages. **Source**: Israel Central Bureau of Statistics, 2004

	1993	2003
Potable	71	56
Effluent	12	24
Brackish	6	11
Surface	11	9
Total	100	100

version. For many years, the powerful stature of agriculture in Israeli political culture was bolstered by the Planning and Building Law (1965) that gave agricultural zoning preference as a "default" to any land that was not designated otherwise. During the 1990s, a series of decisions changed that and led to a softening of zoning lines, which had previously locked farmers into agricultural usage. At the same time, economic conditions and high inflationary loans pushed many farmers to take advantage of the new "speculative" opportunities and sell out (Feitelson 1997). This transformation can be seen in such regions as the Sharon and Galilee. It also changed the perception of farmers among environmentalists, who increasingly valued agriculture as a hedge against urban sprawl.

Israel's national water management system since its inception has been designed to subsidise agricultural production. Water prices constitute one of the clearest economic manifestations of the aforementioned ideological commitment to agriculture. Under Israel's Water Law (1959) farmers pay a low-base price for the first 50 % of their water allotment. The price increases for the next 30 % and 20 % respectively. Water prices for water with high concentrations of salinity or effluents can be as much as 100 % cheaper. This provides a disincentive to water conservation, as low-grade saline water is cheap to use. Urban uses can be charged as much as eight times more. In recent budgets, the cost of water subsidies has been roughly 73 million dollars (U.S.). As one commentator explained, frequently, the most expensive water that is actually delivered will be priced at the lowest level (Plant 2000).

In the past, drops in domestic water use came through moral suasion. When the Israeli public was convinced that the water shortage was acute and genuine, it responded by reducing their consumption. Lawns were dried up and even cemented over, shower times shortened, and water saving devices installed in bathrooms etc. The agricultural sector was also politically more willing to accept water allocation reductions. For example, when Israel's Supreme Court disqualified spartan water quotas issued by Water Commissioner Dan Zaslavksy in the early 1990s, left with little alternative he made a direct appeal to the public. Given the three successive years of drought that had depleted and overdrawn Israel's fresh water resources considerably he asked Israelis to cut back. The public responded positively. Subsequent to Zaslavksy's request, some 10 % drop in overall use was recorded (Tal 2002). Albeit, this drop was temporary, as the following above average rainfall years resulted in cut backs to be withdrawn.

In other areas, Israelis have shown a great willingness to pay for public natural resources when they felt they were threatened, their crushingly high tax burden not withstanding. For example, in the wake of arson in the Carmel forests, citizens made substantial donations to telethon campaigns designed to cover the replanting expenses (Shechter 1996). Entrance fees to nature reserves and parks have not excessively deterred visitation rates. As the availability of desalinated water increases, Israelis will, for the first time be able to manifest their "willingness to pay for water," with a potentially unlimited supply of water, but for a price. Here, societal support for alternative users of water (nature, agriculture) can be expected.

Ironically higher rainfall may have an important role in influencing this particular factor. That is to say, when there is drought, the predictable efforts to galvanise the public to reduce water consumption have varying degrees of success, depending on the integrity of the appeal and the message. During wet periods, however, while there are basic infrastructure improvements (for example dissemination of two tank toilets, etc.) there is less of an actual appeal for restraint and conservation and the issue of demand management remains tucked far away from public consciousness. In other words, a crisis management response dominates the public's behaviour. The challenge is to convert this response to a sustainable one that pre-empts crisis rather than responding to it.

In sum, the water culture in Israel is driven by the hegemony of agriculture that is rooted in Zionist ideology. Demand management and conservation are retroactive and are short term responses to crises and not proactive and long term. Supply side management dominates with special attention being focused on technological panaceas to the water crisis such as the building of desalination plants on the Mediterranean coast and the proposed Red-Dead Conveyance project already discussed above.

9.3.2 Water Culture in Palestine and Jordan

There are several objective differences between the water resources in the Palestinian and Jordanian sectors and those in Israel. The most obvious one involves absolute quantities of available water. Israel currently has the upper hand in control of both surface and ground waters of the Jordan River watershed. At the same time, water delivery infrastructure in Jordan and Palestine is not as developed as it is in Israel. This means that water quality is not a high concern in Israel but it is for Jordan and Palestine. The discrepancy in both water quantity and quality is an important factor in the water culture of Jordan and Palestine. The consumption patterns of water by Palestinians is thus due in part to political constraints (Hosh 1995). The most basic disparity between Israeli and Palestinian attitudes towards water can be traced to how much they receive, or "per capita" allocation rates. The average Israeli consumes roughly 350 cm/year while Palestinians roughly 100 cm/year .

Table 9.3: Water consumption in Palestine in percentages. **Source**: Palestinian National Information Center

Use	1995	1996	1997	1998
Domestic	44	45	48	44
Agrarian	56	55	52	56
Total	100	100	100	100

Table 9.4: Water consumption in Jordan in percentages. **Source**: Shannag and Al-Adwan, 2000

Sector	1985	1989	1995	2005
Domestic	24	25	22	22
Agricultural	76	75	78	78
Total	100	100	100	100

In absolute terms, agriculture is a far smaller consumer of water in both Jordan and Palestine than in Israel. The division between domestic/industrial and agricultural usage is roughly 89 MCM for agriculture with 57 MCM for the domestic sector, ironically making Palestinian agricultural a *relatively* greater consumer of water than the Israeli sector. Of course the water management profile of agriculture in the West Bank is completely different than in the Israeli sector. For example, irrigation techniques in the West Bank do not rely on capital intensive drip systems, although this depends on the region and crop. Indeed, traditional Palestinian reliance on rainfall and streams, and lack of an irrigation-based agricultural sector is considered by leading Palestinian experts to be an ecological advantage (Assaf 1994).

Another difference is the relative contribution of surface water to overall resources. Roughly 70 % of Jordanian waters (747 MCM) is surface waters with only 389 MCM coming from groundwater while there are some 527 known springs in the West Bank, providing roughly half of domestic consumption. As these springs historically were not regulated by the Israeli authorities, historic rights remained in force. Some 67 % of these streams are utilised – roughly two-thirds by agriculture in the West Bank with the other third used for domestic purposes. Wastewater reuse in Jordan is still fairly minimal. As of 2000 wastewater generated only some 13 percent of the 521 MCM being utilised for irrigation in agriculture, largely for trees and fodder (Al-Shreideh 2000).

The enormous magnitude of lost water to delivery systems has been documented in a number of contexts (Palestine Hydrology Group 2000) with as much as 30 % loss of local waters attributed to leaky pipes (Palestine Academic Society for Study of International Affairs 2002). Jordan suffers from similar problems with frequent pipe bursts and seepages through ageing water systems considered a major source of water loss (Khatib 1998). While theoretically, this problem falls in the technological rather than the social realm, clearly expanding water efficiency in the municipal sector through investment in infrastructure is driven by social/political considerations. For example, the hesitancy of Palestinians to rely on Israeli technology as this may indicate recognition of Israeli sovereignty of water resources in Palestinian territory.

In general, the relative scarcity of water (both in terms of quantity and quality) in Jordan and Palestine drives local perceptions and attitudes towards this resource. An additional factor driving attitudes is the traditional use of water in some villages in the West Bank and Jordan. Where local control of water still remains, water allocations for agriculture are socially determined. Unfortunately, these systems are under threat as centralised authorities such as the Palestinian Water Authority begin to assume control. Further, the dominant role of political instability and the recent Intifadah within the day-to-day reality of Palestinians has enormous manifestations within the social dynamics of this society regarding water. In fact, it is a key element in the water culture of Jordan and Palestine due to the hegemonic position of Israel.

While Israelis are vaguely aware of the geopolitical conflict in the area as a source of tension regarding water allocations, these issues are extremely high in the perceptions of Palestinian communities. The Oslo accords brought with them a spate of public works projects, largely American funded, with the goal of strengthening the water infrastructure of the West Bank.

The impact of the military activities of the Israel Defence Forces (IDF) on water infrastructure is frequently cited as exacerbating a situation that was already extremely deficient. The freezing of critical water infrastructure projects (e.g., the sewage treatment plant in Hebron or Sulfit) as a result of the present hostilities suggests that to a large extent there is justification for linking water policies with the broader context of Israeli-Palestinian relations. In a word, for the West Bank, the present round of hostilities affects everything, with water management and perceptions of water issues being no exception.

During periods of curfew, water delivery becomes a critical issue for all Palestinian citizens, regardless of socio-economic class. Basic access to drinking water becomes the primary focus of households. Showers and personal hygiene are delayed so as not to waste valuable water. As bottled water is too expensive for most of the population, tap water (or delivery in trucks for the 200 villages that remain without running water) is the critical resource, and during summer months, supply is sometimes interrupted.

As such, Palestinians tend to blame Israel for water scarcity problems. A pervasive sense of injustice in the allocation of water resources is a common feature of almost all Palestinians' personal ideology, regardless of the individual's political or theological inclinations.

While the Jordanian population has less direct contact with Israelis and its water resources, for many years geo-political forces have only indirectly or "historically" affected them. Hence while their attitudes on the subject are less passionate, there are varying degrees of blame apportioned to Israel and their upstream neighbour, Syria for the shortages. Overall scarcity constitutes the basic common factor in Jordanian perceptions. There is of course, a solid objective basis for this. With water delivery in Amman only reaching homes once a week in many neighbourhoods, significant planning is necessary to meet basic domestic needs (laundry, hygiene, cooking, etc.).

Cisterns and storage of rainwater constitutes a basic element in many Palestinian and Jordanian homes. This direct involvement by citizens offers a constant reminder of perennial shortages. In other words, the citizens experience in generating their own water, makes them appreciate the resource and they are acutely conscious of its value as opposed to residents of Israel that are buffered from personally experiencing scarcity due to efficient water distribution infrastructure.

With scarcity dominating local perceptions, other uses of water are often perceived as frivolous or irrelevant. For example, should a conflict between nature and human needs arise, the acute shortage among Palestinian and Jordanian communities makes concern for natural values, such as that of the Dead Sea, considered to be a "luxury" with the expansion of supply for basic human needs considered to be the pre-eminent priority in discussions. A peace treaty that included a redistribution of water for the region that included allocations for nature (as well as generating expanded supply) may be able to change this perception by leveraging a parallel increase in water allocations to consumers in Jordan and Palestine.

Water prices are set at an artificially low level in Jordan and Palestine in order to ensure universal access, regardless of economic capabilities. Bottled water, although widely available in stores, is only utilised by a small percentage of the local population due to the high (relative to income) associated costs. Tap water is sufficiently expensive, and unavailable to justify a variety of "collection" activities by local populations in both Jordan and Palestine, where individuals drive to springs or private treatment centres and fill up containers.

Farmers typically do not pay for water at all in either Jordan or Palestine. Stream-supplied irrigation is received free of charge, due to the persistence of historical rights. This suggests that any direct expenses assigned to them for water usage will have an immediate affect on their agronomic decisions.

Water conservation is a highly developed ethos in both Palestinian and Jordanian societies whereas it is lacking in Israel. Regulation of agricultural utilisation is often done by social pressures, with the wasting of water considered to be an inappropriate behaviour which brings with it social repercussions.

The government in Jordan has invested considerable energies in promoting conservation practices and the public has been largely responsive. Calls for installation of water saving devices in toilets, baths, showers and sinks have been effective.

Unlike Israel where there exists a certain level of animosity towards the agricultural sector for "wasting" limited water resources, Palestinian and Jordanian farmers do not appear to be the subject of resentment by their urban countrymen. The general public is aware of the poor quality of effluents, which are occasionally used by the agricultural sector, and tends to have an "inflated" view of its contribution to irrigation supply. As such, most city-dwellers have little desire to "compete" for these sources of water.

Moreover, there is no "perceived" agricultural lobby driving public policy in water in these sectors as it in Israel. In fact "agri-business" in Jordan is likely to exert considerable influence on the thinking of the Minister of Water and the Minister of Agriculture. The poorly organised subsistence farmers (fellahin) are less likely to wield direct influence in the corridors of power, but at the local level they can be a powerful force (Trottier 1999). In either case, the political process in Palestine and Jordan does not lend itself to making water a "hot" political issue in the domestic context, if for no other reason, because of the issue's public persona as one of many areas of conflict involving Israel.

There are great gaps in the availability and quality of water in both Jordanian and Palestinian societies. Palestinian communities without access to running water are typically more indigent and rural. More importantly, they are more vulnerable to contamination of springs, which provide a sole source of water for the at least 200,000 people in these villages. There are growing number of reports of utilisation of polluted streams by Palestinians, notwithstanding their classification as a resource unfit for consumption.

In Jordan it is more difficult to generalise regarding the rural sector. In the area of Ghor Safi on the southern shore of the Dead Sea, for example, where subsistence farming provides most of the livelihood, water quality is relatively poor. It has been suggested that there is an attempt to provide "reverse discrimination" to balance overall economic inequities. Hence, the poorer sections of East Amman are thought to receive water of better quality than the wealthier sections because they have the option of purchasing bottled water as an alternative.

Historically, personal gardens have never been an important factor in the household sector for most Palestinians and Jordanians. Although in West Amman there are irrigated lawns, these are limited to among a very select, affluent sector, and as the phenomenon remains marginal, their contribution to overall consumption is minimal.

9.4 Residents of the Dead Sea Basin

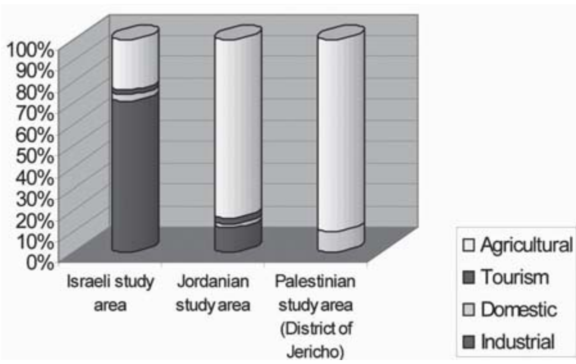
Israelis, Palestinians and Jordanians reside within the Dead Sea basin. The three publics differ culturally, economically and politically which in turn influences their water culture. The Israeli public has by far the lowest population density within the basin. The total population of residents is approximately 1,500 individuals. The majority of the residents reside in agricultural settlements (kibbutzim or moshavim in Hebrew). The region is divided into two regional authorities. The southern Tamar regional authority is located within Israel's pre-1967 borders whereas the northern Megillot regional authority is beyond the post-1967 borders. Any peace agreement with the Palestinians will most likely result in a shift in Israeli demographics in the basin. Date farming for export is the most profitable agricultural activity. Food crops, primarily vegetable crops, are also grown. The largest industrial activity, located at the southern basin, is the Dead Sea Works which extracts minerals from the Dead Sea and is the world's fourth largest producer and supplier of potash products. Tourism is also an important contributor to the local economy and is well developed with a string of high class hotels along the western shore of the southern basin. Most of the employees of the Dead Sea Works and of the hotels however, come from outside of the basin.

The Palestinian population in the study area resides in urban and rural communities as well as in refugee camps. The total Palestinian population in the study area as of 2002 was 512,238. Most of the communities are located in the western part of the Dead Sea basin, whereas the eastern part is sparsely populated. Economic activities are local scale agriculture including livestock farming (sheep and goats), stone quarrying and olive oil pressing. Manufacturing and service related industries are practiced in the urban centres.

On the Jordanian side of the Dead Sea population estimates are approximately 54,000 people. Rural farming is the dominant activity. Both fruits and vegetables are grown. According to land area cultivated: lemons, olives, tomatoes and beans are the dominant crops. The rural farming community is estimated at 53,000 people. The Arab Potash Company is located at the southern end of the Dead Sea and produces similar products to that of the Dead Sea Works in Israel. The company employs 300 people who live on the premises. There are also three hotels located on the northern basin on the Jordanian side of the Dead Sea.

Water consumption by sector varies for the three riparians. The dominant sector in Israel is the industrial sector, primarily that of the Dead Sea Works. In Palestine and Jordan agriculture is the dominant sector (figure 9.4).

Figure 9.4: Water consumption by sector in the Dead Sea basin. **Source**: Elisha, R, 2006



The variability in water use across sectors and countries of the basin poses a challenge for integrated water management. It is therefore essential that as a first step towards integration a stakeholder assessment is carried out.

9.5 Assessing Local Attitudes Towards Water Use in the Dead Sea Basin

The following is an exploration of water culture at a local level among the three nationalities of the Dead Sea basin with an attempt to compare the degree of conformity of local attitudes to national positions. This analysis is also of value to any decision support system for integrated water management in the region. The research was conducted using two instruments. The first was a survey questionnaire targeted at the residents of the Dead Sea basin in Israel, Palestine and Jordan. The second was a series of focus group meetings (FGMs) with a select group of stakeholders in the region.

The survey data are meant to assess the public's point of view on the decline of the Dead Sea. However, caution must be exercised in interpreting the survey data due to the fact that people may interpret the questions posed by the survey differently, many people may lack sufficient knowledge to answer a question correctly or truthfully and many biases that may influence how a person responds may be present and often unavoidable. This being said, surveys can provide some insight on where the public stands on an issue and what they may be willing to accept and/or reject. The data therefore are of use as they help frame the debate on an issue.

Focus groups are a powerful means to evaluate where a particular group stands on an issue. A series of meetings with a select group of stakeholders were held across the basin to provide a more in-depth look into the fate of the Dead Sea. The FGMs were held over a period of seven months. The FGMs were held respectively in Israel, Palestine and Jordan. The FGMs were facilitated by an expert facilitator and were conducted in the local language (Hebrew for Israel and Arabic for Palestine and Jordan).

A total of seven FGMs took place: two in the West Bank with representatives from the governmental, non-governmental and research/science sectors, and farmers, three in Jordan with participants from the private, research/science and governmental sectors, and two in Israel with representatives from the farming and kibbutzim communities, governmental representatives and NGOs. The Jordanian FGMs offer a more complete sample of the interests and opinions held by the various stakeholders involved as participants from all the sectors involved were present. The views expressed the attendees were summarized according to the following topics:

- Water Shortages – General Perceptions
- State of the Dead Sea
- The Role of Agriculture
- The Red Sea – Dead Sea Canal
- New Water Investment
- Cooperation

9.6 Survey Results

The survey instrument consisted of a combination of dichotomous choice and close-ended questions to address (a) water use and consumption habitats, (b) knowledge of water supply and demand infrastructure in the Dead Sea basin, (c) support for conservation practices and willingness to pay for such practices and, (d) the importance of international cooperation in future management of the Dead Sea.

The dichotomous choice section on water use and consumption habitats used a 5-point Likert scale (1 for strongly agree to 5 for strongly disagree with 3 being neutral). The other sections of the questionnaire used close-ended questions. Responses were coded for statistical analysis. The final section of the questionnaire gathered socioeconomic and sociodemographic information from the respondents. Pre-testing of the survey was conducted with an expert evaluator from Tel Aviv University. The questionnaire was translated into Hebrew and Arabic with slight variations in survey design according to cultural norms. A group of volunteers, residents of the basin, and supervised by the author, disseminated the questionnaires to the residents who were asked to fill out the questionnaire and return it the next day. A random representative sample of both urban and rural residents of the basin were selected (table 9.5). Cross-cultural analyses were conducted among Israeli, Palestinian and Jordanian respondents.

Table 9.5: Population Surveyed in the Dead Sea Basin*

Country	Population	Sample Size
Palestine	512,238	741
Israel	1,408	176
Jordan	53,300	623
Total	566,946	1,540

*Population sizes were independently selected by experts from the three countries

A series of statements were posed to respondents on their water use habits, their attitudes to the shrinking Dead Sea and the importance for transboundary cooperation to save the Dead Sea.

According to the statement: Most families use more water than they need, most respondents from all three countries acknowledged they uses more water than was perhaps necessary. However, close to a third of Palestinians and Jordanians disagreed with this statement whereas less than a third of Israelis disagreed (table 9.6).

Table 9.6: Most Families Use More Water Than They Need

Most families use more water than they need			
	IL	PA	JO
Agree	74	73.2	69
Neutral	12	3.6	3
Disagree	14	23.2	28
	100	100	100

A corollary to the above statement was what people thought about their availability of their local water supply. For all three countries people were relatively evenly split between confidence in local water supply meeting current needs versus mistrust in local supplies meeting the communities' needs (table 9.7).

Table 9.7: There is Enough Water to Meet Your Community's Needs

There is enough water to meet your community's needs			
	IL	PA	JO
Agree	49	36.6	34
Neutral	13	15.8	13
Disagree	38	47.6	52
	100	100	100

In terms of being able to reduce the amount of water people use, over 50 % of respondents from all three countries admitted that this would be difficult to do. Approximately 30 % of the respondents said that their household water use could be reduced (table 9.8).

Table 9.8: It Would be Difficult to Reduce the Amount of Water Used in Your Household

It would be difficult to reduce the amount of water used in your household			
	IL	PA	JO
Agree	54	56.8	55
Neutral	13	9.5	10
Disagree	33	33.7	35
	100	100	100

The above statements reflect that although there are differences in national water cultures, at the local level in terms of household water use, these differences are less apparent.

The following statements attempted to reflect the resident's perception on the state of the Dead Sea..

Table 9.9: Declining Water Levels are a Cause for Concern

Declining water levels are a cause for concern			
	IL	PA	JO
Agree	93	85.1	83
Neutral	6.1	6.2	6.6
Disagree	1.2	8.7	11
	100	100	100

According to table 9.9 the vast majority of residents across the basin all agree that the declining water levels of the Dead Sea are a cause for concern. Going deeper, how do people think about available water supplies in the region to meet demand both now and in the future for agriculture, industry and domestic needs?

Table 9.10: There is Enough Water in the Dead Sea Region to Support Agriculture Now and in the Future

There is Enough Water in the Dead Sea Region to Support Agriculture now and in the Future			
	IL	PA	JO
Agree	23	32.3	44
Neutral	25	30.9	21
Disagree	52	36.8	34
	100	100	100

According to table 9.10, approximately 50 % of Israelis believe that there is not enough water to meet the needs for agriculture whereas Palestinians and Jordanians mostly either agreed or disagreed with this statement. Tentative conclusions to be drawn are that Israelis are more aware of the status of water availability in the region but also that their water consumption for agriculture is greater than in either Palestine or Jordan.

In terms of water needs for industry, all residents mostly agree that water supply will continue to meet water demand (table 9.11). This result may reflect the economic importance attributed to the industrial sector in the basin, at least for Israel and Jordan. The importance of the mineral extraction industries in the basin cannot be underestimated both in terms of their economical importance to the countries but also in their impact on the Dead Sea. The evaporation ponds managed by the industries contributes to an increase in the evaporation rate of the Dead Sea, exacerbating the water level decline of the sea. It will be imperative for any integrated management plan to include directly the industrial stakeholder community in the future management of the basin.

Table 9.11: There is Enough Water in the Dead Sea Region to Support Industry Now and in the Future

There is enough water in the Dead Sea region to support industry now and in the future			
	IL	PA	JO
Agree	52	58.9	79
Neutral	19	23.3	8.9
Disagree	29	17.8	12
	100	100	100

In terms of the domestic sector, some differences come to light. Israelis are slightly optimistic that municipal water needs will meet demand whereas Jordanians are not as sanguine (table 9.12). Interestingly enough, it is the Palestinians, who face water scarcity directly, to be the most optimistic. This may reflect the low population density of Palestinians living near to the Dead Sea or in the fact that their domestic water is low with little capacity for it to increase in the near future.

Table 9.12: There is Enough Water in the Dead Sea Region to Support Your Community Now and in the Future

There is enough water in the Dead Sea region to support your community now and in the future			
	IL	PA	JO
Agree	48	56.5	35
Neutral	15	9.4	13
Disagree	38	34.1	52
	100	100	100

A vital water resource in the basin is groundwater. Most local water sources come either directly from groundwater or from where groundwater comes to the surface as springs. Agricultural use in the Palestinian sector is heavily dependent on groundwater use and the Dead Sea Works in Israel gets most of its freshwater, which is used for cooling purposes in its industrial processes, from groundwater. Water for agriculture in Israel and Jordan on the other hand comes mostly from outside the basin in terms of surface water diversions that brings water to the farmers from either outside or from the northern portion of the watershed. People's perceptions of groundwater is therefore crucial for integrated management. It seems that only Israelis favor a "keep pumping" option on groundwater use whereas many Palestinians and a majority of Jordanians favor a "reduce pumping" option (table 9.13)..

Table 9.13: Opinions on Groundwater Pumping

Opinions on groundwater pumping			
	IL	PA	JO
Keep pumping	54	44.6	36
Reduce pumping	46	55.5	64
	100	100	100

This result may indicate the proximity the Palestinian and Jordanian populations have on the dependence of groundwater and that many groundwater wells are locally managed and knowledge of water levels is therefore necessary. In Israel, on the other hand, groundwater pumping is centrally managed by a far off ministry and the local population has little or no input. Their awareness therefore of the important linkage of groundwater to the health of the Dead Sea may be minimal as well as to ground water levels in general.

Any integrated management plan for the Dead Sea basin will require by default some form of cooperation by the riparians. It is therefore important to assess the willingness of the population to work together in achieving this aim. The following data sought to address the level to which the population of the basin is willing to work together. In the data presented in table 9.14, respondents were asked to consider who they felt to be the most responsible for the Dead Sea's decline. They were offered the following categories: Palestine, Jordan, Israel, All of the countries, None of the countries, Don't Know.

Table 9.14: In Your Opinion, the Entity Most Responsible for the Dead Sea's Decline Is...

In your opinion, the entity most responsible for the Dead Sea's decline is...			
	IL	**PA**	**JO**
PA	1.8	3.6	3.1
JO	6.7	0.7	18
IL	26	41.6	23
All	41	36.5	36
None	6.7	3.7	5.8
Don't know	18	13.9	14
	100	100	100

A large percentage of all respondents said that Israel was to blame (26 % of Israelis, 42 % Palestinian and 23 % Jordanians). However, many also said that all the countries were to blame (41 % Israelis, 37 % Palestinians, 36% Jordanians). It is not surprising that many feel that Israel is to blame as it is the hegemonic water user in the basin. Nevertheless it is also encouraging that many consider all of the countries equally responsible. This is an optimistic assessment on which an integrated management plan could be built.

Finally, we asked the respondents their viewpoint on cooperation in the basin (table 9.15). The overwhelming response was yes; cooperation with the neighbours is favored in helping to address the decline of the Dead Sea. With such data in hand, one may now begin to move forward on exactly how such cooperation will come about as the data lead toward some kind of a mandate by the public for cooperation.

Table 9.15: It Is Important to Cooperate with Your Neighbors in Managing the Dead Sea

It is important to cooperate with your neighbors in managing the Dead Sea			
	IL	**PA**	**JO**
Agree	95	79.8	72
Neutral	3.7	10.4	11
Disagree	1.2	9.8	18
	100	100	100

9.7 Focus Group Meeting Results

9.7.1 Water Shortages

All of the participants from all of the FGMs agreed that there is a water shortage in the area both in terms of quality and quantity. However, the understanding about the reasons and implications of this water shortage varied. For instance, the private farmers in Jordan whose water is supplied regularly by the Jordan Valley Authority believe that the shortages they experience are not critical and are due mainly to the lack of maintenance or technology. Conversely, their scientific and governmental counterparts are aware that the region is in fact water scarce along with understanding the reasons for this both in terms of water diversion projects in the upper Jordan watershed and regional climatological and meteorological conditions.

The participants from Palestine believe that they experience water shortages due to both their location within the Eastern Mediterranean region and the current geopolitical situation. Additionally, they believe that the lack of integrated trans-boundary water management has added to the uneven allocation of resources.

The Israeli residents from the Dead Sea Basin also see the water shortage problem as one of allocation as there is competition for resources mainly between industry and agriculture.

9.7.2 The State of the Dead Sea

All the participants believe that without intervention the future of the Dead Sea is precarious. The disappearance of the Dead Sea will damage the region not only economically but psychologically as well in terms of the loss of a unique ecosystem. Thus all participants agreed that any solution to the decline in the Dead Sea must be on a national (respectively) level with a balance met between industrial, agricultural and private needs, with the Jordanian scientific representatives noting that the solution must be holistic as the issue has an impact at both the regional and national levels.

The Palestinian representatives believe that the decline of the Dead Sea Basin is mainly due to the unilateral management of the Jordan River by Jordan and Israel. While the participants from the scientific community in Jordan assert that it is also due to decreased precipitation and the diversion of surface water bodies in the upper part of the watershed.

The farming representatives from both Jordan and Israel mentioned the diversion of water resources to serve the industries (chemical, tourism) within the area playing a major role in the sea's decline. Moreover the Jordanian farmers felt that while there are some negative impacts such as lack of humidity and the appearance of sinkholes, they also believe that there are potential benefits in the way of increased land for agriculture.

9.7.3 The Role of Agriculture

With regard to the role of agriculture in the decline of the Dead Sea and the future of agriculture in the area, there were differing opinions and beliefs. Most participants agreed that current practices are not the most water efficient and changes need to happen both in terms of crops being grown (Jordan no longer grants licences to high water consumption crops like bananas) and technology being used.

Though drip irrigation is already currently used, there is a need for more education about additional water resource alternatives. For instance the Jordanian farmers were not aware of the possibility of using treated wastewater to irrigate their crops. After a brief description was given of this technology, they were mostly opposed as they felt it would harm their crops marketability. It is clear that there is a need for more information and education about alternatives to be disseminated from the "experts" (i.e. policy-makers and scientists) to the practitioner in order to implement lasting change.

Current agriculture depends on European markets where prices change rapidly, thus making it difficult for farmers to make long term plans. This economic instability also creates uncertainty about the future of agriculture on a local level, as the younger generations do not necessarily have the desire/ability to carry on the family business. There is the additional belief of the farmers, both from Jordan and Israel, that agriculture will become more industrialized in the future with the number of farmers decreasing as the size of farms grow.

Most participants were of the opinion that investment in new technologies (desalination, treated waste water) as well as new industry (biotechnology, gypsum, tourism) would serve this region both in terms of water conservation and as way to increase the economic viability of the communities living within the region.

9.7.4 Red Sea-Dead Sea Canal

At this point it is not clear whether this project is a reality due to the high cost and potential environmental impact of such a project. If the canal is built the role that it will play in the region will depend on the particular point of view of each stakeholder. The impact on the various stakeholders is not yet clear, and will be clarified with the aid of the feasibility studies to be carried out soon by the World Bank. However, the World Bank's studies will not include social and environmental impacts so the comprehensiveness of such studies is in some doubt.

The farmers in Jordan were interested in the project but expressed concern about their land being damaged. The Palestinians on the other hand have rejected the project in spite of their attempts to support the Jordanians without affecting their water rights and the final status negotiations with the Israelis. Their rejection was a response to the Israeli position towards considering the Palestinians as beneficiary partners in the project and not as full partners. The participants believe that the project will not be implemented without the acceptance of the three parties as required by the World Bank.

9.7.5 New Water Investment

Aside from the proposed Red Sea-Dead Sea Canal, desalination, dams, artificial recharge of the aquifers, micro scale water management, improvements in irrigation technologies and the reuse of treated wastewater were mentioned as areas for further development. However it was also noted that it is imperative to invest in education: not only to educate the public, and future generations, about water shortages but also to raise awareness about implications of not conserving this resource and to provide effective methods for conservation.

The case of treated waste water serves to highlight the disparity in knowledge and awareness between the public and the scientific community: the scientists and environmentalists are all in agreement that the reuse of treated waste water should become standard procedure in agriculture whereas the local farmers were less sure of the concept, especially in Jordan. The perceived stigma of irrigating crops with treated waste water is a concern among farmers who consider the practice to adversely effect the acceptance and price of their crops in overseas markets. Social understanding of the farmer's point of view needs to go hand in hand with investment to spread awareness about potential new water sources and to allay any concerns or questions the farmers and public may have.

9.7.6 Cooperation

While the future of the Dead Sea Basin is unclear, it is clear from the responses of the stakeholders that any resulting cooperation that will occur between the three nations involved must be of obvious benefit to all those involved.

The benefits, for example, to Palestinians and Jordanians of working with Israel, a country with high water productivity and water saving in agriculture, could lead to exchange in the technologies and the know-how of efficient agriculture. This could come as a benefit to the whole water thirsty region. The Israeli farmers, for their part, would need assurance that a genuine division of the resources between the states is not a threat to the Jewish settlements in the area, as is their concern about finding a solution with Palestine.

It is the belief/hope of the Israeli and Jordanian environmentalists and policy makers, at least, that the cooperation would result in a more stable region, bringing in more settlement, investment to the area and helping the economies of the region.

9.8 Discussion

People think differently about water. Differences and similarities can be found among Israelis, Palestinians and Jordanians. The data also reveal a complex picture where in some cases there is agreement on issues while on other topics there is disagreement.

The results from both the survey and the focus groups are meaningful. Besides providing insight into the water culture of the three countries, they offer insight into what kinds of policies may be acceptable for the management of the Dead Sea. For example, education programs and conservation campaigns that consider the viewpoint of the public and the various stakeholders may prove to be more successful than those that do not consider these views.

In many cases the data reveal more questions than answers, specifically from the survey data. But perhaps what the data do offer is what questions need to be asked next and in what direction one should be headed in formulating an integrated management plan for the Dead Sea. Teasing apart the reasons behind the responses presented in this paper will require more in-depth anthropological and sociological study. What has simply been revealed here is the complexity inherent in a society where one's social context is an important predictor or "shaper" of one's perceptions and attitudes about water. What one can say is that society, any society, should not be seen as a homogenous unit, as was once considered by early anthropologists, but that there are important individual differences within a society. This is especially germane for a transboundary water resource such as the Dead Sea basin. I suggest therefore that policy makers take a closer look at the heterogeneity in society and the ways in which this heterogeneity shapes perceptions and attitudes.

Institutional, social, gender and economic issues related to water management options for the Dead Sea basin are thus far more complex than what is currently envisioned by engineers and policy makers. These issues need to be addressed adequately to achieve equitable and sustainable water management. As we tease apart the many layers by which people in any society act and interact, we need a greater degree of precision on how people think about an issue.

In the case of the Middle East in general and the Dead Sea basin in particular, the centralization of the water management system provides policy makers with a clouded lens on how people respond to current policies of water management. This lens hampers consideration of new policy structures, including more "disaggregated" (often more local) policies that may be highly effective. This study provides a starting point for such disaggregation by considering the water culture of communities as the foundation upon which to build sustainable water policies–rather than as passive end points of a centrally determined system.

References

Abu-Faris, H. G.; Bromber, G.: Fariz, S.; Hoermann, S.; Turner, M., 1999: *Moving Towards a Dead Sea Basin Biosphere Reserve and World Heritage Listings* (Amman, Jordan: Friends of the Earth Middle East).

Abu-Zeid. M. A., 1998: "Water and Sustainable Development: The Vision for World Water, Life and the Environment", in: *Water Policy*, 1,1: 9–19.

Al-Weshah, R. A., 2000: "The Water Balance of the Dead Sea: An Integrated Approach", in: *Hydrological Processes*, 14,1: 145–154.

Anati. D.A.; Shasha. S., 1989: "Dead Sea Surface Level Changes", in: *Israel Journal of Earth Sciences* 38,11: 29–38.

Assaf. K. K.; Ben-Zvi. M., Clarke, J. S.; El-Naser, H.; Kesselman, S,; Landers, M. N.; Nuseibeh, M. F., Wipperfurth, C. J., 1998: *Overview of Middle East Water Resources: Water Resources of Palestinian, Jordanian and Israeli Interest* (Washington, D.C.: US Geological Service. EXACT Middle East Water Data Banks Project).

Baer, G.; Schattner, U.; Wachs, D.; Sandwell, D.; Wdowinski, S.; Frydman, S., 2002: "The Lowest Place on Earth is Subsiding: An InSAR Interferometric Synthetic Aperture Radar Perspective", in: *Geological Society of America Bulletin*, 114: 12–23.

Bowman D.; Banet-Davidovich, D.; Bruins, H. J.; Van der Plicht. J,, 2000: "Dead Sea Shoreline Facies with Seismically Induced Soft-Sediment Deformation Structures", in: *Israel Journal of Earth Sciences*, 49: 197–214.

Bruvold, W. H.; Cook, J., 1989: "What the Public Thinks: Reclaiming and Reusing Wastewater", in: *Journal of the American Water Works Association*, 77: 10–17.

Burmil S.; Daniel, T. C.; Hetherington, J. D., 1999: "Human Values and Perceptions of Water in Arid Landscapes", in: *Landscape and Urban Planning*, 44: 99–109.

Coussin, O., 2001: "Wild and Stunning and Shrinking Fast: The Dead Sea Region is being Undermined by Industry and Tourism, but is Anybody Paying Attention?", in: *Haaretz Daily Newspaper* (Tel Aviv, Israel).

Douglas M.; Wildavsky, A., 1982: *Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers.* (University of California Press, Berkeley).

EcoPeace. 1998: *Final Symposium Report. Symposium on Promoting an Integrated Sustainable Regional Development Plan for the Dead Sea Basin* (Jerusalem: EcoPeace-Middle East Environmental NGO Forum).

Elisha, R., 2006: "Water Budget Analysis Around the Dead Sea in Israel, Jordan and the District of Jericho" (MSc thesis. Ben Gurion University of the Negev, Israel).

Feitelson, E., 2000: *The Ebb and Flow of Arab-Israeli Water Conflicts: Are Past Conflicts Likley to Resurface Water Policy*, 2: 343–363,.

Falkenmark, M., 1989: "Freshwater as a Factor in Strategic Policy and Action", in: Davis, K.; Bernstam, M. and Sellers, H. (Eds.): *Population and Resources in a Changing World* (Stanford, CA: Morrison Institute for Population and Resource Studies).

Friends of the Earth Middle East, 2000: *Let the Dead Sea Live - Concept Document Towards the Dead Sea Basin Biosphere Reserve and World Heritage Listings* (Amman, Jordan: Friends of the Earth Middle East).

Frederick, K. D., 2000: "Water as a Source of International Conflict", in: *Resources for the Future*,: 123 (Washington, DC: RFF).

Fry, K.; Mingledorff, N., 1996: *Overcoming Cultural Biases in the Introduction of Water Saving Technology: No Need to Flush a Waterless Urinal* (American Water Works Association).

Gavrieli, I.; Lensky, N.; Gazit-Yaari, N., Oren, A., 2002: *The Impact of the Proposed 'Peace Conduit' on the Dead Sea: Evaluation of Current Knowledge on Dead Sea-Seawater Mixing* (Jerusalem: The Ministry of Regional Cooperation).

Gebetsroither, E.,; Afaneh, A.; Lipchin, C.; Lehrer, D., 2004: "An Analysis of the Feedback Structure Driving Water Dynamics in the Dead Sea Region", Paper for the MEDAQUA INCO-MED Water Conference, Amman, Jordan, June 14Flakenmark15, 2004

Gertmann, L., 1999: *The Hydrogeography of the Dead Sea* 1999-2000 (Israel Oceanographic and Limnological Research Center.

Gleick, P. H., 1993: "Water and Conflict: Fresh Water Resources and International Security", in: *International Security*, 18: 79–112.

Gleick , P. H., 1994: "Water, War and Peace in the Middle East", in: *Environment*, 36: 5–41.

Hamberg, D., 1995: *The Mediterranean-Dead Sea and The Red Sea-Dead Sea Projects. Paper for the International Peace Conference on the Peace Process and the Environment (*Tel Aviv: Tel Aviv University, Israel).

Hellstrom, D.; Jeppsson, U.: Karrman, E.. 2000: "A Framework for System Analysis of Sustainable Urban Water Management", in: *Environmental Impact Assessment Review*, 20: 311–321.

Hillel. D., 1994: *Rivers of Eden: The Struggle for Water and the Quest for Peace in the Middle East* (Oxford University Press, New York).

Hoekstra, A. Y., 1988: "Appreciation of Water: Four Perspectives", in: *Water Policy*, 1: 605–622.

Hoon, P.; Singh, N. W. S., 1997: *Sustainable Livelihoods: Concepts, Methods and Principles for Indicator Development*. UNDP Discussion Paper (New York: UNDP).

Isaac, J.; Hrimat, N.; Rishmawi. K.; Saad, S.;, Abu Kubea, M.;, Hilal. J.; Owawi, M.; Sababa, G.; Awad, M.; Ishaq, F.; Zboun, I., 2000: *An Atlas of Palestine: The West Bank and Gaza* (Bethlehem, Palestine: Applied Research Institute Jerusalem).

Jeffrey, P., 2000: *Water Recycling Opportunities for City Sustainability* (Cranfield University, UK: School of Water Sciences).

Jeffrey, P.; Seaton, R., 1998: "The Theory and Practice of Exposing Public Perception of Wastewater Reuse Options. Small and Medium Size Domestic Water Conservation", in: *Waste Water Treatment and Reuse*, 4,1: 33–38.

Jeffrey, P., 2000: *Cross-Cultural Valuations of Natural Resources. A Case Study in the Galilee Region of Northern Israel*. A Report to the British Council under the Lord Goodman Fellowship Scheme (London: The British Council).

Klein, C., 1985: "Fluctuations of the Level of the Dead Sea and Climatic Faluctuations in the Country during Historical Times", Paper for the Symposium on Scientific Basis for Water Resources Management, International Association of Hydrological Sciences, Paris, 5–7 August.

Lipchin, C., 1997: *Water Scarcity, International Security and Resource Disputes - The Case of the Tigris-Euphrates and Jordan Basin River System* (Ann Arbor, MI: University of Michigan).

Lipchin, C., 2000: "Water Use in the Southern Arrava Valley of Israel and Jordan: A Study of Local Perceptions", in: *Journal of the International Institute*, 11: 112–114

Lowi, M. R., 1993: "Bridging the Divide: Transboundary Resource Disputes and the Case of West Bank Water", in: *International Security*, 18: 113–138.

Mancy, K. H.; Fattal, B.; Kelada, S., 2000: "Cultural Implications of Wastewater Reuse in Fish Farming in the Middle East", in: *Water Science and Technology*, 42: 235–239.

Meunier, J., 1999: *Keeping the Dead Sea Alive: Toward a Regional Environmental Management Plan* (Winnipeg: International Development Research Center).

Murdock, S. H.; Albrecht, D. E.; Hamm, R. R.; Bachman, K,; Parpia, B., 1988: *An Analysis of the Effects of Sociodemographic Factors on Daily per Capita Residential Water Use in Texas Cities.* (Texas Water Resources Institute, Texas: A&M University).

Oliver, M. D., 1999: "Attitudes and In-action: A Case Study of the Manifest Demographics of Urban Water Conservation", in: *Environment and Behavior*, 31: 372–394.

Orthofer, R.; Daoud, R.; Fattal, B.; Ghanayem, M.; Isaac, J.; Kupfersberger, H.; Safar, A.; Salameh, E,; Shuval, H,; Wollman, S., 2001: *Developing Sustainable Water Management in the Jordan Valley*. (Brussels: European Commission, DG Research).

Orthofer. R., 2001: *Land Use and Water Use in the Jordan Valley* (Vienna: Austrian Research Centre, Environmental Planning Department).

Pandey, J., 1990: "The Environment, Culture and Behavior", in: Brislin, R. W. (Ed.): *Applied Cross-Cultural Psychology*, 14: 254–277.

Pearce, F., 1995: "Raising the Dead Sea", in: *New Scientist*, 147: 1987: 33–37.

Postel, S. L.; Wolf, A. T., 2001: "Dehydrating Conflict", in: *Foreign Policy*: 60-67.

Postel, S. L., 1993: *The Politics of Water* (Washington, D.C.: World Watch Institute).

Rabi, A., 1997: *Ecological Resources of the Dead Sea Basin and Their Sustainable Use: Problems and Cooperation between the Countries of the Basin. Paper for the International Conference on Transboundary Protected Areas as a Vehicle for International Cooperation* (Geneva: UNEP World Conservation Monitoring Center).

Rishmawi, K,; Hrimat, N., 1999: "The Use of High Resolution Satellite Images to Monitor the Changes in the Rates and Directions of Desertification in the Southeastern Part of the West Bank", Paper for the Second Palestinian Geographic Conference, Al Quds University, East Jerusalem, 26–28 April 1999.

Schempp, C. H., 2000: "Magnesium Ions Inhibit the Antigen Presenting Function of Huma Epidermal Langerhans Cells *in vivo* and *in vitro*: Involvement of ATPase, HLA-DR, B7 Molecules, and Cytokines", in: *Journal of Investigative Dermatology*, 115: 23–34.

Segev, G., 1995: The Mediterranean-Dead Sea Canal and The Red Sea-Dead Sea canal. Paper for the International Peace Conference on the Peace Process and the Environment. Tel Aviv University, Israel.

Shavit U. R., 2001: "Water Sources and Quality Along the Lower Jordan Valley", in: Rubin, H. (Ed.): *Water Resources Quality: Preserving the Quality of our Water Resources* (Berlin: Springer): 127–148.

Shannag, E.; Al-Adwan, Y., 2000: "Evaluating Water Balances in Jordan", in: Brooks, D.; Mehmet, O. (Eds.): *Water Balances in the Eastern Mediterranean* (Ottawa: International Development Research Center, Canada).

Shelef, G., 1995: "The Coming Era of Intensive Wastewater Reuse in the Mediterranean Region", Paper for the International Conference on the Peace Process and the Environment, Tel Aviv University, Israel, 18 May.

Simon, P., 1998: *Tapped Out: The Coming World Crisis in Water and What We Can Do About it.* (New York: Welcome Rain).

Simon, R. J., 1971: "Public Attitudes Toward Population and Pollution", in: *Public Opinion Quarterly,* 35: 93–99.

Spaulding, I. A., 1972: "Social Class and Household Water Consumption", in: Burch Jr., W. R.; Cheech Jr., N. H.: Taylor, L. (Eds.) (New York: Harper and Row).

Stanhill, G., 1984: *Evaporation from the Dead Sea. A summary of Research until Sept.* 1984. Mediterranean Dead Sea Project , Tel Aviv, Volcani Institute.

Tal, A., 2001: *Pollution in a Promised Land* (Berkeley, CA: University of California Press).

UNDP, 2003: *Mainstreaming Gender in Water Management: A Practical Journey to Sustainability: A Resource Guide* (New York, USA: UNDP).

Van Liere, K. D.; Dunlap, R. E., 1980: "The Social Bases of Environmental Concern: A review of Hypotheses, Explanations and Empirical Evidence", in: *Public Opinion Quarterly*, 44: 180–197.

Wardam, B., 2000: "Lowest Point on Earth is Getting Lower", *Jordan Times*, 18 October (Amman, Jordan).

Wilson, M.; Daly, M., 1998: "The Evolved Psychological Apparatus of Human Decision-Making Is One Source of Environmental Problems", in: Caro, T. (Ed): *Behavioral ecology and conservation* (Oxford: Oxford University Press): 501–523.

Wilson. M.; Daly. M.; Gordon, S.; Pratt. A., 1996: "Sex Differences in Valuations of the Environment", in: *Population and Environment: A Journal of Interdisciplinary Studies*, 18: 143–159.

Wolf. A.; Lonergan, S., 1995: "Resolving Conflicts over Water Disputes in the Jordan River Basin", in: Dinar, A.; Loehman, E.T. (Eds.): *Environmental change, adaptation, and human security* (London: Praeger).

Yechieli, Y., 1996: *Influence of the Changes in Dead Sea Level on the Groundwaters around Israel* (Haifa: Israel Association Water Resources).

10 Formulating A Regional Policy for the Future of the Dead Sea – The 'Peace Conduit' Alternative

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Abstract

The Dead Sea is a severely disturbed ecosystem, greatly damaged by anthropogenic intervention in its water balance. Since the beginning of the 20th century, the Dead Sea level have dropped by more than 20 meters, and presently (2006) it is about 419 meters below mean sea level. The rate of water level drop over the last 10 years is about 1.0 m/yr, representing an annual water deficit of about 650 million cubic meters. The sharp level drop reflects the annual interception by riparian countries of over 1000 million cubic meters of freshwater which in the past drained to the Dead Sea. In addition to the water interception upstream, the Israeli and Jordanian mineral industries contribute to this deficit by artificially maintaining extensive evaporation surfaces in the otherwise now dried southern Dead Sea basin.

Three alternatives for the future of the Dead Sea exist and need to be examined:

1. Maintaining the present situation. The Dead Sea level is expected to decline further to around -550 m, when a new equilibrium between inflow and evaporation will be reached.
2. Changing the regional water policy whereby freshwater from the Jordan and the Yarmouk river systems will be diverted back to the Dead Sea. In view of the severe regional water deficiency, such a program requires unprecedented regional cooperation and investments to compensate for the freshwater that will be diverted back to the Dead Sea.
3. Construction of the 'Peace Conduit' that will convey seawater and/or reject brine after desalination, into the Dead Sea. Such a plan has already been announced by Israel and Jordan in 2002 during the Johannesburg World Summit on sustainable development.

The renewed interest by Israel and Jordan in the construction of the 'Peace Conduit' is due to a number of related issues: (1) a growing concern that the Dead Sea must be 'saved'. (2) The possibility of utilizing the proposed conduit for desalinization of the inflowing seawater, thereby providing freshwater to the surrounding entities. (3) The development of infrastructure and tourist facilities around the lake has been adversely affected due to the receding shoreline and the danger presented by the regional collapse of the infrastructure. All parties acknowledge that the 'Peace Conduit' is an ambitious project that is bound to change the Dead Sea and its surroundings. While the project has the potential to stop and possibly restore damaging processes that currently occur in the Dead Sea and its surrounding, mixing of seawater in the Dead Sea may also lead to undesired changes in the lake.

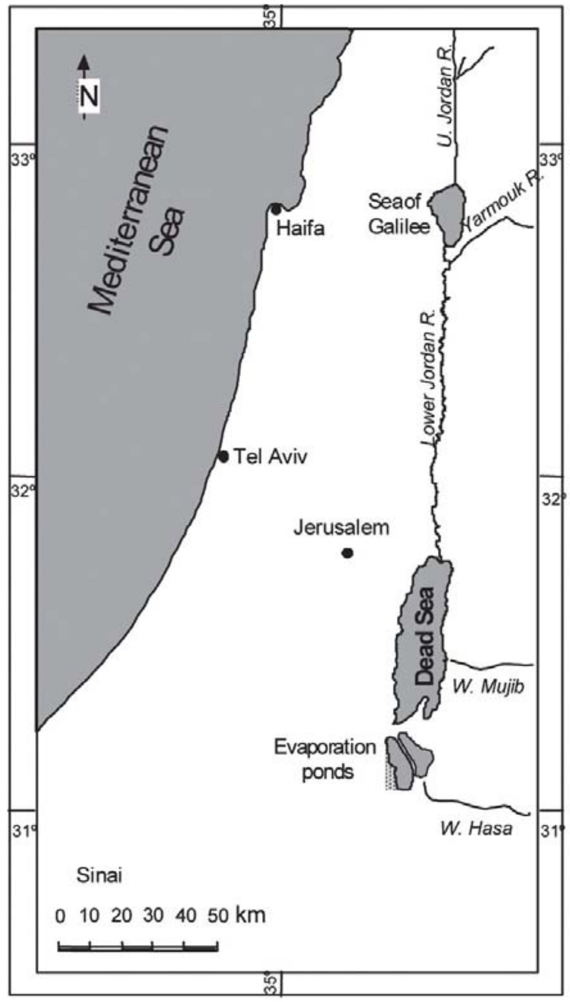
The impact of changes on the Dead Sea and its surroundings needs to be carefully evaluated before a final decision is made.

Keywords: Dead Sea water balance, water level, Peace Conduit, desalinization, gypsum precipitation, microbial blooming, sustainable development, Israel, Jordan.

10.1 Introduction

The Dead Sea is a hypersaline terminal lake located in the Dead Sea Rift valley which developed along the Dead Sea Transform (figure 10.1). Its water level is the lowest surface on earth and is currently (year 2006) 419 m below mean sea level (-419 m). At its deepest place the lake is over 300 meters deep, making it the lowest terrestrial place on Earth (-730 m). The Dead Sea brine is characterized by high salinity (TDS >340 g/l), high density (>1.236 kg/l) and a unique composition. Over the last several thousands of years the water level of the lake fluctuated around -400 m (Stein 2002; Bookman et al. 2004). This elevation coincides with the elevation of the sill that divides between the shallow southern basin of the lake and the much deeper northern basin. Higher water levels were attained during rainy periods when the lake extended into the southern basin and the surface water was diluted. Lower levels reflect dry periods, with negative water balance and large area shrinkage, including the drying out of the southern basin. The smaller surface area and higher salinity results in a drastic decrease in evaporation which serves to buffer further lake level drop.

Figure 10.1: Location Map of the Dead Sea.

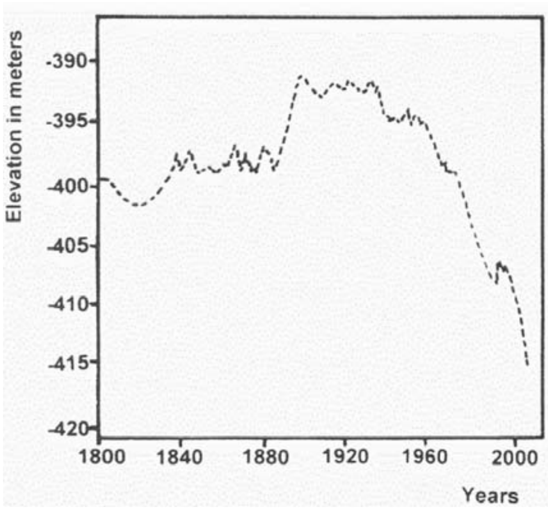


10.2 Recent and Future Changes in the Dead Sea

Since the beginning of the 20th century, the Dead Sea level has dropped by more than 20 meters (figure 10.2). The decline in the Dead Sea level is a manifestation of the negative water balance of the lake, whereby evaporation greatly exceeds inflow (Gavrieli/Oren 2004). It reflects the annual interception by riparian countries of over 1000 million cubic meters (MCM) of freshwater which in the past drained to the Dead Sea. The intercepted water is diverted from Lake Kinneret to the Israel National Water Carrier and from the Yarmuk River by Syria and Jordan. The latter constructed the King Abdullah Canal which runs along the eastern side of the Jordan Rift Valley and supplies water for irrigation. Additional water is captured upstream of the Sea of Galilee by Lebanon and from smaller tributaries either draining to the Lower Jordan River or directly to the Dead Sea.

In 1976, when the lake level reached an elevation of -400 m the southern basin dried up (Steinhorn et al., 1979; figure 10.3). A few years later, in 1979, the Dead Sea water column overturned and mixed (Steinhorn 1985), ending a period of about 300 years of stratification (Stiller/Chung 1984), whereby the upper water column of the lake was relatively diluted while the lower brine was more concentrated (Neev/Emery 1967). Since then the Dead Sea experiences mostly

Figure 10.2: Dead Sea water levels: 1800–2000. **Source**: After Gavrieli et al., 2005



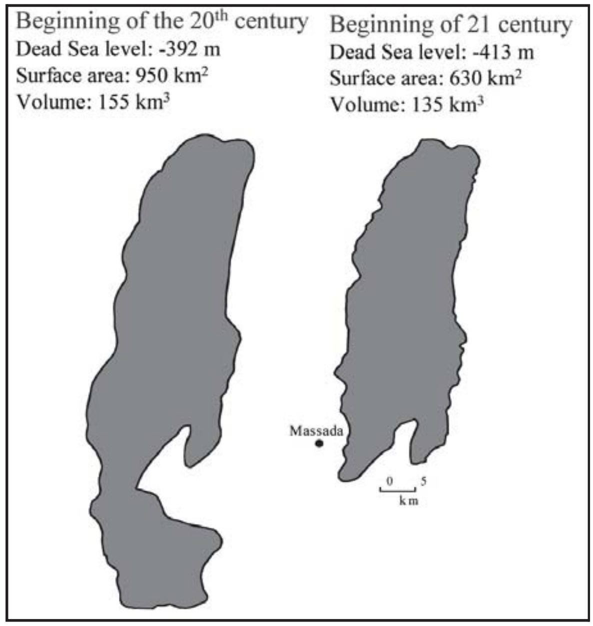
annual stratification and overturns, while its salinity rises (Anati/Stiller 1991; Gertman/Hecht 2002).

The average rate of water level drop over the last few years is about 1.0 m/yr, denoting an annual water deficit of about 650 MCM. About 200–250 MCM/yr of this deficient, accounting for about 35 cm/yr water level drop, is attributed to the activities of the Israeli and Jordanian mineral industries that are based on the Dead Sea. These industries pump together 450–500 MCM from the Dead Sea into the evaporation ponds located in the southern basin, where halite (NaCl) and carnallite ($KMgCl_3 \cdot 6H_2O$) precipitate. At the end of the process less than 200 MCM of concentrated brines (density = 1.35 kg/l; TDS = 500 g/l) are returned to the Dead Sea.

10.3 The Future of the Dead Sea

If the current situation prevails, the Dead Sea level is expected to continue to decline. Models and thermodynamic calculations proposed by Yechieli et al. (1998) and Krumgalz et al. (2000), respectively, for the future evolution of the lake suggests that under current conditions the lake level will continue to decline but will approach a steady state at an elevation of about -550 m, i.e. ~130 m below the present level (figure 10.4). The rapid water level decline will continue during the coming decades but will begin leveling off within a few hundred years. A steady state level will be approached when the evaporation will be compensated by inflowing water. Such conditions will be achieved due to the combined effect of diminishing surface area and decrease in evaporation rate due to the increasing salinity of the brine.

Figure 10.3: Comparison between the Dead Sea at the beginning of the 20th and 21st centuries. **Source**: After Gavrieli et al., 2002

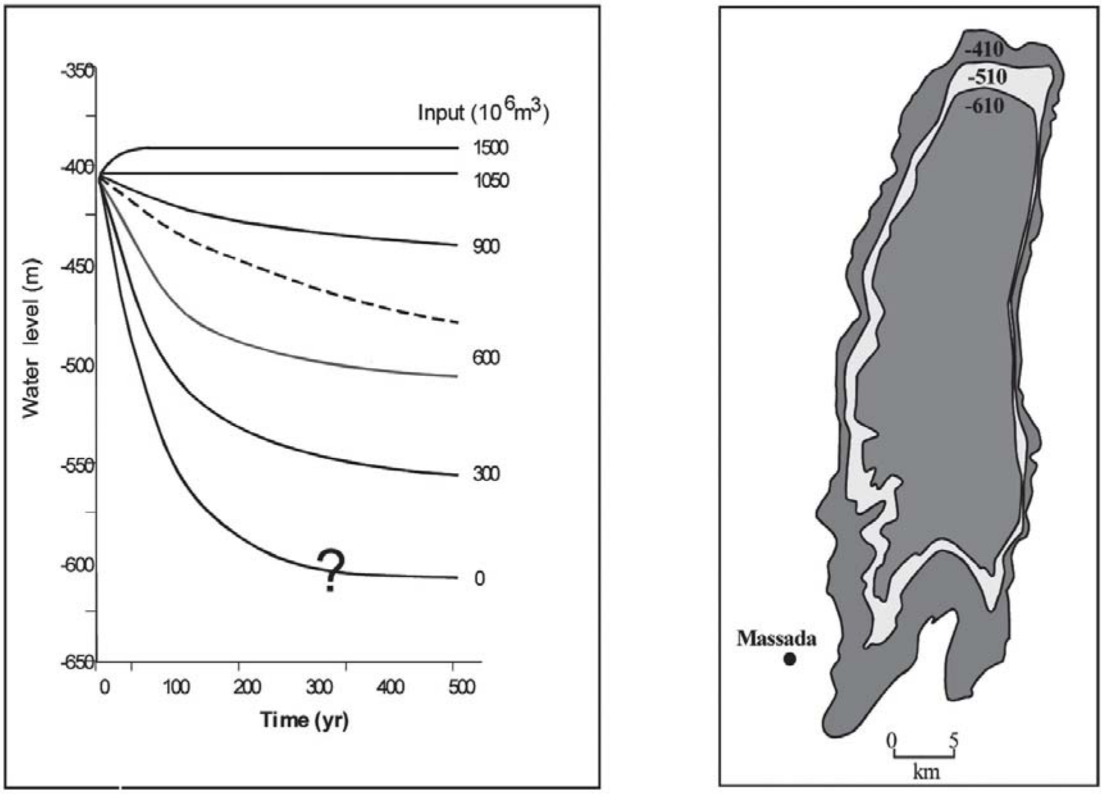


Over the last decade hundreds of sinkholes developed along the shores of the Dead Sea and large areas are subsiding. This phenomenon, which has major economic and safety implications, is linked to the drop in the level of the Dead Sea and subsurface salt dissolution (Wachs et al. 2000; Yechieli et al., 2006; Baer et al. 2002; Abelson et al. 2003). The rapid drop in the water level results in rapid geomorphological changes, which lead to damages in the surrounding infrastructure, mainly to roads and bridges (Avni et al. 2003). Thus, the Dead Sea area, which has major economic, tourist and environmental potentials, is in fact being neglected. This makes future planning difficult and needs to be reconsidered.

Three alternatives for the future of the Dead Sea exist and need to be examined:

1. Maintaining the present situation and allowing the water level to continue to decline until the above-described steady state level is attained.
2. Changing the regional water policy whereby freshwater from the Jordan and the Yarmouk river systems will be diverted back to the Dead Sea. In light of the severe regional water deficiency, such a program requires unprecedented regional cooperation and investments to compensate for the

Figure 10.4: Predicted changes in the water level of the Dead Sea for different water inputs (in 10^6 m^3/yr). All cases assume continued evaporation from the evaporation ponds of the potash industries. **Source:** after Yechieli et al. (1998)



freshwater that will be diverted back to the Dead Sea.

3. Conveying seawater from the Red Sea to the Dead Sea via the proposed 'Peace Conduit'. Such a plan has already been announced by Israel and Jordan in 2002 during the Johannesburg World Summit on sustainable development. However, the environmental impact of this project needs to be further examined, evaluated and quantified before a final decision is made.

10.4 The 'Peace Conduit'

The interest in the construction of a canal/pipeline between the Red Sea and the Dead Sea, termed lately as the 'Peace Conduit', is due to a number of related issues: (1) a growing public concern that the Dead Sea must be 'saved' in order to maintain the scenic beauty of the area and preserve its historical and environmental uniqueness for future generations. (2) The possibility of utilizing the proposed 'Conduit' for desalinization of the inflowing seawater, thereby providing freshwater to the surrounding entities. This aspect of the project is particularly attractive to Jordan, which suffers from a major water shortage as its main consumption centers are far away from any coastline. (3) The difficulty of developing the area around the Dead Sea due to the uncertainty imposed by the receding shoreline and the danger presented by the regional collapse of infrastructure described above.

The first to propose a canal between the sea and the Dead Sea was William Allen, who in 1855 suggested the use of such canals as a waterway connecting the Mediterranean with the Red Sea (Allen 1855). Some 50 years later Herzl (1902) envisioned a canal between the Mediterranean and the Dead Sea that would serve as a hydroelectric power source. This vision was also the foundation for the Mediterranean Sea – Dead Sea Company, which following the 1973 energy crisis funded diverse feasibility studies to evaluate the economic, environmental and engineering aspects of such a canal (Mediterranean Sea-Dead Sea Company 1984). More recently, following the peace treaty between Israel and Jordan, a pre-feasibility study was conducted to study a proposed Red Sea-

Dead Sea Canal (RSDSC). The principal objective of this project was to utilize the 400 meter elevation difference between the seas to desalinize seawater on the shores of the Dead Sea by reverse osmosis. The study concluded that the project is financially and environmentally feasible and can produce (with the investment of additional external energy) 800 to 850 MCM of desalinated water annually. The reject brine coming out from this plant is to be discharged to the Dead Sea (Harza JRV Group 1996).

During the Johannesburg 2002 World Summit on Sustainable Development the two countries jointly announced their mutual commitment to the project. The primary aim of the project, as stated in the announcement, is to save the Dead Sea through stabilizing its level. Desalinization of seawater is a potential by-product of this proposed 'Peace Conduit' project.

It should be emphasized that the implementation of the 'Peace Conduit' differs from intervention with an undisturbed natural ecosystem: the Dead Sea basin experiences major man-induced physical and infrastructure changes that have accelerated over the past thirty years due to the rapid water level decline. The project has the potential of stopping and even reversing the undesired environmental processes that currently occur in the basin. Yet, there is a possibility that the mixing of seawater in the Dead Sea brine may also bring about undesirable changes to the Dead Sea. Additional environmental aspects need also be considered: pumping of huge volumes of seawater from the Gulf of Eilat may harm the ecosystem at the tip of the gulf, while leakages from the Conduit pose a salinization threat to the groundwater in Wadi Arava. Below we outline the expected changes to the limnology of the Dead Sea due to seawater mixing. These changes will need to be quantified through an integrated lake-model, put into a time frame and weighed against the benefits of the project. The impact of the 'Peace Conduit' on the Gulf of Eilat and Wadi Arava are subjects of other, independent studies.

10.5 Impact of Seawater Mixing in the Dead Sea

Following is a summary of the identified changes in the limnology of the Dead Sea that will accompany the inflow of seawater into it. These are discussed in details in Gavrieli et al. (2002, 2005). It should be kept in mind that other changes that have not yet been identified might also take place.

Stratification of the water column: During the filling period of the lake to the desired level, mixing of seawater and Dead Sea brine will lead to formation of a stratified water column with a diluted surface layer, composed of a mixture of Dead Sea brine and seawater, and a lower water body with salinity similar to that of current Dead Sea. The dilution and continuous decrease in surface water density will continue throughout the filling period. The rate at which the density will decrease will be determined by the rate of inflow and depth of stratification. Once the desired lake level has been attained, inflow will be controlled so that it will only compensate for evaporation. The density of the upper water at this stage will begin to increase due to accumulation of seawater-derived salts. Its density will increase until it attains the density of the lower water column and overturn will occur. From this stage onward, the density of the entire water column will increase and the development of periodic stratification will depend primarily on the mode of operation.

Stratification of the Dead Sea water column is not a new phenomenon in the Dead Sea (Neev/Emery 1967; Anati/Stiller 1991; Gertman/Hecht 2002) and in itself will not have a negative environmental impact, provided that the composition and density of the upper water body would not alter to the degree that the Dead Sea would loose its uniqueness. Current knowledge, however, does not allow us to determine either the depth of stratification and mixing ratio, or the composition and change in density of the upper water body. These depend on numerous physical and operational parameters which will have to be modeled in the dynamic-limnological model and considered when planning the Conduit.

Precipitation of gypsum: Mixing between the calcium (Ca^{2+}) – rich Dead Sea brine and the sulfate ($SO4^{2-}$) – rich seawater will result in precipitation of gypsum ($CaSO_4 \cdot 2H_2O$) (Levy 1984; Levy/Kushnir 1981; Katz et al. 1981). Kinetic effects will determine if the gypsum will precipitate continuously or if the incoming sulfate will accumulate in the mixture and precipitate periodically once over-saturation attains a critical value. The rate at which the gypsum crystals or agglomerates settle from the upper water column will determine if, how, and to what extent the turbidity of the water column will increase. The most extreme case is that of 'whitening' of the surface water for prolonged periods of time. An increase in surface water turbidity is not a desired outcome of the project because it may be accompanied by local climatic changes due to changes in the reflectivity of the water's surface and may also impact negatively on the visual attractiveness of the Dead Sea. It is still to be determined at what point, if at all, turbidity becomes unbearable to the extent that it could hamper the project. It should be noted, however, that small-scale field studies conducted in the past do not support a scenario of prolonged whitening. Some laboratory experiments, however, do suggest that this phenomenon is nonetheless possible.

Microbial blooming: Field studies indicate that dilution of the Dead Sea brine by 10 per cent and the addition of phosphate, which is a limiting nutrient in the Dead Sea, initiate algal and bacterial blooming (Oren/Shilo, 1985; Oren et al., 2004). In desalinization plants, anti-scaling agents, usually based on phosphate, are common additives. Thus, it is essential that the anti-scaling additives in the desalinization plant envisioned for the Dead Sea will not be phosphate-based. However, this does not ensure that microbial blooming will not occur just as a result of the dilution of the upper water column. Algal and bacterial blooming has been observed in the Dead Sea in the past, following particularly rainy winters, when the upper water column was diluted (Oren 1993). Blooming lasted for several weeks during which the Dead Sea had a reddish hue. Quantitative information on the biological properties of the lake prior to 1980 is virtually absent except for a single report that describes high microbial densities in surface water in 1964. The duration of blooming events that may take place in the Dead Sea following the continuous introduction of seawater and the consequent dilution of the surface water and change in its composition has never been studied and is uncertain. Occurrence of microbial blooms will have both limnological and industrial consequences that must be examined carefully. The basic assumption is that algal and bacterial blooming is not desired in the Dead Sea just as it is not desired in any other open water system. It will impact on the ecology of the Dead Sea and its surroundings, decrease the attractiveness of the lake, which will cease to be 'dead', and will have negative impact on the potash industries. Here too it is not possible yet to define if or at what point the increased turbidity of the water due to blooming becomes unbearable to the extent that it could hamper the project.

Increased rate of evaporation: Water balance calculations constitute an integral and crucial part in the proper planning and management of the 'Peace Conduit'. Yet even the present-day water balance of the Dead Sea is not agreed upon (Lensky et al. 2005). One of the most critical factors in the calculation of the water balance is the rate of evaporation, for which estimates range between 1.05 and 2 m/yr (e.g. Stanhill 1994; Salameh/El-Naser 2000). Dilution of the surface water due to the inflow of seawater will invariably increase the rate of evaporation and will have a major impact on the required capacity of the 'Peace Conduit'. Increased turbidity of the upper water column due to possible suspended gypsum crystals and/or microbial blooming may increase evaporation rates even more than what would be expected from dilution alone. If, on the other hand, the gypsum concentrates at the surface, the evaporation rate may in fact decrease due to changes in the Dead Sea's reflectivity.

Development of anoxic conditions in the lower water column: The development of long-term stratification of the Dead Sea water column will lead to the removal of oxygen and development of anoxic conditions in the lower water column. Under these conditions the anoxic lower water column may have dissolved H_2S, elevated levels of iron (Fe^{2+}) and other trace metals at lower concentrations. Similar conditions existed in the Dead Sea prior to the 1979 overturn of the water column that ended the stratification that lasted for hundreds of years (Neev/Emery 1967). However, at that time, the anoxic brine was not brought to the surface. The potash industry (only the Israeli Dead Sea Works Ltd. existed at the time) pumped its brine from the less saline surface layer. In the context of the 'Peace Conduit' and expected dilution and compositional changes in the surface water, the potash industries would most likely prefer to pump brine from the concentrated lower water body. Exposure of large volumes of anoxic brine (hundreds of million cubic meters per year) to the atmosphere in the feeding canals and the evaporation ponds will be accompanied by release of sulfur gasses (H_2S). This, as well as the presence of iron and other trace metals in the brine, may have an environmental impact and can impair the industrial processes. It is therefore important to determine if it will be possible to overcome the above impacts through development of appropriate industrial methods.

Infrastructure collapse and sinkholes: The rise in Dead Sea level will lead to re-flooding of large areas where sinkholes have developed. Many of the areas that currently experience collapse and destruction (Baer et al., 2002; Abelson et al., 2003, 2004) will again be covered by water. Water from the upper water column, which will be unsaturated with respect to halite, will replace freshwater in the subsurface. Thus, some exposed parts of the shorelines will still be susceptible to development of sinkholes because of halite dissolution and development of cavities in the subsurface. However, over the long run, with the gradual rise in salinity in the entire Dead Sea system, these processes will slowly come to a standstill.

To conclude, the 'Peace Conduit' will have both positive and negative impacts on the future evolution of the Dead Sea. Based on current knowledge, the various aspects of Dead Sea – seawater mixing discussed above do not provide grounds for overall negation of the proposed project. Yet, the final decision regarding the implementation of the 'Peace Conduit' needs to take into consideration the expected changes in the Dead Sea following the discharge and mixing of seawater. The 'Peace Conduit' can potentially reverse processes of environmental degradation that have resulted from the diversion of freshwater from the Jordan River and other tributaries. Also, the contribution to regional cooperation and the consolidation of peace is of major significance. Yet, based on current knowledge it is not possible at this stage to quantify expected changes in the Dead Sea and therefore their environmental, industrial and economical outcome cannot be assessed. Such examination requires quantification of the processes described above and their interdependencies in the long run. A long-term complex forecast and integration of these processes is possible only through a dynamic limnological model. Such a model is currently being developed in the Geological Survey of Israel (Ministry of National Infrastructure). The environmental and economic assessments that will be based on the outcome of the model will provide decision makers with the information required to determine and shape the future of the proposed 'Peace Conduit' project.

10.6 Summary and Conclusions

The Dead Sea is a severely disturbed ecosystem, greatly damaged by anthropogenic intervention in its water balance. Since the 20th century, the Dead Sea level has dropped by more than 20 meters, and at present (year 2006) it is about 419 meters below mean sea level. Three alternatives for the future of the Dead Sea exist and need to be examined:

1. Maintaining the present situation. The Dead Sea level is expected to decline further to around -550 m, when a new equilibrium between inflow and evaporation will be reached.
2. Changing the regional water policy whereby freshwater from the Jordan and the Yarmouk river systems will be diverted back to the Dead Sea. In view of the severe regional water deficiency, such a program requires unprecedented regional cooperation and investments to compensate for the freshwater that will be diverted back to the Dead Sea.
3. Construction of the 'Peace Conduit' that will divert seawater and/or reject brine after desalination, into the Dead Sea. Such a plan has already been announced by Israel and Jordan during the Johannesburg World Summit on sustainable development.

The implementation of the 'Peace Conduit' differs from intervention with an undisturbed natural ecosystem. The project has the potential of stopping undesired environmental processes that currently occur in the basin such as the decline in lake level, retreat of the shoreline, and the collapse of the surrounding infrastructure. However, the mixing of seawater in the Dead Sea brine has the potential of bringing about changes, some of which are undesirable, to the Dead Sea with significant negative environmental and economic impacts. These changes include renewed stratification of the water column, precipitation of gypsum upon mixing, change in rate of evaporation, microbial blooming in the diluted surface waters, development of anoxic conditions in the lower water column and on the long run, change in the composition of the Dead Sea brine. It is imperative that these changes be quantified in an integrative dynamic limnological model and evaluated before a decision is taken regarding the implementation of the 'Peace Conduit'.

References

Abelson, M.; Baer, G.; Shtivelman V.; Wachs, D.; Raz, E.; Crouvi O.; Kurzon, I.; Yechieli, Y., 2003 "Collapse-sinkholes and radar interferometry reveal neotectonics concealed within the Dead Sea basin", in: *Geophysical Research Letters*, 30,52: 1–4.

Abelson, M.; Yechieli, Y.; Bein, A.; Shtivelman, V.; Crouvi, O.; Calvo, R.; Steinberg, J.; Baer, G.; Wachs, D., 2004: "Classification and mapping of potential level for the development of the Dead Sea sinkholes", in: *Geological Survey of Israel Report*, GSI/13/2004 [in Hebrew].

Allen, W., 1855: *The Dead Sea, A New Route to India* (London: Longman, Brown, Green, Longmans).

Anati, D.A.; Stiller, M., 1991: "The post-1979 thermohaline structure of the Dead Sea and the role of double-diffusive mixing", in: *Limnology and Oceanography*, 36,2: 342–354.

Avni, Y.; Zilberman, E.; Shirav, M., 2003: "Response of the geomorphologic system the Dead Sea water level declination and its implications on the surrounding infrastructure", in: *Geological Survey of Israel Report*. GSI/9/03.

Baer, G.; Schattner, U.; Wachs, D.; Sandwell, D.; Wdowinski, S.; Frydman, S., 2002: "The lowest place on Earth is subsiding – an InSAR (interferometric synthetic aperture radar) perspective", in: *Geological Society of America Bulletin*, 114: 12–23.

Bookman, R.; Enzel, Y.; Agnon, A.; Stein, M., 2004: „Late Holocene lake-levels of the Dead Sea", in: *Bulletin of the Geological Society of America*, 116: 555–571.

Gavrieli, I.; Bein, A.; Oren, A., 2005: "The expected impact of the "Peace Conduit" project (the Red Sea - Dead Sea pipeline) on the Dead Sea, in: *Mitigation and Adaptation Strategies for Global Change*, 10(1), 3–22. Erratum: p. 739 and pp. 759–777

Gavrieli, I.; Lanski, N.; Yaari-Gazit, N.; Oren, A., 2002: "The Impact of the Proposed "Peace Conduit" on the Dead Sea: Evaluation of Current Knowledge on Dead Sea – Seawater Mixing", in: *Geological Survey of Israel*, Report GSI/23/2002.

Gavrieli, I.; Oren, A., 2004: "The Dead Sea as a dying lake", in: Nihoul, J.C.J.; Zavialo P.; Micklin P.P (Eds.). *Dying and Dead Seas; Climatic versus Anthropogenic causes*. NATO ARW/ASI Series, (Dordrecht: Kluwer): 287–306.

Gertman, I.; Hecht, A., 2002: "The Dead Sea hydrography from 1992 to 2000", in: *J. Marine Systems*, 35: 169–181.

Harza JRV Group, 1996: *Red Sea-Dead Sea Canal Project, Draft Prefeasibility Report*, Main Report. Jordan Rift Valley Steering Committee of the Trilateral Economic Committee.

Herzl, T., 1902: *Altneuland* (Berlin: Verlag Benjamin Harz).

Katz, A.; Starinsky, A., Taitel-Goldman, N., Beyth, M.; 1981: "Solubilities of gypsum and halite in the Dead Sea in its mixtures with seawater", in: *Limnology and Oceanography*, 26: 709–716.

Krumgalz, B.S.; Hecht, A.; Starinsky, A.; Katz, A., 2000: "Thermodynamic constraints on Dead Sea evaporation: can the Dead Sea dry up?", in: *Chemical Geology*, 165: 1–11.

Lensky, N.G.; Dvorkin, Y.; Lyahovsky, V.; Gertman, I.; Gavrieli, I., 2005: "Mass and energy balance of a hypersaline lake: the Dead Sea", in: *Water Resources Research*, 41, W12418, doi:10.1029/2005WR004084.

Levy, Y., 1984: "The influence of the admixture rate of partly evaporated Mediterranean water to the Dead Sea on the properties of gypsum that is formed in the brine". Mediterranean – Dead Sea projects, Summary of Research and Surveys. Mediterranean - Dead Sea Company 5, 279–282 [in Hebrew].

Levy, Y.; Kushnir, Y., 1981: "Laboratory Measurements of Nucleation Processes and the Growth of Gypsum in the Mediterranean – Dead Sea Mixed Brine", in: *Geological Survey of Israel Report* (Rehovot: The Weizmann Institute of Science).

Mediterranean - Dead Sea Company, 1984: *Mediterranean - Dead Sea Projects*. Vol. 5, Summary of Research and Surveys. reports in Hebrew and English.

Neev, D.; Emery, K.O., 1967: "The Dead Sea: Depositional Processes and Environments of Evaporites", in: *Geological Survey of Israel Bulletin*, 41: 147 pp.

Oren, A., 1993: "The Dead Sea - alive again", in: *Experientia,* 49: 518–522.

Oren, A.; Shilo, M., 1985: "Factors determining the development of algal and bacterial blooms in the Dead Sea: a study of simulation experiments in outdoor ponds", in: *FEMS Microbiology Ecology*, 31: 229–237.

Oren, A.; Gavrieli, I.; Gavrieli, J.; Lati, J.; Kohen, M.; Aharoni, M., 2004: "Biological effects of dilution of Dead Sea water with seawater: implications for the planning of the Red Sea – Dead Sea 'Peace Conduit'", in: *Journal of Marine Systems*, 46: 121–131.

Salameh, E.; El-Naser, H., 2000: "Changes in the Dead Sea level and their impacts on the surrounding groundwater bodies", in: *Acta Hydrochimica et Hydrobiologica*, 28: 24–33.

Stanhill, G., 1994: "Changes in the rate of evaporation from the Dead Sea", in: *International Journal of Climatology*, 14, 465–471.

Stein, M., 2002: "The fall and rise of the Dead Sea during the post – Glacial and the Younger Dryas event", in: *Geochimica et Cosmochimica Acta 12th Annual Goldschmidt Conference*. Davos, Abstract A738.

Steinhorn, I., 1985: "The disappearance of the long-term meromictic stratification of the Dead Sea", in: *Limnology and Oceanography*, 30, 451–472.

Steinhorn, I.; Assaf, G.; Gat, J.R.; Nishri, A.; Nissenbaum, A.; Stiller, M.; Beyth, M.; Neev, D.; Graber, R.; Friedman, G.M.; Weiss, W., 1979: "The Dead Sea: Deepening of the mixolimnion signifies the overturn of the water column", in: *Science*, 206: 55–57.

Stiller, M.; Chung, Y.C., 1984: "Radium in the Dead Sea: A possible tracer for the duration of meromixis", in: *Limnology and Oceanography*, 29: 574–586.

Wachs, D.; Yechieli, Y.; Shtivelman, V.; Itamar, A.; Baer, G.; Goldman, M.; Raz, E.; Rybekov, M.; Schattner, U., 2000: "Formation of Sinkholes along the Dead Sea Shore – Summary of Findings from the First Stage of Research", in: *Geological Survey of Israel Report*. GSI/41/2000.

Yechieli, Y.; Gavrieli, I.; Berkowitz, B.; Ronen D., 1998: "Will the Dead Sea die?", in: *Geology*, 26: 755–758.

Yechieli, Y.; Abelson, M.; Bein, A.; Cruvi, O.; Shtivelman,V., 2006: "Sinkhole 'swarms' along the Dead Sea coast: reflection of disturbance of lake and adjacent groundwater systems", in: *Geological Society of America Bulletin*, 118: 1075–1087..

Part III Water Trade and Water Markets

11 Water Management, Infrastructure, Negotiations and Cooperation: Use of the WAS Model

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Abstract

Joint efforts of Israeli, Jordanian, Palestinian, Dutch, and American experts have produced an optimizing model for water management, infrastructure analysis, and conflict resolution. That model – 'WAS', for 'Water Allocation System' – applies economic analysis, broadly defined, to the solution of water problems. It provides a systematic and system-wide method for analyzing water policies, infrastructure, negotiations, and conflict resolution.

- Infrastructure questions investigated include the necessity of desalination on the Mediterranean Coast and – for Jordan – the somewhat complicated interrelations of the various projects being considered to alleviate the coming water crisis in Amman (including the Disi fossil aquifer and the oft-discussed Red Sea-Dead Sea Canal.)
- It is shown how the WAS model can assist negotiations. Estimates of the effects of the water loss to Israel in the event of a return of the Golan to Syria or the pumping of the Hasbani by Lebanon show the effects to be small.
- The possible effects of Israeli-Palestinian cooperation in water are evaluated and shown to be a win-win situation for both parties.

The WAS model provides a powerful tool for domestic infrastructure analysis. More importantly, water is shown not to be worth war and to be a potential source of cooperation.

Keywords: Conflict Resolution, Cooperation, Cost-Benefit Analysis, Negotiations, Optimal Management

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1 This paper owes much to the book by: Fisher/Arlosoroff/Eckstein/Haddadin/Hamati/Huber-Lee/Jarrar/Jayyousi/Shamir/Wesseling (2005) which gives a much fuller discussion. An earlier version of some of the material was published as Fisher/Arlosoroff/Eckstein/Haddadin/Hamati/Huber-Lee/Jarrar/Jayyousi/Shamir/Wesseling (2002). See also Fisher (2002). All tables and figures are reprinted with permission from Fisher, et. al (2005).

11.1 Thinking about Water: The Fishelson Example

So important is water that there are repeated predictions of water as a *casus belli* all over the globe. Such forecasts of conflict, however, stem from a narrow way of thinking about water.

Water is usually considered in terms of quantities only. Two (or more) parties with claims to the same water sources are seen as playing a zero-sum game. The water that one party gets is simply not available to the other, so that one party's gain is seen as the other party's loss. Water appears to have no substitute save other water.

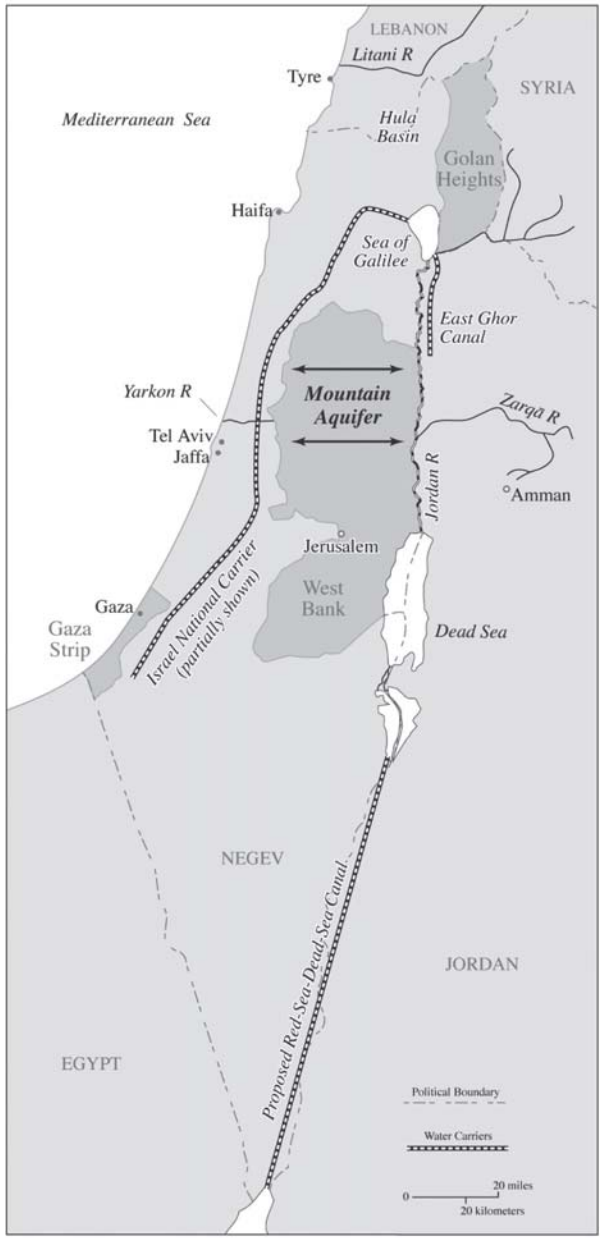
But there is another way of thinking about water problems, a way that can lead to dispute resolution and to optimal water management. That way involves thinking about the value of water and shows that water can be traded off for other things.

The late Gideon Fishelson, an outstanding economist of Tel Aviv University, once remarked that "Water is a scarce resource. Scarce resources have value, and, no matter how much one values water, one cannot value it at more than its cost of replacement."[2] He went on to point out that desalination of seawater puts an upper bound on the value of water to any country that has a seacoast. Consider, then, the following example:[3]

A major part of the conflicting water claims of Israel and Palestine[4] consists of rival claims to the water of the so-called Mountain Aquifer (see figure 11.1). That water comes from rainfall on the hills of the West Bank and then flows underground. Most of it (even before there was a state of Israel) has always been pumped in pre-1967 Israel, in or near the coastal plain where the well depths are considerably less than in the West Bank

Now, the cost of desalination on the Mediterranean Coast of Israel and Palestine is currently between 50 and 60 U.S. cents per cubic meter (m^3). For purposes of this example, I shall use 60 ¢/m^3. Fishelson's principle means that the value of water on the Mediterranean Coast can never exceed 60 ¢/m^3 (unless there are large changes in energy prices). But the water of the Mountain Aquifer is not on the Mediterranean Coast. To extract it and convey it to the cities of the coast[5] would cost roughly 40 ¢/m^3. But that

Figure 11.1: Simplified Map of the 'Middle East' (Israel, Jordan, and Palestine), Its Major Water Resources, and Major Conveyance Infrastructure.



2 In this paper, 'valuing water' means valuing molecules of H_2O. Particular water sources can, of course, be valued for historical or religious reasons, but such value is not the value of the water as water.

3 In this example, I have updated Fishelson's calculation to reflect current estimates.

4 The use of names is a sensitive subject. I do not intend here to prejudge the ultimate outcome of the Israeli-Palestinian conflict. I use the term, 'Palestine', out of respect for my Palestinian colleagues, and because nearly all sides now predict the existence of a Palestinian state.

means that the value of Mountain Aquifer water *in situ* cannot exceed 20 ¢/m^3 (60 ¢/m^3 – 40 ¢/m^3).

To put this in perspective, observe that 100 million cubic meters (MCM) per year of Mountain Aquifer water is a very large amount in the dispute. If the Palestinians were to receive this, they would have nearly double the amount of water they now have. But the Fishelson calculation shows that 100 MCM/yr. of Mountain Aquifer water is not worth more than $ 20 million per year.[6] This is a trivial sum between nations. Certainly, it is not worth continued conflict.

And it must not be thought that the desalination-cost driven numbers are more than an upper bound. We find below that desalination will not be cost-effective on the Mediterranean Coast for a number of years except in times of very substantial drought. In more normal times, the water of the Mountain Aquifer is worth much less than 20 ¢/m^3.

11.2 The Water Economics Project

Fishelson's remarks were a principal impetus to the creation of the Water Economics Project (WEP).[7] That project of which I am the chair is a joint effort of Israeli, Jordanian, Palestinian, Dutch, and American experts). It is facilitated by the government of The Netherlands with the knowledge and assent, but not necessarily the full agreement, of the regional governments. The WEP has produced a tool for the rational analysis of water systems and water problems. Its goals are as follows:

1. To create models for the analysis of domestic water systems. These models can be used by planners to evaluate different water policies, to perform cost-benefit analyses of proposed infrastructure taking system-wide effects and opportunity costs into account, and generally for the optimal management of water systems.
2. To facilitate international negotiations in water. This has several aspects:
   - The use of the Project's models leads to rational analysis of water problems. In particular, it separates the problems of water ownership and water usage. In so doing, it enables the user to value water ownership in money terms (after imposing his or her own social values and policies). This enables water negotiations to be conducted with water seen as something that can, in principle, be traded. Further, since the Project shows that water values are not, in fact, very high (partly because of the availability of seawater desalination), the water problem can be made a manageable one. (The Project has had some success in promoting this point of view among professionals, but it is certainly far from universally understood or accepted.)
   - Even using the Project's tools to investigate the water economy of the user's own country, the user can evaluate the effect of different water ownership settlements. (By making assumptions as to the data, policies, and forecasts of other parties, the user can also gain information as to the effects on them.) This should assist in preparing negotiating positions if the ultimate agreement is to be of the standard water-ownership-division type with no further cooperation.
   - Perhaps most important of all, the Project shows clearly that continued cooperation in water tends to be for the benefit of all parties. Such cooperation in the form of an agreement to trade water at model prices can lead to very large gains to all participants (sellers as well as buyers) and is a superior solution to the standard water-quantity-division agreement. Our results show that there are very large benefits to both Israel and Palestine from such an arrangement. The gains are far larger than the value of ownership of more or less of the disputed water is likely to be.
   - Beyond the economic gains of such an arrangement are the gains from a flexible, cooperative water agreement in which allocations change for everyone's benefit as situations change. Such an agreement can turn water from a source of stress into a source of cooperation.

In sum, the Project hopes to promote 'outside-the-box' thinking about water problems and thus to remove them as an obstacle to peace negotiations. The rest of this paper explains the ideas and some of the results of the WEP in more detail.

5 This example assumes that this would be the efficient use of Mountain Aquifer water. Other cases are more complicated but do not lead to qualitatively different conclusions.

6 I use 100 MCM/yr. only as a metric. The qualitative conclusion would be the same if one took 200, 300, or more MCM/yr. All money values are in 1995 prices.

7 Formerly the Middle East Water Project (MEWP).

11.3 Water Values, Not Water Quantities

Returning to Fishelson's example, the result of the calculation of the value of the water of the Mountain Aquifer may seem surprising. But the really important insight here is that one should think about water by analyzing water values and not just water quantities. This should not come as a surprise. After all, economics is the study of how scarce resources are or should be allocated to various uses. Water is a scarce resource, and its importance to human life does not make its allocation too important to be rationally studied.

In the case of most scarce resources, free markets can be used to secure efficient allocations. This does not always work, however; the important results about the efficiency of free markets require the following conditions:

1. The markets involved must be competitive consisting only of very many, very small buyers and sellers.
2. All social benefits and costs associated with the resource must coincide with private benefits and costs, respectively, so that they will be taken into account in the profit-and-loss calculus of market participants.

Neither of these conditions is generally satisfied when it comes to water, partly because water markets will not generally be competitive with many small sellers and buyers, and partly because water in certain uses – for example, agricultural or environmental uses – is often considered to have social value in addition to the private value placed on it by its users. The common use of subsidies for agricultural water, for example, implies that the subsidizing government believes that water used by agriculture is more valuable than the farmers, themselves, consider it to be.

This does not mean, however, that economic analysis has no role to play in water management or the design of water agreements. One can build a model of the water economy of a country or region that explicitly optimizes the benefits to be obtained from water, taking into account the issues mentioned above.[8] Its solution, in effect, provides an answer in which the optimal nature of markets is restored and serves as a tool to guide policy makers.

Such a tool does not itself make water policy. Rather it enables the user to express his or her priorities and then shows how to implement them optimally. While such a model can be used to examine the costs and benefits of different policies, it is not a substitute for, but an aid to the policy maker.

It would be a mistake to suppose that such a tool only takes economic considerations (narrowly conceived) into account. The tool leaves room for the user to express social values and policies through the provision of low (or high) prices for water in certain uses, the reservation of water for certain purposes, and the assessment of penalties for environmental damage. These are, in fact, the ways that social values are usually expressed in the real world.

First briefly the theory behind such tools is outlined as applied to decisions within a single country. Then the implications for water negotiations and the structure of water agreements are considered and examples are given drawn from the analysis of water in the Middle East.

11.4 The WAS Tool

The tool is called WAS for 'Water Allocation System'. At present, it is a single year, annual model, although the conditions of the year can be varied and different situations evaluated. The country or region to be studied is divided into districts. Within each district, demand curves for water are defined for household, industrial, and agricultural use of water. Extraction from each water source is limited to the annual renewable amount. Allowance is made for treatment and reuse of wastewater and for interdistrict conveyance. This procedure is followed using actual data for a recent year and projections for future years.

Environmental issues are handled in several ways. Water extraction is restricted to annual renewable amounts; an effluent charge can be imposed; the use of treated wastewater can be restricted; and water can be set aside for environmental (or other) purposes. Other environmental restrictions can also be introduced.

The WAS tool permits experimentation with different assumptions as to future infrastructure. For example, the user can install wastewater treatment plants, expand or install conveyance systems, and create seawater desalination plants.

8 The pioneering version of such a model (although one that does not explicitly perform maximization of net benefits) is that of Eckstein/Zackay/Nachtom/Fishelson (1994).

Finally, the user specifies policies toward water. Such policies can include: specifying particular price structures for particular users; reserving water for certain uses; imposing ecological or environmental restrictions, and so forth.

Given the choices made by the user, the model allocates the available water so as to maximize total net benefits from water. These are defined as the total amount that consumers are willing to pay for the amount of water provided less the cost of providing it.[9]

Along with the optimal allocation of water, WAS generates a *shadow value* for water in each district. The shadow value of water in a district shows the amount by which net benefits would increase if there were an additional cubic meter of water available there. It is the true value of additional water in that district. Similarly, the shadow value of water at the source is the *scarcity rent* of the water in that source – the true measure of what water is worth at the margin.

One should not be confused by such use of marginal valuation. The fact that water is necessary for human life is taken into account in WAS by assigning large benefits to the first, relatively small quantities of water allocated. But the fact that the benefits derived from the first units are greater than the marginal value does not distinguish water from any other economic good. It merely reflects the fact that demand curves slope down and that water would be (even) more valuable if it were scarcer.

It is the scarcity of water and not merely its importance for existence that gives water its value. Where water is not scarce, it is not valuable.

WAS provides a powerful tool for the analysis of the costs and benefits of various infrastructure projects. For example, if one runs the model without assuming the existence of seawater desalination facilities, then the shadow values in coastal districts provide a cost target that seawater desalination must meet to be economically viable. Alternatively, by running the model with and without a proposed conveyance line, one can find the increase in annual benefits that the line in question would bring. Taking the present discounted value of such increases gives the net benefits that should be compared with the capital cost of plant construction. Note that such calculations take into account the system-wide effects that result from the projected infrastructure.

9 The total amount that consumers are willing to pay for an amount of water, Q*, is measured by the area up to Q* under their aggregate demand curve for water. Note that "willingness to pay" includes ability to pay. The provision of water to consumers that are very poor is taken to be a matter for government policy embodied in the pricing decisions made by the user of WAS.

11.5 Infrastructure Analysis: Some Results

I now present some examples of WAS-generated results for Israel, Palestine, and Jordan. These are results for each of the parties separately assuming them only to have access to the water they now have (in late 2006). Results involving cooperation are given later.

I begin with Israel and desalination. Figure 11.2 shows the shadow values obtained for 2010 both in a situation of normal availability of natural resources ('normal hydrology') – the upper numbers – and in a severe drought when that availability is reduced by 30 per cent – the lower numbers. Israel's price policy ('Fixed Price Policies') of 1995 are assumed to remain in effect. These policies heavily subsidize water for agriculture while charging much higher prices to household and industrial users. Note that Israel's practice of reducing the quantity of subsidized agricultural water in times of drought has not been modeled, so the results are *more* favorable to the need for desalination than would be the case in practice.[10]

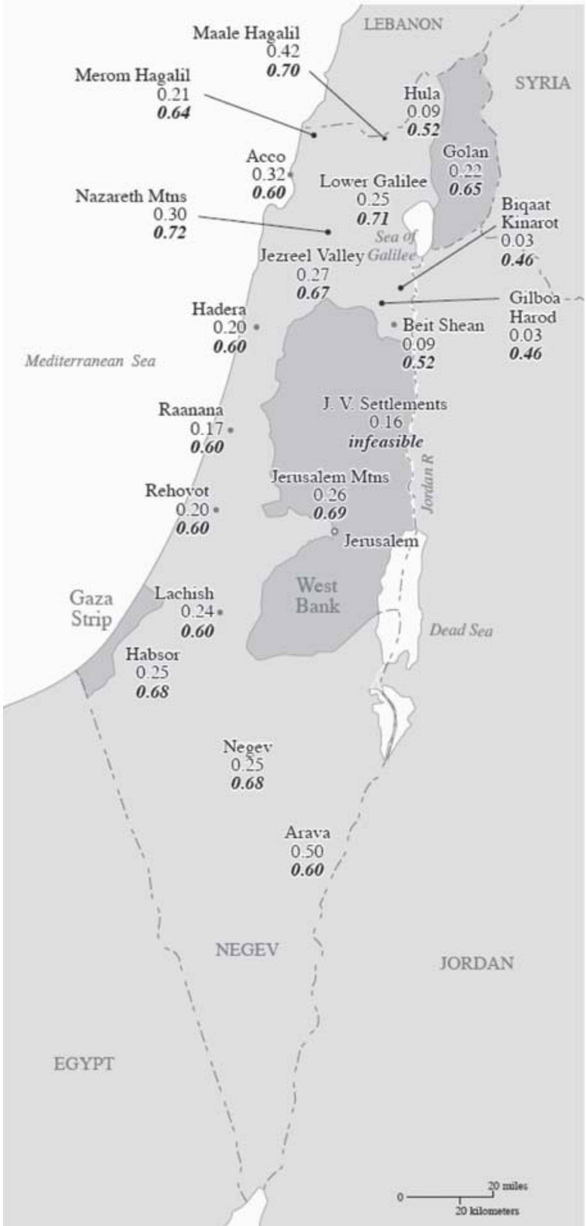
The important result with which to start can be seen in the upper shadow values for the coastal districts: Acco, Hadera, Raanan, Rehovot, and Lachish. The highest shadow value is at Acco and is only $ 0.319/m^3 – well below the cost of desalination. This means that desalination plants would not be needed in years of normal hydrology.

On the other hand, such plants would be desirable in severe drought years. In the lower numbers in figure 11.2, desalination plants operate in all the coastal districts at an assumed cost of $ 0.60/m^3. The required sizes of such plants (obtained by running WAS without restricting plant capacity and observing the resulting plant output) are given in table 11.1.

Results for 2020 are similar, although, as one should expect, it does not take so severe a drought to make desalination efficient, and the required plant sizes are larger.

10 The infeasibility listed for the Jordan Valley Settlements in the drought case reflects the fact that the full amount of subsidized water required for the supply of agriculture there cannot be delivered.

Figure 11.2: 2010 Shadow Values with Desalination: Normal Hydrology vs. 30 Per Cent Reduction in Naturally Occurring Fresh Water Sources; Fixed-Price Policies in Effect.



Of course, much of the cost of desalination consists of capital costs – here included in the price (or target price) per m^3. Such costs are largely incurred when the plant is constructed. After that, the plants would be used in normal years unless the operating costs were above the upper shadow values in figure 11.2 (highest $0.319/$m^3$). Israel therefore needs to consider whether the insurance for drought years provided by building desalination plants is worth the excess capital costs.[11] (Note that the system of Fixed Price Policies contributes substantially to the need for desalination; without such policies, the plants required for severe drought would be far smaller than shown in table 11.1, and some would not be required at all.)

Table 11.1: Desalination (or Import) Requirements in Mediterranean Coastal Districts in 2010 with 30 per cent Reduction in Natural Fresh Water Sources and Fixed-Price Policies in Effect.

District	Water Requirements (MCM/Yr.)
Acco	80
Hadera	64
Raanana	17
Rehovot	51
Lachish	29
TOTAL	241

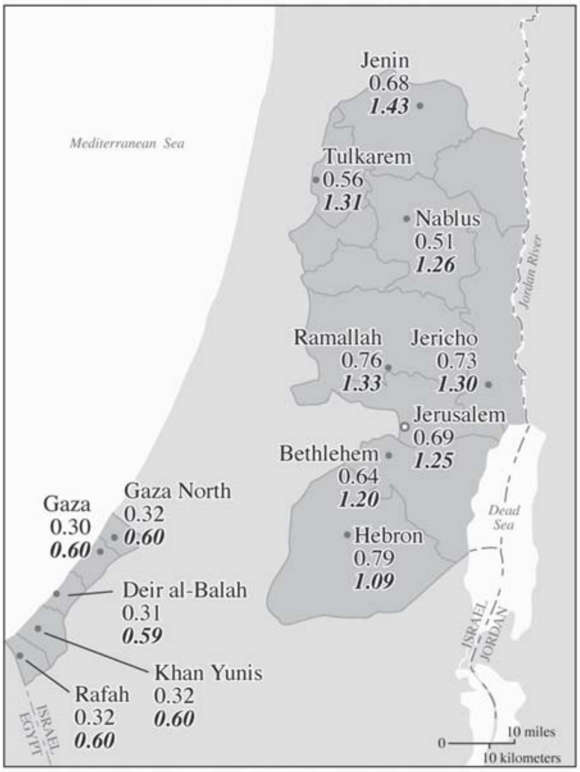
11.5.1 Desalination: Palestine

A similar analysis for Palestine produces a quite surprising result. Palestine can desalinate seawater only on the seacoast of the Gaza Strip (figure 11.1). Consider figure 11.3. Here results for 2010 are presented on the assumption that Palestine builds recycling plants and conveyance lines.

The upper shadow values are for the case in which Palestine has only its current natural water resources. We see that desalination at $0.60/$m^3$ is efficient in two of the Gazan districts. But the reason for this is not the obvious one of population growth in Gaza. Rather, it is because, with its limited water resources on the Southern West Bank, it would actually pay Palestine to desalinate water in Gaza and *pump it uphill* to Hebron! This can be seen from the fact that if the Palestinian West Bank water were doubled, and the lower shadow values obtained, desalination would cease to be efficient at prices higher than $0.356/$m^3$. Of course, this result is for a year of normal hydrology and for a middle estimate of Gazan population growth, but the main point is there. Without more water or cooperation in water with Israel (see below), Palestine should build one or more desalination plants at Gaza by 2010; but with more water on the West Bank or with cooperation with Israel, that neces-

11 Note that a multi-year version of WAS (discussed below) could be of substantial aid in such a calculation.

Figure 11.3: Comparison of Full-Infrastructure Scenario with (upper values) and without (lower values) Double the Quantity from the Mountain Aquifer, 2010.



sity will disappear. Even in 2020, the need for Gazan desalination plants will remain a close question in years of normal hydrology, our results suggesting that such plants would be barely cost-efficient at costs above $ 0.55/m^3. An important implication of these results will appear when we consider cooperation below.

11.5.2 Jordan and the Interdependence of Infrastructure Decisions

For Jordan (where seawater desalination is currently possible only at Aqaba on the Red Sea), I report results on other issues. Without action, Jordan faces an increasing water crisis in Amman and nearby districts. Indeed, our results show that if nothing were done, the shadow value of water in Amman would reach roughly $ 27/m^3 by 2020 (and that in years of normal hydrology). This is not a tenable situation, and the value of $ 27/m^3 is not presented as a value that people will pay for water but as an indication of the coming water-scarcity crisis. To alleviate this, Jordan has various options:

1. Jordan is increasing the capacity of the conveyance line that takes Jordan River water to Amman from 45 MCM per year to 90 MCM per year. This would reduce the shadow value in Amman in 2020 from $ 27.23 to $ 10.56 per cubic meter. The gain in net benefits in 2010 is only approximately $ 2 million per year, but by 2020, that gain reaches almost $ 500 million per year. (Our evaluation of the other options assumes this conveyance line to be in place.)
2. Jordan could act to reduce the large leakage in pipes in Amman and other districts. We find that, by 2020, this would result in an increase in Jordanian water benefits of about $ 250 million *per year*, probably making it worth the capital costs involved – not counting the disruption to the population. Nevertheless, this does not satisfactorily alleviate the crisis, only reducing the shadow value in Amman to about $ 6.43/m^3, still unacceptably high.
3. Jordan is considering the construction of a conveyance line from the Disi fossil aquifer to Amman. This will help considerably. If the conveyance line will carry about 100 MCM per year by 2020, then the benefits from its construction will reach more than $ 300 million per year by that date. The resulting shadow value in Amman would be about $ 1.44/m^3, still high, but not catastrophically so. Adding leakage reduction to this would take the value down to about $ 1.13, but, of course, such reduction might not then be worth the capital costs involved, the added benefits as of 2020 falling from $ 250 million per year in the absence of the Disi-Amman pipeline to about $ 93 million per year in its presence. It should also be noted that, given the expansion of the conveyance line from the Jordan River, the Disi-Amman pipeline would not be used in 2010.
4. There are grand plans for the oft-discussed Israeli-Jordanian construction of a canal to take water from the Red Sea to the Dead Sea, the so-called "Peace Canal". While the canal, if it is built, will largely be built for other reasons, there would be water benefits associated with it. In particular, it is planned to use the downfall of water in the canal to generate electricity, and then to use that electricity to desalinate some of the seawater involved and pump it to Amman. It is estimated that it would cost about 22 ¢/m^3 to pump such water uphill to Amman. With the shadow value in Amman at least $ 1.13/m^3, as a result of the combination of leakage reduction and the transfer of water from

> the Disi Aquifer, this would be efficient if such desalination would cost less than about \$ 0.91/m^3. This seems guaranteed *if the main capital costs of canal construction and electricity generation are allocated to other uses* and the capital costs of desalination include only the construction of the desalination plant and the laying of the pipeline from the plant to Amman. The energy costs involved in operating costs would surely be lower with hydroelectric generation than in fuel-fired plants.

But note the following: The effects of the Red Sea-Dead Sea project would undoubtedly reduce the shadow value of water in Amman to a figure well below \$ 1.13/m^3 in 2020. If the shadow value in Amman were at such a level, it would no longer make sense to transport water to Amman from the Disi Aquifer. In such a case, that water could efficiently be used in the Aqaba district, quite possibly forestalling the necessity of a desalination plant there.

This does not mean that it would be a mistake to build the Disi-Amman pipeline. Far from it. First, the Red Sea-Dead Sea Canal may never be built. Second, if it is, it will be a long time before it is complete. During that period, and after 2010, the Disi-Amman pipeline may very well be highly necessary to avert the Amman water crisis.[12]

Note how the benefits of an infrastructure project depend on what other projects have been undertaken. Note further how WAS can be used to investigate such interdependencies.

11.6 Water Ownership and the Value of Water

I now turn to the use of WAS in the resolution of water disputes. The view of water as an economic, if special, commodity has important implications for the design of a lasting water arrangement that is to form part of a peaceful agreement among neighbors. There are two basic questions involved in thinking about water agreements: These are:

- the question of water ownership and
- the question of water usage.

One must be careful to distinguish these questions.

All water users are effectively buyers irrespective of whether they own the water themselves or purchase water from another. An entity that owns its water resources and uses them itself incurs an opportunity cost equal to the amount of money it could otherwise have earned through selling the water. An owner will thus use a given amount of its water if and only if it values that use at least as much as the money to be gained from selling. The decision of such an owner does not differ from that of an entity that does not own its water and must consider buying needed quantities of water: the non-owner will decide to buy if and only if it values the water at least as much as the money involved in the purchase. *Ownership only determines who receives the money (or the equivalent compensation) that the water represents.*

Water ownership is thus a property right entitling the owner to the economic value of the water. Hence a dispute over water ownership can be translated into a dispute over the right to monetary compensation for the water involved.

The property rights issue of water ownership and the essential issue of water usage are analytically independent. For example, resolving the question of where water should be efficiently pumped does not depend on who owns the water. While both ownership and usage issues must be properly addressed in an agreement, they can and should be analyzed separately.[13]

The fact that water ownership is a matter of money can be brought home in a different way. It is common for countries to regard water as essential to their security because water is essential for agriculture and countries wish to be self-sufficient in their food supply. This may or may not be a sensible goal, but the possibility of desalination implies the following:

Every country with a seacoast can have as much water as it wants if it chooses to spend the money to do so. Hence, so far as water is concerned, every country with a seacoast can be self-sufficient in its food supply if it is willing to incur the costs of acquiring the necessary water. Disputes over water among

12 If the only problem in Jordanian water management were the coming crisis in Amman, then this could be readily solved by a further expansion of the conveyance system bringing water from the Jordan River to the capital. (It is interesting to note that expansion of the conveyance system, *not* additional water *ownership* is what would be directly involved.) However, this would divert the river water from its current principal use in which it is mixed with wastewater and used in agriculture in the Jordan Valley. Jordan could not then continue to subsidize Jordan Valley agriculture. The effects of such an action are not readily captured without an analysis of the social consequences.

13 This is an application of the well-known Coase Theorem of economics. See Coase (1960).

such countries are merely disputes over costs, not over life and death.

The monetization of water disputes may be of some assistance in resolving them. Consider bilateral negotiations between two countries, A and B. Each of the two countries can use its WAS tool to investigate the consequences to it (and, if data permit, to the other) of each proposed water allocation. This should help in deciding on what terms to settle, possibly trading off water for other, non-water concessions. Indeed, if, at a particular proposed allocation, A would value additional water more highly than B, then both countries could benefit by having A get more water and B getting other things which it values more. (Note that this does not mean that the richer country gets more water. That only happens if it is to the poorer country's benefit to agree.)[14]

Of course, the positions of the parties will be expressed in terms of ownership rights and international law, often using different principles to justify their respective claims. The use of the methods here described in no way limits such positions. Indeed, the point is not that the model can be used to help decide how allocations of property rights should be made. Rather the point is that water can be traded off for non-water concessions, with the trade-offs measured by WAS.

Moreover, such trade-offs will frequently not be large. For example, water on the Golan Heights (see figure 11.1) is often said to be a major problem in negotiations between Israel and Syria, because the Banias River that rises on the mountains of the Golan is one of the three principal sources of the Jordan River. By running the Israeli WAS model with different amounts of water, we have evaluated this question.

In 2010, the loss of an amount of water roughly equivalent to the entire flow of the Banias springs (125 million cubic meters annually) would be worth no more than $ 5 million per year to Israel in a year of normal water supply and less than $ 40 million per year in the event of a reduction of thirty percent in naturally occurring water sources. At worst, water can be replaced through desalination, so that the water in question (which has its own costs) can never be worth more than about $ 75 million per year. These results take into account Israeli fixed-price policies towards agriculture.

14 If trading off ownership rights considered sovereign is unacceptable, the parties can agree to trade short-term permits to use each others' water. See below.

Note that it is *not* suggested that giving up so large an amount of water is an appropriate negotiating outcome, but water is not an issue that should hold up a peace agreement. These are trivial sums compared to the Israeli GDP (gross domestic product) of approximately $ 100 billion per year or to the cost of fighter planes.

Similarly, a few years ago, Lebanon announced plans to pump water from the Hasbani River – another source of the Jordan. Israel called this a *casus belli*, and international efforts to resolve the dispute were undertaken. But whatever one thinks about Lebanon's right to take such an action, it should be understood that our results for the Banias apply equally well to the Hasbani. The effects on Israel would be fairly trivial.[15, 16] *Water is not worth war!*

11.7 Cooperation: Gains from Trade in Water Permits

Monetization of water disputes, however, is neither the only nor, perhaps, the most powerful way in which the use of WAS can promote agreement. Indeed, WAS can assist in guiding water cooperation in such a way that all parties gain.

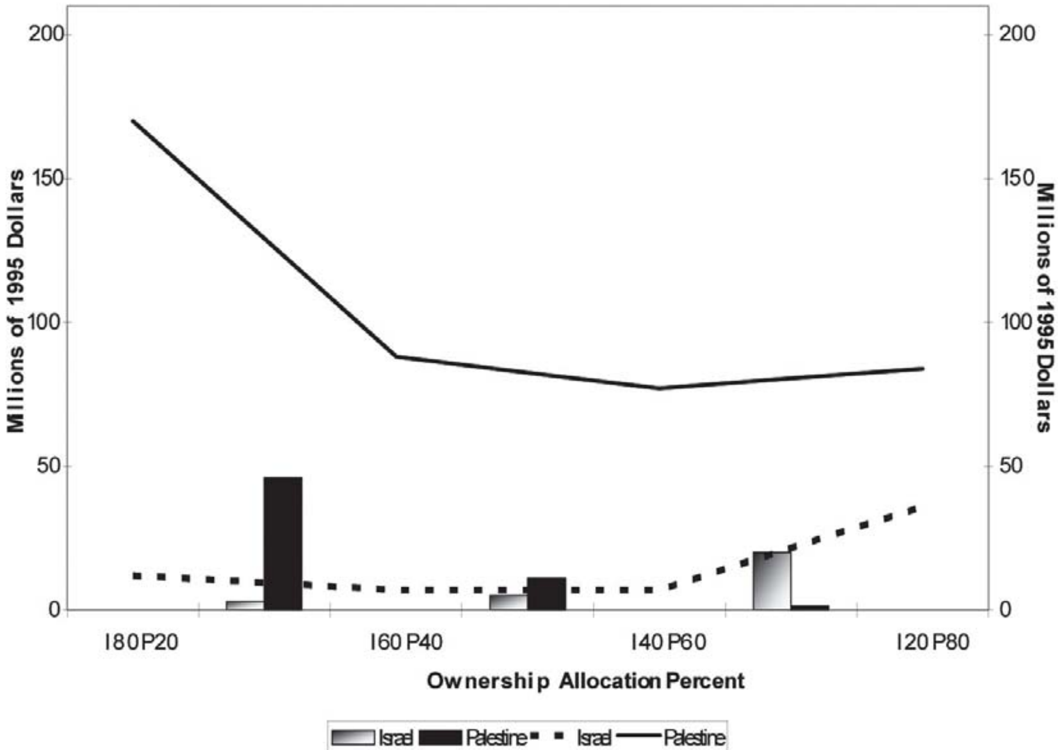
The simple allocation of water quantities after which each party then uses what it "owns" is not an optimal design for a water agreement. Suppose that property rights issues have been resolved. Since the question of water ownership and the question of water usage are analytically independent, it will generally not be the case that it is optimal for each party simply to use its own water.

Instead, consider a system of trade in water permits – short term licenses to use each other's water. The purchase and sale of such permits would be in quantities and at prices (shadow values) given by an agreed-on version of the WAS model run jointly for the two (or more) countries together. (The fact that such trades would take place at WAS-produced prices would prevent monopolistic exploitation). There would be mutual advantages from such a system, and

15 The precise quantitative results depend, of course, on the data and assumptions used. I am informed that other calculations come up with somewhat larger figures. But the qualitative results would be no different.

16 Of course, the question naturally arises as to what the effects on Syria and Lebanon, respectively would be in these two situations. Without a WAS model for those two countries, I cannot answer that question. Both countries would surely profit from such a model.

Figure 11.4: Value of Israel-Palestine Cooperation and Value of Ownership of Mountain Aquifer Without Cooperation: 2010 – Israeli Fixed Priced Policies in Effect.



the economic gains would be a natural source of funding for water-related infrastructure.

Both parties would gain from such a voluntary trade. The seller would receive money it values more than the water given up (else, it would not agree); the buyer would receive water it values more than the money paid (else, it would not pay it). While one party might gain more than the other, such a trade would not be a zero-sum game but a win-win opportunity.

The WEP has estimated the gains to Israel and Palestine from such cooperation and finds them to exceed the value of changes in water ownership that reflect reasonable differences in negotiating positions.

To illustrate this, we examine the gains to Israel and Palestine from such cooperation starting from varying assumptions about the ownership of the Mountain Aquifer. (see figure 11.1.) To simplify matters, the case to be examined is one in which Israel makes use of all the water of the Jordan River. This is to be taken as merely an assumption made for the purposes of generating illustrative examples; it is *not* a political statement as to the desirable outcome of negotiations. We find such gains generally to exceed the value of changes in such ownership that reflect reasonable differences in negotiating positions.

Figures 11.4 and 11.5 illustrate such findings and more for years of normal hydrology. In those figures, we have arbitrarily varied the fraction of Mountain Aquifer water owned by each of the parties from 80 per cent to 20 per cent. (The present division of the water is about 76 per cent to Israel and 24 per cent to Palestine.[17] Results for that division can be approximated by interpolation, but are, of course, fairly close to those for 80 per cent Israeli ownership.)

The two line graphs in figure 11..4 show the gains from cooperation in 2010 for Israel and Palestine, respectively, as functions of ownership allocations.[18] Israeli price policies for water ("Fixed Price Policies")

17 The 'Mountain Aquifer' actually consists of several sub-aquifers. It is very difficult to secure accurate information on how the water in each of these is now divided. The 76 per cent-24 per cent split mentioned in the text is therefore an approximation applying to the total. In the runs reported below, where necessary, we have used that split to represent existing circumstances. Of course, the general conclusions are not affected by this, and the quantitative results cannot be far off.

are assumed to be the same as in 1995, with large subsidies for agriculture and much higher prices for households and industry.

Starting at the left, we find that Palestine benefits from cooperation by about $ 170 million per year when it owns only 20 per cent of the aquifer.[19] In the same situation, Israel benefits by about $ 12 million per year. As Palestinian ownership increases (and Israeli ownership correspondingly decreases), the gains from cooperation fall at first and then rise. At the other extreme (80 per cent Palestinian ownership), Palestine gains about $ 84 million per year from cooperation, and Israel gains about $ 36 million per year. In the middle of the figure, total joint gains are about $ 84–95 million per year.[20]

It is important to emphasize what these figures mean. As opposed to autarky, each party benefits as a buyer by acquiring cheaper water. Moreover, each party benefits as a seller *over and above* any amounts required to compensate its people for increased water expenses.

Why do the gains first decrease and then increase as Palestinian ownership increases? That is because, at the extremes, there are large gains to be made by transferring water from the large owner to the other party. Palestine has large benefits at the left-hand side of the diagram because it can obtain badly needed water; it has large gains at the right-hand side because, when it owns most of the Mountain Aquifer water, it can gain by selling relatively little-needed water to Israel (who gains as well). The same phenomenon holds in reverse for Israel – although there the effects are smaller, largely because Israel is assumed to own a great deal of water from the Jordan River.

One might suppose that the gains would be zero at some intermediate point, but that is not the case. The reason for this is as follows:

It is true that a detailed, non-cooperative water agreement could temporarily reduce the gains from cooperation to zero. That would require that the agreement exactly match in its water-ownership allocations the water-*use* allocations of the optimizing cooperative solution. That is very unlikely to happen in practice (and, if it did, would only reach an optimal solution that would not last as populations and other factors changed). In our runs, it does not happen for two reasons.

1. We have not attempted to allocate ownership in the Mountain Aquifer in a way so detailed as to match geographic demands. Instead, we have allocated each common pool in the aquifer by the same percentage split.
2. There are gains from cooperation in these runs that do not depend on the allocation of the Mountain Aquifer. For example, it is always efficient for treated wastewater to be exported from Gaza to the Negev for use in agriculture.

There are further results to be read from figure 11.4. The heights of the various bars in the figure show the value to the parties *without cooperation* of a change in ownership of 10 per cent of the Mountain Aquifer (about 65 MCM per year or nearly half of the amount of Mountain Aquifer water now taken by the Palestinians). These are shown as functions of ownership positions midway within each 20 percentage point interval. For example, the left-hand-most set of bars shows the value to each of the parties of an ownership shift of 10 per cent of the Mountain Aquifer starting at an allocation of 70 per cent to Israel and 30 per cent to Palestine; the next set of bars examines the value of such a change starting at 50–50. Note that the value of cooperation is generally greater than, or at least comparable to, the value of such ownership changes. This is especially true for Palestine, but holds for Israel as well.

Further, now look at figure 11.5. This differs from figure 11.4 only in the height of the ownership-value bars. In figure 11.5, the height of those bars represents the value of shifts of 10 per cent aquifer ownership *in the presence of cooperation.* That value is about $ 8 million per year. The lesson is clear:

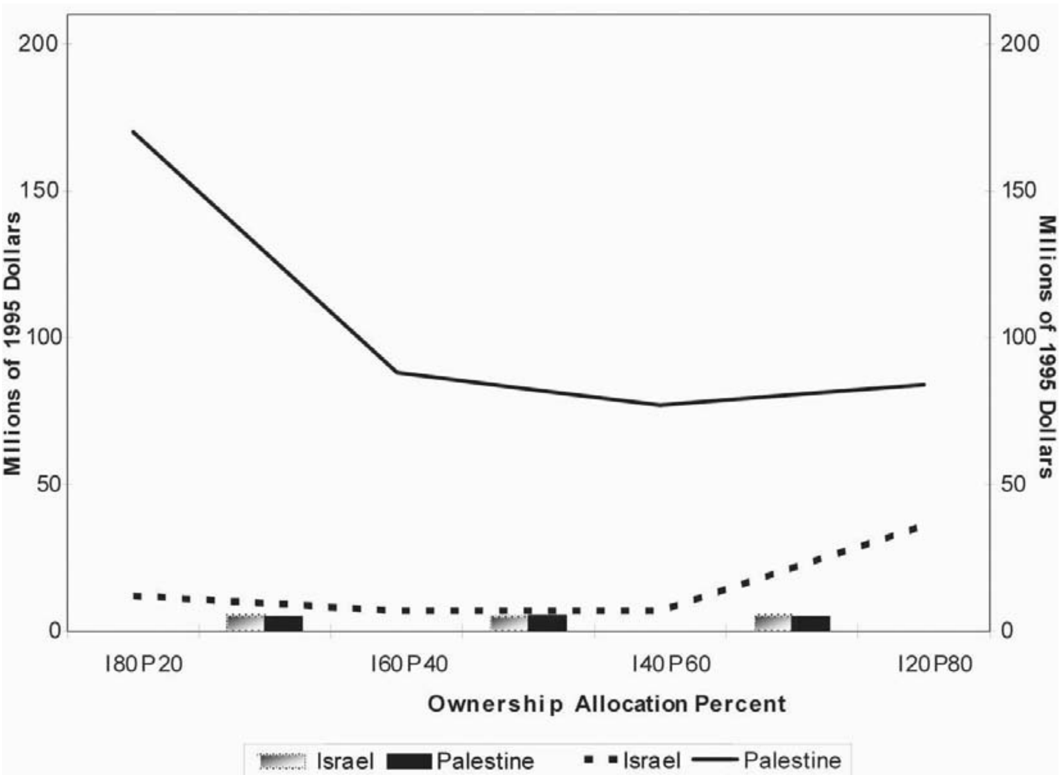
Ownership is surely a symbolically important issue, and symbols really matter. But cooperation in water reduces the practical importance of ownership allocations – already not very high – to an issue of very minor proportions. The results for 2020 are qualitatively similar to those for 2010.

18 The results discussed in this section are all for years of normal hydrology. Results for drought years are not qualitatively different, although all numbers are larger.

19 Here and later, the gains with this division are so large as to dominate the scale of the figure. This must be taken into account in examining the results.

20 While the qualitative conclusions remain the same, the quantitative results are substantially different from those presented in Fisher/Arlosoroff/Eckstein/Haddadin/Hamati/Huber-Lee/Jarrar/Jayyousi/Shamir/Wesseling (2002). This is due partly to improved data, but mostly from a more realistic treatment of intra-district leakage in Palestine which affects the value of water.

Figure 11.5: Value of Israel-Palestine Cooperation and Value of Ownership of Mountain Aquifer With Cooperation: 2010 – Israeli Fixed priced Policies in Effect.



11.8 The Real Benefits From Cooperation

The greatest benefits from cooperation may not be monetary, however. Beyond pure economics, the parties to a water agreement would have much to gain from an arrangement of trade in water permits. Water quantity allocations that appear adequate at one time may not be so at other times. As populations and economies grow and change, fixed water quantities can become woefully inappropriate and, if not properly readjusted, can produce hardship. A system of voluntary trade in water permits would be a mechanism for flexibly adjusting water allocations to the benefit of all parties and thereby for avoiding the potentially destabilizing effect of a fixed water quantity arrangement on a peace agreement. It is not optimal for any party to bind itself to an arrangement whereby it can neither buy nor sell permits to use water.

Moreover, cooperation in water can assist in bringing about cooperation elsewhere. For example, as already indicated, the WAS model strongly suggests that, even in the presence of current Israeli plans, it would be efficient to have a water treatment plant in Gaza with treated effluent sold to Israel for agricultural use in the Negev where there is no aquifer to pollute. (Indeed, since this suggestion arose in model results, there has been discussion of this possibility.) Both parties would gain from such an arrangement. *This means that Israel has an economic interest in assisting with the construction of a Gazan treatment plant.* This would be a serious act of cooperation and a confidence-building measure.

11.9 Problems and Conclusions

Naturally, there are a number of issues that arise when considering such a cooperative arrangement. Chief among them is that of security. What if one of the partners to such a scheme were to withdraw? Of course, such withdrawal would be contrary to the interest of the withdrawing party, but, as we have sadly seen, people and governments do not always act in their own long-run self-interest.

The main cost of such a withdrawal would occur if the non-withdrawing party had failed to build infrastructure that would be needed without cooperation but not with it. In the case of Israel and Palestine, it might appear that such risk would be chiefly Palestinian, since they, but *not* Israel, would need desalination plants in the absence of cooperation but not in its presence. Israel, by contrast, already has a highly developed system of water infrastructure and any decision to build desalination plants does not depend on a decision to cooperate or not cooperate with Palestine.

Interestingly, this conclusion may not hold. We saw above that the WAS results show that it will not be cost-effective (at least in years of normal hydrology) for Palestine to build desalination facilities in the Gaza Strip (its only seacoast) simply to supply the growing Gazan population. Rather, with water ownership greatly restricted on the West Bank, it would pay (without cooperation) to build such facilities and expensively pump desalinated water uphill to Hebron. But this result (which holds only with Palestine owning rather less than 20 per cent of the Mountain Aquifer) also implies that a withdrawal by Israel from a cooperative agreement could be met by Palestine pumping more than now permitted on the West Bank. This reduces the importance of the security issue under discussion.

Hence, for both parties, cooperation appears to be a superior policy to autarky. In an atmosphere of trust, cooperation would be likely to benefit Palestine even more than Israel, at least in the short run. But, of course, such an atmosphere does not now exist. Cooperation requires a partner, and, in late 2006 that does not appear to be immediately likely. Each party is likely to suspect the good faith of the other, even though the proposed arrangement will benefit both.

Despite this, I continue to believe that cooperation is both valuable and possible. As already discussed, water is not worth conflict and can become an area for confidence-building measures. Further, if autarky is truly desired, then one should simply build desalination plants as needed. Autarky in naturally-occurring water is a foolish policy except as a money-saving device – and the money it saves is not great. Every country with a seacoast can have as much water as it wants if it chooses to spend the money to do so. Hence, every country with a seacoast can be self-sufficient if it is willing to incur the costs of acquiring the necessary water. As a result, disputes over water among such countries should be merely disputes over costs, not over life and death.

References

Coase, R., 1960: "The Problem of Social Cost", in: *Journal of Law and Economics*, 3 (October): 1–44.

Eckstein, Z.; Zackay, D.; Nachtom, Y.; Fishelson, G., 1994: "The Allocation of Water Resources between Israel, the West Bank and Gaza – An Economic Analysis", in: *Economic Quarterly*, 41: 331–369 [Hebrew].

Fisher, F.M., 2002: "Water Value, Water Management, and Water Conflict: A Systematic Approach". in: *GAIA*, 11, No. 3: 187–190.

Fisher, F.M.; Arlosoroff, S.; Eckstein, Z.; Haddadin, M.; Hamati, S.G.; Huber-Lee, A.; Jarrar, A.; Jayyousi, A.; Shamir, U.; Wesseling, H., 2002: "Optimal Water Management and Conflict Resolution: The Middle East Water Project", in: *Water Resources Research*, 10.1029/2001WR000943, 16 November 2002.

Fisher, F.M.; Arlosoroff, S.; Eckstein, Z.; Haddadin, M.; Hamati, S.G.; Huber-Lee, A.: Jarrar, A.; Jayyousi, A.; Shamir, U.; Wesseling, H., 2005: *Liquid Assets: An Economic Approach for Water Management and Conflict Resolution in the Middle East and Beyond* (Washington: RFF Press).

12 'Virtual Water' in the Water Resource Management of the Arid Middle East

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Abstract

Agriculture and rural village life have historically played central roles in the life, economy and culture of the Palestinians, Jordanians and Israelis. However, in the 21st century these nations are facing the reality that their natural fresh water resources will shortly become fully utilized and that there is an urgent need to reevaluate their long-term water resources management strategy. While calls for food security based on growing all food locally arouse popular support, this chapter will show that the modern, rational, economic approach to this question is, that the arid countries in the Middle East, with little water should accept the reality that priority in utilization of their limited fresh water resources should go to meet the immediate human needs of drinking water, domestic and urban use as well as for high income producing commercial, industrial, tourism use and assuring the quality of life with green open spaces. It is more rational to import most of the high water consuming food and fodder, particularly the staples which can be shipped and stored easily from those countries with plenty of water from natural renewable sources. In other words, to import 'virtual water' in its most economical form: food. This chapter shows that in reality Israel has de-facto adopted this policy and imports 80 per cent of the national caloric intake from abroad while the Palestinians import over 65 per cent of their caloric intake. Plans must be made over a 20–30 year period to retrain the agricultural population for alternatives employment in a modern economy.

Keywords: Israel/Palestine/Jordan water resources, Middle East, virtual water, food security, agriculture, water for nature and ecology

12.1 Introduction

Agriculture and rural village life have historically played central roles in the life, economy and culture of the Palestinians, Jordanians and Israelis. However, in the 21st century these nations are facing the reality that their natural fresh water resources will shortly become fully utilized and that there is an urgent need to reevaluate their long-term water resources management strategy. While calls for food security based on growing all food locally sound appealing and inspire strong national feelings, these concepts generate unrealistic demands on water for agriculture that are illogical ecoomically and socially. They tend to create non-sustainable demands for massive water allocations for agriculture from rapidly dwindling water resources or the production of irrationally expensive water for agriculture by desalination and/or water transport over long distances.

This chapter will show that the modern, rational, economic approach to this question is that the arid countries in the Middle East, such as Israel, Palestine and Jordan with little water should accept the reality that priority in utilization of their limited fresh water resources should go to meet the immediate human needs of drinking water, domestic and urban use as well as for high income producing commercial, trade, crafts industrial, tourism use and assuring the quality of life with water allocated to nature and green open spaces. It is more rational to import most of the high water-consuming food and fodder, particularly the staples which can be shipped and stored easily from those countries with plenty of water from natural renewable sources. In other words, to import 'virtual water' in its most economical form: food.

12.2 How Much Water is Required for Food Security?

How much water is really needed to grow all of the food needs of an individual? A few selected examples based on calculations made by Gleick (2000) from data in the *FAO Production Yearbook* (1989) of the water input required in cubic meter/ton (m^3/ton) to produce various foods (table 12.1).

Table 12.1: Water Input in Various Foods Produced in California in m^3/ton. **Source**: Gleick (2000) and FAO (1989).

Wheat	1,273
Rice	2,005
Maize	978
Potatoes	147
Sugar	2,731
Soybean Oil	21,692
Beef	16,193
Pork	5,760
Poultry	5,730
Eggs	3,740
Milk	971
Butter	22,274

Peter Gleick's estimates based on the FAO data have indicated that the total water input in the human diet varies from country to country depending, of course, on the consumption of food products that require very high water consumption per unit, such as meat, oil and butter and the efficiency of the local agriculture, in water use in food production. Table 12.2 presents a few examples of the total water needs to supply the complete food requirements of an individual in m^3/capita/year (m^3/cap/yr). From the above, it is obvious that those countries with total water resources potential of significantly less than 1000 m^3/cap/yr. can never approach total food self-sufficiency/food security based on locally grown food.

Table 12.2: Total Amount of Water Required to Grow all Food Requirements in m^3/capita/year. **Source**: Gleick (2000) and FAO (1989).

California	2,156 m^3/cap/yr
Egypt	1,540 m^3/cap/yr
Tunesia	1,082 m^3/cap/yr

12.3 Water Availability to Middle Eastern Countries

There are very limited water resources available to the Jordanians, Palestinians and Israelis who share the geography and hydrology of the Jordan River Basin and the adjacent areas. They are currently using essentially all of the natural fresh water resource potential available and then some. It has been estimated that for Israel, based on the 2003 population of 6.5 million and a fresh water resource potential of 1,600 million m^3/yr. (mm^3/yr), the per capita availability of water is about 250 m^3/cap/yr. For the Palestinians, with a population estimated at 3.2 million and a currently estimated available water supply limited to 250 mm^3/yr, their per capita consumption would be some 80 m^3/cap/yr. The Jordanians with a 2003 population estimated at 5 million and a total fresh water supply estimated at about 1000 mm^3/yr have a per capita use of some 200 m^3/cap/yr (see table 12.3).

Table 12.3: Current Fresh Water Availability in m^3/capita/year (2003).

Palestinians	80 m^3/cap/yr
Jordanians	200 m^3/cap/yr
Israelis	250 m^3/cap/yr

This author's studies have shown that the estimated *Minimum Water Requirement* (MWR) to meet all of hygienic, social and economic requirements for domestic, urban, commercial, industrial, tourist uses for a reasonably high standard of urban living in arid areas in the Middle East is some 125 m^3/cap/yr (Shuval

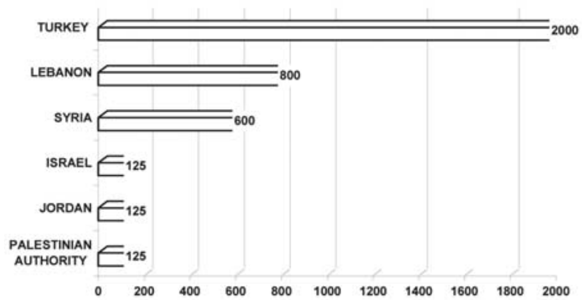
1992). This assumes little fresh water for agriculture and import of most food. Israel and Jordan are not much above that level today, while the Palestinians face serious water deprivation and are already well below the MWR.

Currently, some 60–80 per cent of the water resources, of these three nations, are utilized by agriculture. However, it can be estimated that there will be a doubling of the population in each of these nations in some 30 years time, with the additional population living mostly, if not entirely, in the urban sector. There will also be a significant increase in per capita urban water consumption, in particular among the Palestinians and Jordanians, due to raised standards of living, which will result in at least a doubling if not more of the water demand in the urban, commercial and industrial sector. If we assume a scenario of no additional water supplies becoming available, then the only way to meet the rapidly growing urban demand, would be through a reallocation of high quality fresh potable water supplies, currently used in agriculture to the domestic, urban, commercial and industrial sectors.

From a social and economic view point this policy can be justified since the marginal value of water and the income produced from its use for the domestic, urban, commercial, industrial and tourist sector has been estimated as being some 100 times greater than its value in agriculture. In addition there would be no alternative employment for the increased population other than in commerce, building, crafts, trade, tourism and industry in the urban sector. Thus, the transfer of the fresh potable water to the urban, commercial, industrial and tourism sector would result in a major cutback in irrigated agriculture with all its difficult social implications involved. Israel's water planners have already reluctantly accepted this water transfer and reallocation policy as inevitable. The Israeli farming sector has not fully readjusted to this reality.

For comparative purposes an estimate of the total fresh water resources that may be available from all sources per capita/year (m^3/cap/yr) in the five riparian countries in the Jordan River basin and Turkey in the year 2000 are shown in table 12.2 above and for the 2030 in figure 12.1 below. This estimate assumes that the Jordanians, Palestinians and Israelis will obtain some additional water resources through the development of alternative sources such as desalination and reallocation of water resources among them in the framework of the peace process in order to achieve at least the *Minimum Water Requirement* to assure a reasonable standard of living for all the peo-

Figure 12.1: Potential Fresh Water Resources Available in Cubic Meters/Person/Year in 2030 (Assuming a doubling of the population and additional water for Palestinians and Jordanians to meet the minimum water requirement of 125 m^3/person/year.



From this rough estimate based on figures from the World Bank (1992) and other sources it can be seen that by the year 2030 Jordan, Israel and Palestine will have just enough fresh water to meet their domestic, urban, commercial and industrial demands with essentially no fresh water for agriculture, other than recycled wastewater, while Syria and Lebanon, the relatively more water rich neighbors to the north, will still have some fresh water resources available for agriculture. Turkey, on the other hand, even in the year 2030, will remain a truly water rich country with enough water to meet all local needs including for agriculture and food production, plus enough water to spare to enable it to sell and transfer significant amounts to their less fortunate neighbors to the south.

12.4 Import of 'Virtual Water' as Food Staples for Food Security

Under these conditions of water scarcity with little or no water available for agriculture, how will Jordan, Palestine and Israel assure that their population has the food required – in other words to assure 'food security'? The modern, rational, economic approach to this question is that countries with little water should import, what Allan and Olmsted (2003) have termed *virtual water.* That is, importing the high water consuming foods they need, particularly the staples which can be shipped easily and stored for long periods, from those countries with plenty of water from natural renewable sources and sufficient areas of arable land. Import of staple foods such as grains, dried beans, food oil, fodder and even frozen meat and fish and storing them in grain silos, local warehouses and cold storage facilities is a more economical way of assuring an adequate supply of food while avoiding the irrational implications of the misguided goal of *local self-sufficiency in food production* under the *food security* concept. Our studies (Buchwald/Shuval 2000) show, for example, that in reality Israel has de-facto adopted this policy and in the year 2000 imported 80 per cent of the national calorie intake of food from abroad as 'virtual water' (see table 12.4.) while it is estimated that the Palestinians import over 65 per cent of their caloric intake.

Table 12.4: Examples of food staples, 100 per cent of which are imported by Israel supplying some of 70 per cent of Israel's total *Calorie Intake* (calculated as percent of total mean calorie intake in imported foods based Israeli mean food basket. Total mean calorie intake = 3000 calories/day). **Source**: Buchwald/Shuval (2000).

Wheat/Grains/Starch/Sugar/Candy
Sesame /Fats/oils/Frozen-Salt Fish
Dried Fruit /Dried Lentil

As an example of the economy of virtual water, every ton of wheat has imbedded within it some 1200 tons (or m^3) of the water required to grow it. The world market price of wheat is about $ 150–$ 200/ton so that if two thirds of the cost of growing it is labor, seeds, fertilizer, harvesting, storage and transport then the cost of the water imbedded in wheat is estimated at 4–5 US cents/m^3. There is no cheaper source of produced or imported water. What about fresh vegetables and salad crops which cannot be so easily imported from abroad? The growing of limited amounts of fresh vegetables and salad crops for local consumption requires very little water and this author has estimated that with an allocation of fresh water of some 25 m^3/cap/yr, a country can grow most if not all of the fresh vegetables and salad crops used locally.

Naff (1965) has suggested a differentiation between 'food security' and 'food sufficiency'. Food security, according to Naff, requires a guarantee of enough food produced locally to satisfy a population's minimal needs over a long period of time. Such a policy traditionally has implied self-contained, domestically produced food sufficiency. In the water short areas of the Middle East, insisting on a national policy of food security often implies generating a perceived need to assure local irrigated agricultural production even if the country does not have sufficient local water resources to sustain such a policy.

While public policy insisting on assuring food security and water security may appeal to national pride and be politically popular it has often resulted in the perception of unrealistic needs for greatly increased water resources. This often means increased demands for the reallocation of shared water resources from limited trans-boundary water resources and the resulting exacerbation of water conflicts between nations. It has also led in some cases to the problematic construction of expensive and uneconomic massive water projects such the huge 500 km long pipe-line in Libya transporting a one time reserve of fossil water from deep in the desert to the more arable coastal areas or the use of desalinated sea water for the irrigation of wheat and other staples in Saudi Arabia, regardless of costs and benefits. In both of these cases the cost of the food produced with such expensive water is many times greater than the price of the same food products on the world market. Naff (1995) correctly points out that the old concept of food security "in the arid Middle East will always be a wasteful and ill-fated policy".

Food sufficiency, on the other hand, only requires that there is on-going sufficiency of food for the needs and development of a society, attained chiefly by trade based on the import of *virtual water*. However, it must be understood that this strategy, to assure *food sufficiency* (as an alternative to *food security*) requires an economy that generates enough income, particularly foreign currency, from exports, commerce and tourism to cover the cost of the needed food imports. In the arid areas of the Middle East there is, in the long run very little alternative to developing the economy based on low water consuming industry, crafts, trade, commerce and tourism which will provide employment and a higher standard of living rather than an economy based mainly on low income producing agriculture. The studies by Beaumont (2000) have shown that for Middle Eastern countries the economic return on one cubic meter of water allocated to agriculture is about $ 2.00 (US) while a cubic meter of water used in commerce or industry yields a return of $ 100 to $ 500. Such an economy based on commerce, industry and tourism will be able to provide sufficient financial resources to import and store all the food required to assure food sufficiency and as well a higher standard of living for all (see table 12.5).

It is one of the fundamental premises of this chapter that the conventional concept of *food security* meaning total local self-sufficiency in food production in the arid areas of the Middle East and other arid regions of the world, cannot be seen as a realistic or sustainable one. It can only lead to unnecessary, increased conflict over limited water resources or the irrational waste of economic resources, which in the long rum can lead to a decrease in security. Middle Eastern countries facing current and/or future severe water shortages must carefully consider the more realistic and less conflict arousing policy of *food sufficiency* based essentially on the import of *virtual water* as an acceptable long term policy with important political, economic and security advantages.

Table 12.5: Wealth Generated By Water in Various Sectors in $/m^3$ (GDP of sector/water used by sector. **Source**: based on Beaumont (2000)

Country	Agriculture	Industry	Commerce
Egypt	0.96	19	686
Iran	1.22	93	512
Israel	1.49	120	687
Jordan	1.80	170	360
Kuwait		1889	237
Morocco	1.47	110	2036
Syria	2.18	53	1512
Turkey	2.54	93	512
Average	1.86	533	650

What about those arid count ries in the transition stage that cannot yet generate enough foreign currency to purchase all their vital food needs in the world market? The international community should create institutions such as a *World Food Bank*, to assure that all countries, including the weakest of those in the third world, are assured adequate food supplies from the reserves of the surplus food producers in the world.

12.5 What Will Happen to the Farmers or Falachim?

What will happen to that sector of the population that currently bases its life and livelihood on agriculture in rural villages, the farmers or the falachim? The transition from a quasi-agricultural economy to an economy based mainly on commerce, industry, trade and tourism – a high-tech economy, is in fact already occurring. In Israel it is in an advanced stage with only 3 per cent of the population employed in agriculture and producing only about 2 per cent of the GDP. In Palestine and Jordan the population employed in agriculture is about 30–40 per cent but their share in the GDP is relatively small. The high numbers employed in agriculture today among the Palestinians is partially a result of the present political situation and strife and the lack of employment in other sectors which previously employed many Palestinians. Nevertheless, employment in the commercial/trade, industry and tourism sectors is growing even in this difficult period and is expected to grow rapidly in an era of peace. There will have to be a well planned, well financed and carefully phased program of training and education of the younger farmers and the children of the farming sector to prepare them for more productive occupations in the commercial, trade, industry and tourism sectors of a modern economy as the years go by.

The question is asked: if the agricultural sector will shrink considerably in the years to come, how will Palestine be able to absorb the several hundred thousand refugees expected to return to the new Palestine state once it is established? Some Palestinians planners have suggested that the agricultural sector could absorb these refugees. This is a difficult question to answer at this time but, it is questionable if many of the returning refugees will be interested in settling in agricultural occupations even if their forefathers were farmers and falachim. Over the years, many, if not most of the refugees, have left agricultural occupations far behind and many have learned trades and skills in other more economically rewarding professions. Despite the present very poor economic and social conditions of most refugees it is not unreasonable to anticipate that their expectations for employment on return to Palestine will be different than those of their forefathers. The more productive occupations in the commercial/trade/crafts/building/industry and tourism sectors will bring a higher standard of living than a return to agriculture which in any event will not be practical since there will never be enough water available to support a significant portion of the population in agriculture.

12.6 Change in Country-Side after a Cut-Back in Agriculture

Environmentalists, ecologists, lovers of nature and the public at large will undoubtedly ask the very legitimate question: "What will the country-side be like if there is a major cut-back in agriculture? Agriculture keeps the country green!" What is happening in Israel in this area, is of great concern. Particularly in the central areas of Israel, near the major urban centers, where land values are high, the farmers have become the major promoters of selling their farm-land for housing projects. This is profitable to the farmers and is turning large areas into densely built-up red tiled roofed houses. This not only is an environmental eyesore but green areas are rapidly disappearing and the impervious roofs, asphalt roads and parking areas have reduced the infiltration of rain water into the vital groundwater aquifers and have increased storm water run-off to the sea.

There is an urgent need to develop strategies and operational plans to prevent this process and for the gradual conversion of agricultural areas into low water consuming 'green lungs' – parks, nature reserves, lakes, pastures, sport fields and green recreational areas of all kinds – so vital to assure the quality of life in a densely populated society. While allocations of fresh water to agriculture will have to be reduced over the years there is a need to accept a new priority concept that in order to live in a high-tech urban society in an arid area, major allocations of water for nature, ecology and green lungs must be assured.

12.7 Conclusions

In conclusion, there needs to be a fundamental revision in the understanding of such concepts as *water security* and *food security,* in relation to the arid countries of the Middle East. These can only achieve the needed levels of water and food security by developing economies based on commerce, trade, crafts, tourism and industry which can earn sufficient cash and foreign currency to enable them to import low cost *virtual water* by purchasing all the required food staples on the world market. A *World Food Bank* may be required to help poorer countries in transition to meet these needs, while the countries rich in water resources and arable land must be encouraged to grow the food for those countries that will never have enough water to grow all of their own food.

As populations grow in Jordan, Palestine and Israel and the demand for water in the urban, comercial, industrial sectors increases, water from the agricultural sector will have to be reallocated to the urban, commercial and industrial sectors so as to assure the maintenance of the quality of life, decent levels of hygiene, the economic viability and standard of living of the majority of the population living in the urban sector. Thus, as less water becomes available for irrigation in the agricultural sector there will be less employment in agriculture. There will have to be a well planned, well financed and carefully phased program of training and education of the younger farmers and the children of the farming sector to prepare them for more productive occupations in the commercial, trade, industry and tourism sectors of a modern economy as the years go by. Arid countries based on a sound commercial and industrial economy who are adjacent to the sea coast, never need to face shortages of drinking quality water for domestic, urban, commercial, tourism and industrial use since relatively low cost desalination of seawater has now made it possible to produce all the water they will ever require to meet those needs. However, desalinated sea water is still far too expensive to justify its use in agriculture.

This chapter has shown that the modern, rational, economic approach to this question is, that the arid countries in the Middle East: Jordan, Palestine and Israel with little water should accept the reality that priority in utilization of their limited fresh, potable water resources should go to meet the immediate human needs of drinking water, domestic and urban use as well as for high income producing commercial, industrial and tourism use. It is more rational to import most of the high water consuming food and fodder, particularly the staples which can be shipped easily and stored for longer periods, from those countries with plenty of water from natural renewable, sustainable sources and sufficient areas of arable land. In other words, to import 'virtual water' in its most economical form: food. The recycling of highly treated urban wastewater can provide an important and economically feasible source of additional water for use in support of 'green lungs' and some agriculture as well as other industrial and urban non-potable water uses. Imports of 'virtual water' can provide the *food security* and low cost desalinated seawater can now meet all domestic, urban, commercial and industrial needs.

References

Allan, J.A; Olmsted, J. 2003: "Trading Virtual Water. The MENA water deficit and the consequences of for water policy reform", in: Lofgren, H. (Ed): *The Middle East Water Economy* (Washington, D.C.: IFPRI)

Beaumont, P., 2000: "The Quest For Water Efficiency. Restructuring of Water Use in The Middle East", in: Belkin, S. (Ed.): *Water, Air and Soil Pollution*, *Proceedings of the IWRA Conference in Jerusalem* 2000 (Dordrecht: Kluwer Academic Publishers): 123: 551–564.

Buchwald, S.; Shuval, H., 2000: *The Role of the Import of Virtual Water in the Israel Food Supply* - Unpublished study (in Hebrew) (Jerusalem: The Hebrew University of Jerusalem, Division of Environmental Sciences).

FAO, 1989: *Food and Agriculture Organization Production Yearbook*, Vol. 43 (Rome: FAO).

Gleick, P. H., 2000: *The World's Water* 2000-2001*, Chap.- Water and Food* (New York: Oxford University Press).

Naff, T., 1995: "Conflict and Water in the Middle East in Water in the Arab World ", in: Rogers, Peter; Lydon, Peter (Eds.): *Water in the Arab World. Perspectives and Prognoses* (Cambridge, MA: Harvard University Press).

Shuval, H., 1992: "Approaches to Resolving the Water Conflicts Between Israel and her Neighbors-a Regional Water for Peace Plan", in *Water International*,. 17: 133–143.

World Bank, 1992: *World Development Report* (New York: Oxford Press).

13 Virtual Water Trade as a Policy Instrument for Achieving Water Security in Palestine

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Abstract

Severe water shortage is facing Palestine today as a result of population growth, agriculture and industry. Agriculture is the main water-using sector, which makes up more than 63 per cent of the country's total amount of water use. Out of 279 Mm^3/year used by different water consumers, about 178 Mm^3/year goes to the agricultural sector. The country is not self-sufficient in agricultural production. The citrus sector, however, is successful enough to export its surplus. The remaining food deficit is imported to meet local demand. The quantities of water used in the agricultural production process can be translated into 56 Mm^3/year exports and 2,200 Mm^3/year imports of virtual water in Palestine. An estimated 20 per cent of Palestinian's total water is being exported in virtual form. Economically, agriculture constitutes 25 per cent of total Palestinian exports with total revenue of US $ 60 million. The expenditure in agricultural imports such as wheat and meat products is about U S$ 620 million. The Palestinian water sector should allocate water to a crop like vegetables which brings the best return to water suppliers. Currently, the country has a water use that is unsustainable and may lead to a water crisis. Palestine should continue importing virtual water imbedded in food commodities to avoid such a crisis. Citrus exports from Palestine contribute to a huge virtual water loss. Reducing these exports would be a good start in addition to looking for other alternatives.

Keywords: agriculture production, virtual water, water security, water trade

13.1 Introduction

Virtual water is defined as: "the quantity of water used in the production process of an agricultural or industrial product" (Hoekstra 2002). Another definition is: "the water requirement to provide the essential food import needs by an economy" (Allan 1997). The importance of virtual water lies with its potential to balance water-rich and water-poor areas in the world through the international trade in agricultural products.

If a country exports a water-intensive product to another country, it exports water in virtual form. For the water scarce countries it is attractive to achieve water security by importing water-intensive products. At the same time water rich countries can profit from their abundance of water resources by producing water-intensive products for export. The national economy can balance its water needs by accessing invisible water outside its national boundaries. The food trade is thus an indirect trade in water. The term 'virtual water' has been presented as a solution to balance economic and population growth, and it helps to achieve ecological sustainability. As an example, 1000 tons of water is needed to yield one ton of grain. It also implies that when one imports a ton of wheat, it can be the equivalent to importing 1000 cubic meters of water. There are two types of agricultural water uses:

- *Blue water* is the water occurring as renewable ground water in the aquifers and as surface water in water bodies (Savenije 2001). It is water that has

Table 13.1: Water Balance in Palestine. **Source**: Abu Zahra (2000).

Hydrological Parameter	West Bank contribution to the water balance		Gaza Strip contribution to the water balance		Total
	Percentage	Mm^3 /y	Percentage	Mm^3 /y	Mm^3 /y
Annual rainfall	100	2248	100	101	2349
Evapotranspiration	68	1529	52.5	53	1582
Surface run-off	3.2	71	1.98	2	72
Natural recharge	28	648	45.5	46	692
Return flow	RFWB*		8.9	9	9+RFWB

*RFWB (Return flow West Bank)

been used by irrigation, neglecting evapotranspiration from rainfall and soil moisture.

- *Green water* refers to total evaporation from agriculture production, including evapotranspiration from plants and evaporation from irrigation water (Rockstrom 2001). This water is rainwater situated in the unsaturated zone of the soil. It provides about 60 per cent of the world food production (Savenije 2001).

Water consumed by the crops is either green water, found in the soil due to direct rainfall, or blue water, transferred to the soil artificially through an irrigation system. Therefore, virtual water can either be green or blue water.

As the ratio between photosynthesis and transpiration is fairly constant, the volume of water needed to produce 1 kg of biomass is also rather constant; (a rule of thumb is that 300 kg of water is needed to produce 1 kg of biomass). In order to calculate how much water is needed for the edible part of the biomass, we need to know the harvest index. In the case of wheat, for example, the index is 0.5. This means that about half of the total biomass ends up in grains; 2 kg of biomass is needed to end up in 1 kg of grains. Therefore, it takes 600 kg of water to produce 1 kg of grain. This amount of water used by crops refers to the transpiration only. Crop water use can vary due to various reasons, like the type of the crop, the soil characteristics etc. As stated above, a ton of grain can also require 1000 tons (m^3) of water to produce it (Botzer 2001).

However, the efficiency of water use can only be increased during the process of obtaining, transporting and applying the water to the field, but not in the final use by the crop. There are two ways to calculate the virtual water use. One is the bottom-up approach by knowing the water requirement of the crop. The other way is empirical, by checking how much water from the rain is applied to the field and, how much water is applied by irrigation.

The research objectives are threefold:

1. to analyze and quantify the virtual water imports and, exports from agricultural products;
2. to estimate the physical aspects of virtual water export and import; and
3. to evaluate the economic aspects of virtual water export.

13.2 Physical Features of Water in Palestine

In general, Palestine has a Mediterranean climate characterized by semi-arid and arid conditions, by long, hot dry summers and short, cool, rainy winters. Geographically, Palestine is located between the subtropical aridity of Egypt and the subtropical humidity of the Eastern Mediterranean. Table 13.1 shows the water balance in Palestine.

Topographically, the water resources of Israel and Palestine (West Bank, including East Jerusalem, and Gaza) are highly interconnected and as such qualify as common and shared entity. Table 13.2 shows the water resources shared and distributed in Palestine.

The total water use by the municipal and industrial sector in Palestine during the year 1999 was estimated 101 Mm^3. An amount of 52 Mm^3 was used in the West Bank, whereas a total of approximately 49 Mm^3 was used in the Gaza Strip. The water consumed by the agricultural sector is estimated to be 172–178 Mm^3. According to the Palestinian agriculture ministry 90 Mm^3 is used in the West Bank, and 88 Mm^3 consumed in the Gaza Strip. The Palestinian total water use was 273–279 Mm3/year. Figure 13.1 shows the total water consumption and figure 13.2 the water that was used by various sectors in Palestine in 1999.

Table 13.2: Water Resources Shared and Distributed in Palestine. **Source**: Mehmet (1999).

Water available (Mm^3 /Y)		Water use (Mm^3 /Y)				
Water resource	**Total Resource**	**Used in Israel**	**Used in settlements**	**Used in West Bank**	**Used in Gaza**	**Unused**
Western aquifer	310 – 362	313 – 333	10	21 – 27		
Eastern aquifer	80 – 172	0	35 – 100	62 – 78	0	58
N. Eastern aquifer	131 – 145	101 – 115	5	20 – 25		-2
Gaza coastal aquifer	60-79	5	6		73	
Coastal aquifer		240 – 300				
Jordan River **Yarmuk River**	1060 – 1287 1060 – 1287	560 – 650 (120 – 220 Palestine share)				
Total	1666 – 2045	1219 – 1403	56	103 – 152 (includes Springs)	73	

Figure 13.1: Total Water Consumption in the West Bank and Gaza Strip in 1999. **Source**: Palestinian Agricultural Ministry.

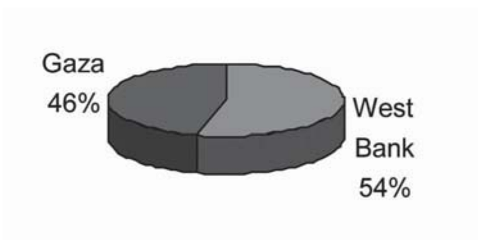
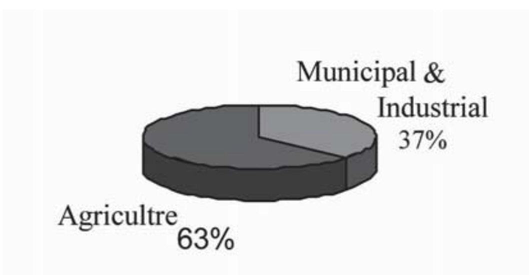


Figure 13.2: Water Used by Various Sectors Palestine in 1999. **Source**: Palestinian Agricultural Ministry.



Out of about 156,000 ha in the West Bank, approximately 7,800 ha are under irrigated agriculture, while in the Gaza Strip, the total area is 16,500 ha whereof 65 per cent is under irrigation (FAO 1996). With 63 per cent agriculture uses the highest amount of water (figure 13.2). For the Palestinian population of 3.3 million inhabitants (1999), the annual quantity of water used for irrigation is around 150 liters/cap/day, or 9,600 m^3/ha/year.

13.3 Virtual Water Export and Import

13.3.1 Physical Aspects

The total water use by different sectors in 1999 was around 279 Mm^3. In the year 2002 water input into the agriculture sector was 178 Mm^3, which consumed 63 per cent of the total water available. Table 13.3 does not give the production and consumption figures for animal products; but table 13.4 shows the average Palestinian consumption of different animal products that are characterized by high water consumption.

Table 13.3: Production, consumption and surplus/deficit of Palestinian agriculture production **Source**: Butterfield et al. (2000).

Commo-dities	Production (1000 ton)	Consumption (1000 ton)	Surplus/ deficit
Vegetables	516.9	645	-128.1
Field crops	35.8	350.3	-314.5
Citrus	153.2	42.2	+111.0
Fruits	134.6	154.1	-19.5
Olives (rainfed)	126.1	80.4	45.7

According to a technical country paper on the West Bank and Gaza Strip, 15 per cent of animal products is produced in Palestine and the remaining 85 per cent is imported (Framework for NG Proposal 2002). Table 13.5 shows the consumption and production of animal products. For the Palestinian population of about 3.3 million, table 13.5 shows the animal production, con-

Table 13.4: Average consumption from different commodities. **Source**: Isaac et al. (2002)

Commodities	Consumption kg/capita/year
Red meat	11
Poultry	14.3
Eggs	6.1
Milk	67.7

Table 13.5: Production, consumption and surplus/deficit of animal products

Commodities	Production (1000 ton)	Consumption (1000 ton)	Surplus/ deficit
Red meat	5.5	36.3	-30.8
Poultry	7.1	47.2	-35.1
Eggs	3.0	20.2	-17.2
Milk	33.5	223.4	-189.9

sumption, surplus and deficit. Tables 13.3 and 13.5 provides production, consumption surplus and deficit figures for agricultural and animal products which have been used to compute the virtual water as shown in table 13.6.

Table 13.6: Virtual water trade. **Source**: Compiled by the author.

Commodities	Surplus/ deficit (1000 ton)	Virtual water content (m^3/kg)	Virtual water import/export Mm^3
Vegetables	-128.1	0.5	-64
Field crops	-314.5	1.0	-314.5
Citrus	111	0.5	+56*
Fruits	-19.5	0.5	-9.8
Olives (rainfed)	45.7	2.0	+91**
Red meat	-30.8	50	-1580
Poultry	-35.1	3.5	-122.8
Eggs	-17.2	3.7	-63.4
Milk	-189.9	1	-189.9
Total			-2,200***

* Water export (Blue water)
** Green water
*** Water import

The virtual trade depends on supplementary irrigation (blue water) except for olives, which use green water (rainfed water). The total water input for agriculture in 2002 was 178 Mm^3/year. Out of the Palestinians virtual water export of 147 Mm^3/year, citrus constituted 56 Mm^3/year while olives constituted 91.4 Mm^3/year. The deficit from Palestinians water needs is imported, amounting to 2,200 Mm^3/year of virtual water. An estimated 56 Mm^3/year of virtual water export implies that about one third of the water used in agriculture is leaving the country as citrus products. Based on the imported virtual water, Palestine imports about 30 times more water than it exports.

13.4 Economic Aspects

Historically, agriculture has played a more dominant role in the Palestinian economy than in Jordan and Israel. Palestinian agriculture is not subsidized by the government and therefore Palestinian farmers pay prices as much as $ 1.2/m^3 for their water, making many types of agriculture infeasible. Palestine does not have an appropriate water pricing structure what limits the productivity of agriculture. Water efficiency remains low due to the high cost of modern irrigation technology. For example, a drip system costs $ 1500–$ 3000/ha. The marginal value of water in the production is different from one crop to another, where the returns on water are higher for vegetables compared to citrus.

Agriculture provides 14 per cent of the Palestinian GDP equal to US $ 733 million in 2000. The number of Palestinians employed in agriculture is 19–22 per cent of the Palestinian labor force (PASSIA, fact sheet-economy, 2002), with an average salary of US $ 16 per day (PCBS 2000). In 1999 the sector generated approximately 25 per cent of all Palestinian exports with total revenue of US $ 60 million. On the other hand, Palestinians imported US $ 620 million agricultural products.

Over the past three decades Palestine had a comparative advantage in producing and exporting vegetables, fruits, citrus and olive products (Jabarin 2000). Israel and Jordan have been the two major outlets for the Palestinian products. But Palestine has not been self-sufficient in producing field crops and livestock products, mainly red meat and milk. In Palestine, a shift in the cropping pattern has contributed to an increase in the production of vegetables. On the import side, Israel has been the major supplier of food and farm products.

Palestinian agricultural trade has been influenced by the political status and the unsettled conditions in the Middle East. Its agricultural exports to or through Israel have been regulated and restricted. The following problems are currently facing Palestine:

- Limited range and quality of products available for export;
- Lack of information about external market opportunities;
- Disrepair of the physical infrastructure with ineffective and weak institutional infrastructure for investment and trade promotion;
- Frequent border closures, resulting in limitation on the free movement of agricultural produce.

Traditional agricultural production has been either stagnant or declining due to: population increase, the limitation or deterioration of natural resources, costly agricultural technology and limited market access. Furthermore, another factor restricting the optimal utilization of the comparative advantage is the pressing need to attain a certain level of food security, on the national and the household levels (Al-Hamaidi 2000). Thus, in the future the main threat to agricultural production is not economic, nor trade dependant but rather ecological.

Virtual water trade and cooperation between neighboring countries is the direction of Palestine to reach food security, and to reduce poverty. But given the prevailing political instability, it may be wise for Palestine to satisfy its own needs.

13.5 Agricultural Policy Measurement of Virtual Water

1. The country has to continue importing virtual water imbedded in food commodities.
2. Exports of citrus from Palestine contribute to a huge virtual water loss and cause groundwater desalinized from over pumping. They could be replaced by vegetables.
3. To improve the water situation in the Gaza Strip, Palestine should shift certain crops from the Gaza Strip to the West Bank, which has better water quantity and cultivated areas. Agricultural water should be reallocated to domestic uses.
4. The Palestinians have the rights to the physical water or water in any forms like virtual water in agricultural production which occurred in the occupied Palestinian lands.
5. Developing the industrial and services sectors (Gaza harbor and airport), thus creating new jobs for workers now employed in the agricultural sector.
6. Increase the agricultural quality to compete in international markets.
7. Research on a better use of wastewater in agriculture is needed.
8. Agriculture needs political support from the Palestinian Authority.

13.6 Conclusion

This study analyzed the virtual water trade in Palestine from a water resources management perspective. The analysis focused on agriculture as a huge water consumer in Palestine. The availability and access to water, rather than a scarcity of land, remain the greatest obstacle to the Palestinian agricultural sector. Agricultural exports generated insufficient economic benefits at the national level. The Palestinian government has not subsidized the agricultural sector and water prices have been very high. Consequently at the farmer's level, the value of agricultural exports does not reflect the real cost of water.

Palestine is not self-sufficient in producing food commodities to meet the national demand. In virtual water trade it imported about 2,200 Mm^3, while it exported citrus with 56 Mm^3/year of blue water and 91 Mm^3/year of green water from olives. Due to the socio-political constraints, water resources have become very complicated. Thus, Palestinian farmers have to keep their lands planted with different trees and crops to prevent Israeli occupation.

The agricultural sector accounts for 63 per cent of the total water use; it contributes 14 per cent of the GDP, and employs 19–22 per cent of the Palestinian labor force. Palestine as a semi-arid and arid country has not been optimizing the use of its limited water resources. By continuing to export virtual water the country is reducing the volume of water available for alternatives of more profitable or sustainable use. The Gaza Strip has been in a critical situation compared to the West Bank in term of water quantity and quality. This requires improving the water situation by shifting some agriculture crops to the West Bank, but also to develop the industrial sector and the public services to create new jobs for agriculture workers.

Currently, the water situation is unsustainable, and water demand greatly exceeds water supply. The projected demand is expected to increase with population growth. Agricultural water policies are needed by increasing water use efficiency to get 'more crops per drop', and effectively allocate the water to get 'more jobs per drop'.

References

Abu Zahra, B., 2000: “Water Crisis in Palestine”, in: *Desalination Strategies South Mediterranean Countries. Desalination* (Jerba, Tunisia), 136 (2001): 93–99.

Al-Hmaidi, M., 2000: *Free trade and the environment in the Euro-Mediterranean context* (Jerusalem: Applied Research Institute (ARIJ), Palestine).

Allan, J., 1997: “Virtual water: a long term solution for water short Middle Eastern economies?” in: “Water and development session”, British Association Festival of Science, University of Leeds, September.

Applied Research Institute [ARIJ], 2002: *The Water Conflict in the Middle East from a Palestinian Perspective* (Jerusalem: ARIJ), at: <http://arij.org.>.

Botzer, A.Y., 2001: *Virtual Water Export from Israel. Quantities, Driving forces and Consequences.* M.Sc Thesis, IHE-Delft, The Netherlands.

Butterfield, D.; Isaac, J.; Kubursi, A.; Spencer, S., 2000: *Impacts of water and export market restriction on Palestinian agriculture*. McMaster University and Economic Research, Canada; at: <http://socserv.socsci.mcmaster.ca>.

FAO, 1996: *The state of food and agriculture* (Rome: FAO).

Framework for NG Proposal, 2002: at. <http://www.euronaid.nl>.

Hoekstra, A., 2002: *Virtual water trade as policy instrument for achieving national water security.* Thesis proposal, IHE-Delft, The Netherlands.

Isaac J,; Kharoub, J.; Mourad, H.; Hrimat, N., 2002: *The nutritional status in Palestinian* (Jerusalem, Palestine: Applied Research Institute – Jerusalem (ARIJ)); at: <http://arij.org>.

Jabarin, A., 2000: *The impact of Euro-Mediterranean partnership Jordan and Palestine's agriculture sector from a water perspective;* at: <http://www.femise.org/PDF/A2jabarin.pdf>. (Amman, Jordan)

Mehmet, O., 1999: *Water Balances in the Eastern Mediterranean: Summary of Workshop* (Ottawa, Ontario, Canada: The Norman Paterson School of International Affairs Carleton University).

Middle East Newsline, 1999: *Palestinians have Black Water Market*; at: <http://allserv.rug. ac.be>.

Palestinian Academic Society for the Study of International Affairs (PASSIA), 2002: *Fact sheet-economy* (Jerusalem, Palestine: PASSIA).

Palestinian Agriculture Ministry, 2002: *Palestinian agricultural water demand* (Gaza city, Gaza Strip: Palestinian Agriculture Ministry).

Palestinian Central Bureau of Statistics [PCBS], 2000: *Country profile in year* 2000 (Ramallah, West Bank, Palestine: PCBS).

Rockstrom, J., 2001: *Soil and Water Resources Management,* Lecture notes. IHE-Delft, The Netherlands.

Savenije, H. H., 2001: *Water Resources Management,* Lecture notes. IHE-Delft, The Netherlands.

14 Water Conflicts and International Water Markets

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Abstract

Israel and the Palestinian Authority (PA) exist in a semi-arid region where the overwhelming use of water is for agriculture. The water deficit that faces each can be closed either by importing food, importing water, achieving higher productivity per unit of water input, or manufacturing water by techniques such as desalination. The problem arises because of autarky in the production of water and the absence of an international trading market for water. Each country can only use the water within its borders or the water it can pilfer from its neighbor if it is an upper riparian. It is as if every country was confined to the energy it could produce within its own borders and did not have access to imported energy on an international market. Obviously, no one would countenance this policy condition for a moment – very few countries could survive in this regime – and the immediate answer would be to trade energy through an international market. But this is precisely what is not done with water. Absent an international trading market, water flowing down its natural course can create national security conflicts and sometimes wars among neighboring countries that share a common water resource, whether it be fresh water above ground in a river or below ground in an aquifer. In the context of water issues between Israel and the PA, this paper will explore problems of water pricing, the relationship between food and water security, the feasibility of an international trading market for water in the 21st century, and how such an arrangement compares in price and efficiency with the principal alternative, desalination.

Keywords: food security, water pricing, international water markets, water conflicts

14.1 Introduction

Food security is connected to water security and both pose national security challenges. Countries that suffer from water deficits invariably have food deficits and these conditions contribute to tensions between themselves and neighboring countries that can erupt into violent confrontation. This chain of security problems derives from the usage of water for food production. Of all the uses of water, food and agricultural production are the most extensive and intensive. Per unit of outcome, their per unit input dwarfs any other use of water. It follows, therefore, that food security is particularly problematic in arid and semi-arid regions and countries where the most intractable conflicts over water occur.

Oil is the commodity that has dominated 20th century security conflicts. In the 21st century that commodity will be freshwater. Unlike oil, however, freshwater has no substitutes.[1] Economic development, population growth, and urbanization — coupled with

1 Coal, for example, can be used in place of oil in powering turbines for electricity. With freshwater, however, substitutes are limited only to so-called ‘grey water’ – partially salinated or treated re-cycled water – for household sanitation, industrial cooling, or a few agricultural products.

universal policies of subsidization and under-pricing – have resulted in an over-exploitation of increasingly scarce water resources with accompanying environmental degradation. Water for domestic agriculture and industrial uses is becoming so scarce in some regions that imminent security conflicts are upon us. In others there are conflicts over a dam in one country that alters the flow of a river across borders.

The common denominator of water is that it courses through several countries, each trying to confine it for its purposes, whether withdrawal or power generation. Aquifers, for example, often extend beyond a single country, so that ground water use in one country degrades and diminishes its availability in another. Water is an exemplar of a globalization that does not recognize borders and fits into a 21st century class of new security challenges. The same river or aquifer transects many countries, creates environmental problems in one that spill over to another, and produces conflicts over uses and the environment. While these problems have always existed, they have now reached such a peak of importance that emerging water-induced national security challenges confront conventional analyses of national security threats.

14.1.1 Some Water and Agricultural Facts

There is currently a widespread discussion of water as a human right which intersects with discussions of food security and minimal guaranteed food as a basic human right. Some advocates go so far as to campaign for free or nearly free water unlimited in scope. This is easily dismissed, because of resource constraints, uneven allocation of water resources across regions and countries, and the basic economic law that a low or no price for a commodity will encourage waste, over-consumption, and inefficiencies, all of which threaten the environment and do not conserve a natural resource. In a balanced assessment of these campaigns, Peter H. Gleick – one of the most authoritative analysts of water – concludes that 50 liters per person per day of fresh water is a minimal requirement, broken down among five liters per day for drinking, 20 for sanitation, 15 for bathing, and 10 for food preparation. This does not include the heavy use of water for food production, which he estimates at 2,700 liters (per day), ranging from current usage of about 5,700 liters in North America to 1,800 in Sub-Saharan Africa (Gleick 2000: 10–11). These variations reflect water scarcities and diet adaptations. The 50 liter per day per person minimal requirement can be provided at a price that is subsidized. Above that level the true long term conservation price can be used, thereby satisfying the dual objectives of delivering a minimum freshwater requirement to everyone at an affordable price and introducing a long term conservation price that will yield preservation of a scarce natural resource.

Freshwater for individual consumption and agricultural production derives from two sources: renewable and non-renewable. Non-renewable freshwater comes from underground aquifers whose water is either harvested or mined. *Harvested* aquifer water replenishes itself but only slowly and at a pace that is not equal to its withdrawal. Like minerals that form under the earth's surface, these underground rivers come from seepage into the soil and accumulate over hundreds if not thousands of years. Once withdrawn they do not reappear unless there is natural or artificial re-charge. In virtually every instance of harvested aquifers, the rate of withdrawal vastly exceeds the rate of re-charge. In addition, this resource becomes unusable long before the water is depleted because salination typically sets in once the aquifer has been drawn down and before it is physically depleted. Then it can no longer be used for freshwater. Aquifers that have no source of replenishment are *mined*; once withdrawn there is no replacement, much like oil or coal.

Renewable freshwater derives from precipitation during the process of a hydrologic cycle in which energy from the sun evaporates fresh water from the earth's supply in rivers, lakes and on land surfaces and redistributes it around the world in an unequal transfer across time and space, depending upon atmospheric conditions throughout the globe. How much freshwater there is cannot be easily determined because much runs off into oceans that could be trapped into reservoirs. Some water deficit countries simply do not have enough renewable freshwater sources, typically those in arid and semi-arid regions. Others are rich in potential freshwater but do not capture it. Various soft and hard technologies can go far in alleviating water deficits in what are otherwise countries that are potentially rich in freshwater.

The existing data on aggregate water resources are approximations, therefore. The best estimates are that of all water on earth 96 per cent is salt water found in oceans. Of the remaining four percent of freshwater stocks over two-thirds (68 per cent) are in glaciers or permanent snow cover. Fresh renewable groundwater sources that are replenished through the hydrologic cycle make up 30 per cent of freshwater stocks in lakes and rivers. These annual renewable water resources were just less than 50,000 cubic kilometers (km^3). They are heavily concentrated and unevenly distributed across regions and countries, not unlike most other natural resources. Twelve countries had 61 per cent of these freshwater resources in 2000 (Gleick 2000: 21, 199–202).[2]

Agriculture is by far the most aggressive user of freshwater. Across 159 countries the unadjusted raw mean for percent of water withdrawal allocated to agriculture is 62 per cent with a wide variance across countries. By region the 26 countries of west and east Europe devote 25 per cent of their water withdrawal to agriculture, as much as 63 per cent in Greece and only 3 per cent in the United Kingdom and 4 per cent in Belgium. Africa devotes 43 per cent, ranging from the Congo River fed and water-rich Democratic Republic of Congo (23 per cent) to 89 per cent in Mozambique and Tanzania. Israel used 79 per cent of its freshwater for agriculture and Jordan 75 per cent in the early 1990s (Gleick 2002: 245–251).[3] There is a trade-off between using water for agriculture and for other uses as against the use of food imports as a way to import water indirectly by substituting food imports for water allocation to domestic agriculture.

For water deficit countries, supply can be augmented in a variety of ways: improved efficiency with the use of water inputs, especially in agriculture; proper scarcity pricing that provides an incentive to conserve and allocate water more effectively across end uses; so-called hard technologies such as desalination and soft technologies such as better drainage systems to collect rain run-off. One direction that has not been as thoroughly vetted as these others, is the creation of an international market for freshwater that is traded among countries.

14.2 International Water Markets

Food deficit countries coincide with poor nations in arid and semi-arid regions where agricultural productivity growth has not kept pace with population growth. Arid and semi-arid regions can only close their water deficit either by importing food, importing water, achieving higher productivity per unit of water input, or manufacturing water by techniques such as desalination. The problem arises because of autarky in the production of water and the absence of an international trading market for water. Each country can only use the water within its borders or the water it can pilfer from its neighbor if it is an upper riparian. It is as if every country was confined to the energy it could produce within its own borders and did not have access to imported energy on an international market. Obviously, no one would countenance this policy condition for a moment – very few countries could survive in this regime – and the immediate answer would be to trade energy through an international market. But this is precisely what is not done with water. Every country is autarkic, cannot import water in any meaningful way on an international market, and in fact seeks to monopolize whatever water resources course through it and neighboring countries if it is an upper riparian and can do so with dams, diversions, and reservoirs. Absent an international trading market these schemes to prevent water from flowing down its natural course create national security conflicts among neighboring countries that share a common water resource, whether it is fresh water above ground in a river or below ground in an aquifer. We would never conceive it possible for every country to be dependent only on the energy it can produce. Why not the same with the water?

There are several answers to this question. Water, first, has an existential claim on the psyche, critical to survival and mystically attached to birth itself by emergence from the water-encapsulated womb. Second, its transparent existence as a nation's resource for all to see, consume, and play in feeds water nationalism, a mark of distinctive national identification. There is thirdly an absence of a 'property right' in water. Without a clearly defined property right there can be no market, and it is difficult to create a price that reflects allocational efficiencies and domestic scarcities that are needed for assessing the competitiveness of the international, market-based water price. This leads to additional and related problems. Water is underpriced by political authorities who exercise a surrogate property right. Water is heavily subsidized, and there is inattention, as well, to long term conservation. This is particularly important for the price subsidies given to agriculture in order to award political favor to food producers. Every country does this, partly because of the iconic character of water, the mythology surrounding the land and food production, and the base popular fear of not being self reliant in food production.

Countries in fact do export and import water but not in a transparent way and in a form that frequently worsens their water deficit. They do so by importing

2 This does not include the non-renewable sources from aquifers that account for significant amounts of freshwater withdrawal.

3 The data reported by Gleick in 2002 are a bit dated: 1990 for Israel and 1993 for Jordan.

and exporting food. Since food products contain so much imbedded water in their production process, whenever food is exported, water is exported. Likewise for imports; whenever food or agricultural products are imported, water is imported. Water deficit countries should then import food but not export food. Many, however, are proud of their food exports – a misplaced national pride that severely threatens their water resources. International agencies such as the International Monetary Fund advise poor countries – even those severely in water deficit – to specialize in export crops, a policy that is counter-intuitive and worsens food security.

Instead of the quixotic quest for food self-sufficiency, water deficit countries can more judiciously achieve food security by importing food while remaining food secure, indeed more food secure. Or they can plan agricultural production so that crops with low water requirements replace those with high water inputs. A water deficit country need not fear a food import boycott from hostile countries, because a multitude of food exporters exists so the prospect of a boycott or cut off from food is remote. Agriculture is a commodity that has many highly competitive producing countries and not susceptible to cartelization. All that is needed for food imports is hard currency that can be more easily acquired if water deficit countries move out of food production and into some other less water intensive commodity that has an international market. Food security, consequently, faces a graver threat from distorted water policies than it does from dependence upon food imports.

The absence of a property right in water hinders the development of an international trading market for water, because it requires political decisions that are difficult for a country to transcend. Selling water in water surplus countries is a symbolic political hurdle that is difficult to clear in the present economic and political environment. Even the idea of importing water either directly or indirectly through food imports is a hard sell as a deliberate policy to shift out of food production and reallocate scarce water resources in water deficit countries to other more efficient uses. This policy configuration will not be available until a real opportunity cost price for water is established that reveals the allocation decisions for water's use as between food production and other uses. There is today no international market for trading water, with one exception that will be discussed later.

The estimated international trading costs of water are probably not competitive today with the alternative of desalination, a process of removing salt from salinated water in order to produce freshwater. However, we do not know this for a fact because the market does not exist for international water trading while it does for desalination. Desalination is very dependent on energy and then there is the problem of disposal of the saline residues. Saline waste disposal will pose an increasingly serious environmental problem as desalination becomes more widely deployed.

We do not know what economies of scale can be obtained once water is traded on an international market. Likewise, desalination is also in its infancy and will be attaining economies of scale and technological change as it becomes more widely used. We also cannot assess the viability of international water trading because existing prices for water are heavily subsidized and therefore water does not even reach its current market price not to mention a more effective long term conservation price. All this will change in this century as water supply becomes scarcer and demands for it increases. Policy will begin to pay more attention to water's pricing, its supply, and the effects of proper pricing on demand for water. Then a more accurate opportunity cost for trading water internationally will become available. The evolution of oil as a primary energy source in the 20th century offers a case study in how a natural resource evolves from one of perceived surplus to scarcity.

Once thought to be so cheap that consumers hardly noticed their energy expenditures, oil prices and dependence upon this resource captured everyone's attention in the 1970s. Taking the lead in exposing a disjuncture between the short term price for oil and its long term conservation price were environmentalists who were far ahead of government public policy. Many of the same environmentalists who recognized the need for a high price on energy – especially gasoline for cars because of its conservation incentives – typically oppose international water markets and proper water pricing. But the argument is the same for both energy and water. Demand is reduced and individuals adjust to higher energy prices by using it more efficiently with less of a unit of input per unit of output. A higher price induces technological change and allows for the search for new supplies. The same reasoning applies to water. Campaigns by NGOs to make water a human right, give it away free or at highly subsidized minimal prices, are inconsistent with the same environmental advocacy of a proper price for energy. Opposition to effective water pricing and to international water markets are truly counter-productive, because they injure the poorest countries that are most challenged by their water and food deficits, particularly in sub-Saharan Africa.

Proposals for more extensive water trade on an international market involve a plan to sell water from Turkey's Manavgat River to Israel, Austria's offer to supply the European Union, and Spain tapping the Rhone River with a pipeline from Montpellier in France to Barcelona. (Gleick 2002: 47) On 6 January 2004 an agreement in principle was signed between Turkey and Israel in which Israel would import 50 million cubic meters (m^3), annually from Turkey for the next 20 years (Gruen 2004: 228). When implemented this will be the first large-scale import and export of fresh water. Canada is a leader in developing transport technology and has broached the idea of selling water to the United States but strong national opposition has so far prevented this.[4] There is one instance of an emerging international market for water in the form of bottled waters. Sales of bottled water worldwide reached nearly 50 billion liters in 1999, starting from about 4 billion liters in 1979. The United States alone accounted for nearly 18 billion liters of which eight percent was imported (Gleick 2002: 43–44).

14.3 Water and Security Conflict

The great American man of letters, Mark Twain, is reputed to have said: "Whiskey is for drinking. Water is for fighting over." In the Near East, in the region surrounding what is today Israel, water conflicts are mentioned in the Old Testament. From that point of origin to the modern period water disputes continue to this day in the region. The relationship between water and its attendant environmental disputes is emphasized by some and downgraded by others as national security challenges. The literature in this field ranges from a position that the environment has minimal to no impact on national security to a point of view that sees environmental degradation as a principal source of security considerations. The fault line is between those who view security in terms of borders and military threat versus security in terms of the political and economic viability of a nation at risk from water and other environmental issues that recognize no national borders.[5]

Although there are limited instances of direct association between environmental degradation, water, and military conflicts among states, water conflicts can nevertheless be a strong contributing factor to direct conflicts. First, water security provides pretexts for conflicts that have collateral causes, culminating in either armed skirmishes or threats and in the extreme direct military engagement. Second, the persistence of resource conflicts involving water are a prime cause of the inability of neighboring countries to settle their relations, move toward more stable cross-border accords that are the goal of stable security compacts, and prevent future military instabilities. Third, water security can lead to an intrastate conflict among groups within a nation that destabilizes regimes and leads them to a more authoritarian hardening inside a territorial space. Distributional consequences over use of a critical resource such as water and their attendant environmental outcomes can lead to intensification of inequality, internal conflicts, and limitations on democratic reforms inside authoritarian regimes. Such a situation has several possible outcomes: a diversion of

4 A German shipping company, *Meyer Werft*, has developed a prototype of a vessel for transporting water. ('Water production and Supply Vessel', June 1999) So-called 'Medusa Bags' – inflatable containers for towing water is part of the discussion between Turkey and Israel for transporting water. One advantage of water as opposed to oil transport is that if an accident at sea occurs, there is no ecologically damaging spill.

5 The single place that best centers the literature on water and environmental security is the Woodrow Wilson Center's *Report* from its Environmental Change and Security project. The Spring 1995 inaugural issue, *Environment and Security Debates: An Introduction,* sets the stage for more specific case studies in subsequent volumes. Articles in that volume by Geoffrey D. Dabelko and David D. Dabelko ("Environmental Security: Issues of Conflict and Redefinition") and Richard A. Matthew ("Environmental Security: Demystifying the Concept, Clarifying the Stakes") are particularly good syntheses. The debate in the literature ranges from Charles Dunlap, "The Origins of the Military Coup of 2012" (*Parameters*, 1992–93) who argues that environment and water conflicts should not be linked to national security to Jessica T. Matthews, "Redefining Security" (*Foreign Affairs*, 1989), who presents the case for the environment as a prime source of security challenges in the 21st century, and Robert D. Kaplan's, "The Coming Anarchy" (*Atlantic Monthly*, 1994) which had a large public impact and caught the attention of Washington policy makers. Two projects on environment and security provide a rich lode of case study materials: The Environmental Conflicts Project, 40 cases published in two volumes, summarized by its co-director, Gunther Baechler in "Why Environmental Transformation Causes Violence: A Synthesis" (Wilson Center *Report*, Spring 1998) and Thomas Homer-Dixon's Project on Environment, Population and Security, in his book co-edited with Jessica Blitt, *Ecoviolence* (1998).

the conflict onto neighboring countries who are blamed for the water-environmental decay, propagandizing the population against those on the other side of a border, and mobilizing for a military conflict that has other more visceral antecedents. Alternatively, an internal hardening can destabilize the regime, making it vulnerable to intrusion from its neighboring country and potentially leading to armed conflict. Environmental stress over water disputes, therefore, is a significant threat within a conflict matrix.

The literature on hydrological security cites river basin inter-state conflicts as the most direct example of the links between environment and security. This is the conclusion drawn from two international research programs: some 40 case studies conducted by an international team of researchers at the Swiss-based Environmental Conflicts Project and the joint University of Toronto and American Association for the Advancement of Sciences Project on Environment, Population, and Security. Their results point toward the unequal power relations between upper and lower riparians and environmental stress caused by pollution and ecological degradation deriving from two sources: upper riparian export of ecological problems downstream to the lower riparians and the absence of any incentive on lower riparians to control pollution owing to distance from control over the source and the lack of 'property rights' over the flow. This becomes a classic economic case of a negative externality that leads to inadequate long-term scarcity pricing of the resource. Everyone sees themselves as a free rider on an indivisible public good. In the region, it is the intersection of such environmental problems as water scarcity and pollution, within a comprehensive historical conflict, that yields important impediments to their resolution.

The one instance often cited that connects water-environmental security to military conflict is the 1967 war in the Middle East when the diversion of the Jordan River and its feeders led to Israel's preemptive strike against Jordan, Syria, and Egypt, leading to the Six Day War, an alteration in the map of the Middle East, and a territorial and resource dispute that remains one of the most serious and intractable unresolved security problems today, some 40 years after the war. The diversion of the Jordan River was but one part of a larger matrix of political conflicts in the region. It has, however, become part of an accepted explanation for the timing of military conflict and remains a perceptual cause of war in the consciousness of Israelis, Syrians, and Jordanians.[6]

The aftermath of the 1967 war has allowed Israel to become an upstream riparian on the Upper Jordan system. This has put it in a favorable strategic position vis-à-vis the downstream riparians of Jordan and the Palestinians. Jordan is in a particularly vulnerable position because it is a downstream riparian as well with the Yarmouk where Syria is upstream. The Palestinians are likewise downstream and are disadvantaged further with respect to ground water on the West Bank. About half of Israel's annual supply of ground water and about one-quarter of its total renewable supply of fresh water originates in West Bank aquifers.

There were three attempts at a resolution of water and environmental security issues in this region prior to Oslo: in 1953–55 (with the Johnston Plan), in 1976–1981, and in 1987–1990. Although considerable progress was made on the technical issues, they all ultimately failed because of the absence of a wider political concord. The peace treaty with Jordan (1994) included sections on water and environmental security between the two countries. A subsequent working group has produced proposals and actual projects. Separately, a working group on water resources, consisting of delegations from 29 countries including representation from Africa and the Middle East, as well as Israel, the PA, and Jordan, met as part of the multilateral track. Its purpose was to provide impartial mediation, to develop confidence-building technical projects as a complement to the bilateral political negotiations with the prospect of each informing and influencing the other.

The interim conclusion one can draw is that a water and environmental security accord awaits a broader political settlement. However, this does not preclude sharing technical information, designing projects, collecting accurate data, and considering unique solutions in anticipation of a wider political

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6 Two books provide an excellent analysis, history, and synthesis of water disputes and proposed solutions: Miriam R. Lowi (1993) and Daniel Hillel (1994). Hydrological engineering analyses are contained in Mashiro Murakami (1995). The proceedings of the first joint Israeli-Palestinian conference on water are in J. Isaac and H. Shuval (1994). The papers from a UN sponsored conference at the University of Illinois that brought together technical experts from countries in the region were published in *Proceedings of the International Symposium on Water Resources in the Middle East* (1993). Specific treaties and agreements are available in full text from either government web sites or in the case of the Israeli-PA agreement on water in Martin Sherman (1999). Technical analyses of proposed water projects appear in Elisha Kally (1993). The complex negotiations with Syria, including water, are detailed in Itamar Rabinovich (1998) and with the PA in Uri Savir (1998).

agreement so that once such an accord is in place these plans can be taken off the shelf and implemented quickly without having to spend several years in their design. One such effort was the first Israeli-Palestinian International Academic Conference on Water (1992) co-sponsored by Israeli and Palestinian academic institutions. These technical efforts constitute a confidence building movement toward conflict management and resolution and become part of a more general security enhancing mosaic.

Scarcity of water, unequal access as between upper and lower riparians in a river basin, and ground water in aquifers that traverse disputed boundaries form one environmental security subset. Another is pollution of water sources, inadequate treatment of sewage, losses due to runoffs that arise from failures to provide adequate catchments, and inefficient management of existing water resources. The section of the Jordan Basin involving Israel and Jordan has been the subject of considerable formal and informal discussion, joint technical planning, and currently intensive project implementation. These developments have moved farther along than any other. However, they are hampered by the absence of Syria and Lebanon, critical countries in the headwaters of the Jordan River. As between Jordan and Israel, water and environmental security were a significant part of the *Treaty of Peace between the State of Israel and the Hashemite Kingdom of Jordan* (26 October 1994). Article 6 of that treaty spoke of a "lasting settlement of all the water problems" between the two countries and committed them to "jointly undertake to ensure that the management and development of their water resources do not, in any way, harm the water resources of the other party." This was supplemented by a detailed Annex II that contained provisions for allocation of water at varying times of the year, water storage, water quality and environmental protection of the water supply, and groundwater issues. Article 18 of the treaty added an environmental section, supplemented by details in Annex IV of the treaty. A country whose land mass is three-quarters desert with few water resources of its own, Jordan has taken the lead in efforts at regional peace and cooperation but is particularly vulnerable to internal destabilization and the security threat this poses.

14.4 Food and Water Security

Food security is inextricably linked with water security in arid and semi-arid regions and both connect with environmental security and national security conflicts. Israel and its surrounding region is a singular case study in this matrix of security problems. To soft technology policies such as better waste management, use of grey water where appropriate, and water saving agricultural techniques to hard technologies of desalination must be added economic policies. These include the phasing out of most water subsidies, long-term conservation pricing, moving away from water absorbing agricultural production, and finally the development of an international trading market for water where water is put on the same footing as all other natural resources. No single policy can succeed and only a matrix of policies will work.

References

Gleick, Peter H, 2000: *The World's Water* 2000–001 (Washington, D.C.: Island Press).

Gleick, Peter H. , 2002 *The World's Water,* 2002–2003 (Washington, D.C.: Island Press).

Gruen, George E. , 2004: "Turkish Plans to Export Water: Their Regional Strategic Significance", in: *American Foreign Policy Interests*, 26: 209–228.

Hillel, Daniel, 1994: *Rivers of Eden: The Struggle for Water and the Quest for Peace in the Middle East* (N.Y. - Oxford: Oxford University Press).

Homer-Dixon, Thomas; Blitt, Jessica (Eds.), 1998: *Ecoviolence: Links Among Environment, Population and Security* (Lanham, MD.: Rowman & Littlefield).

Isaac, Jad; Shuval, Hillel (Eds.), 1994: *Water and Peace in the Middle East: Proceedings of the First Israeli-Palestinian International Academic Conference on Water* (Amsterdam: Elsevier).

Kally, Elisha, 1993: *Water and Peace: Water Resources and the Arab-Israeli Peace Process* (Westport, Conn.: Praeger).

Lowi, Miriam R., 1993: *Water and Power: The Politics of a Scarce Resource in the Jordan River Basin* (Cambridge: Cambridge University Press).

Murakami, Masahiro, 1995: *Managing Water for Peace in the Middle East: Alternative Strategies* (Tokyo and N.Y.: United Nations University Press).

Rabinovich, Itamar, 1998: *Brink of Peace: The Israeli-Syrian Negotiations* (Princeton: Princeton University Press).

Savir, Uri, 1998: *The Process:* 1,100 *Days that Changed the Middle East* (N.Y.: Random House).

Sherman, Martin, 1999: *The Politics of Water in the Middle East: An Israeli Perspective on the Hydro-Political Aspects of the Conflict* (N.Y.: St. Martin's Press).

Woodrow Wilson Center, 1995: *Environmental Change and Security Project Report* (Spring).

Woodrow Wilson Center, 1998: *Environmental Change and Security Project Report* (Spring).

Part IV Water Imports in the Middle East

15 Turkish Water Exports: A Model for Regional Cooperation in the Development of Water Resources

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Abstract

This chapter analyzes the status of Turkish plans to export water to Israel, Palestine, Cyprus, and other countries in the Middle East. The most ambitious of these was President Turgut Özal's 1986 'Peace Water Pipeline', a $ 21 billion project to bring water from the Seyhan and Ceyhan rivers via pipelines to cities in Syria, Jordan, and the Arab Gulf States. This chapter examines why this was not implemented. A shorter pipeline from the Seyhan or Ceyhan rivers to Syria and Jordan, estimated to cost $ 5 billion, may become feasible following the recent rapprochement between Turkey and Syria, but extension of the pipeline to Israel and the Palestinian territories requires a breakthrough in Syrian-Israeli relations, including resolution of disputes over Jordan River headwaters and the Syrian access to the Sea of Galilee (*Kinneret).* This chapter will assess the progress of a Turkish export scheme that has been approved in principle: *Manavgat water to Israel***.** Israel has agreed to purchase 50 MCM annually for 20 years from the Manavgat River near Antalya, but as of November 2006 the agreement had been shelved because the parties had neither finalized the price nor selected the company to implement the water transfer. Israeli advocates of desalination object to the price of Turkish water and question the wisdom of relying on Ankara, whose government has lately been critical of Israeli policies. Palestinian water officials express interest in Turkish water if the cost is subsidized by international aid agencies. Ankara views the Manavgat 'Peace Water Project' as its contribution to the Arab-Israel peace process. A 100 MCM capacity desalination plant was opened in Israel's coastal city of Ashkelon in October 2005, while the idea of importing Turkish water was revived in April 2006 as part of a multi-million-dollar energy and water project that will utilize four underwater pipelines to transport water, electricity and high-speed data, natural gas and oil to Israel. Some of the water would be earmarked for Palestinian and Jordanian use, while most of the oil would be transferred by tankers to the Far East. The European Investment Bank is undertaking a $ 50 million feasibility study.

Keywords: Cyprus, Israel, Palestine, Turkey water exports.

15.1 Turkey's Natural Advantage as a Water Supplier

In contrast to the semi-arid climate and consequent scarcity of water that afflicts many of the countries of the Middle East, Turkey has been blessed with a relative abundance of water resources. The main problem for Turkey is the domestic one of distribution: How to bring this water to the rapidly growing cities and agricultural communities located at considerable distance from the river sources? Moreover, since such major rivers as the Euphrates originate in Turkey before flowing down into Syria and Iraq, Turkey is by nature a significant exporter of water. This fact has embroiled Turkey in decades of controversy with its downstream Arab neighbors over the equitable distribution of this valuable natural resource. Even the terms of the debate have been in dispute. Ankara contends that the issue is one of Turkey's gracious 'allocation' of part of its national water patrimony, based on the theory that the Euphrates is a 'transnational river', over whose resources Turkey enjoys full sovereignty until it flows into Syria. Damascus and Baghdad argue that the Euphrates is an 'international river' and therefore Syria and Iraq should enjoy equal riparian rights with Turkey and that what is required is to devise a fair and equitable formula for 'sharing' their common water resource.

The various water negotiations among Ankara, Damascus, and Baghdad since the establishment of the Turkish Republic in 1923 are described in earlier studies (Gruen 1993, 2000a, 2000b, 2002). Stripped down to its essential core, the basic argument is over what constitutes a fair and equitable allocation of the Euphrates' annual flow. Statistics show that before Turkey constructed dams and diverted considerable water into pipelines to irrigate additional fields in Southeastern Anatolia, the normal natural flow of the Euphrates averaged around 1,000 cubic meters per second (m^3/sec) at the point the river crosses from Turkey into Syria. The Arab states argue that since there are three states sharing the river's flow, each is entitled to one-third, giving the two Arab states a total of around 667 m^3/sec.

The Turkish counter argument is that since nearly 90 per cent of the Euphrates river's flow originates in Turkey, Ankara has been generous in agreeing to supply Syria with 500 m^3/sec., which in a year totals some 15.7 billion m^3 or roughly half the river's flow. This figure was enshrined in a protocol concluded between the Turkish and Syrian Prime Ministers in July 1987. However, this was to be only a temporary arrangement until the reservoir created behind the giant Atatürk Dam was filled. At that time a permanent arrangement would be negotiated. The Atatürk dam began to generate electricity in July 1992 and the first of two large tunnels to divert water for irrigation was completed in November 1994. However, as of November 2006, Syria and Turkey had not yet reached agreement upon the terms of a permanent apportionment of the Euphrates flows. Syria and Iraq have enlisted the help of the Arab League to support their demands that Turkey increase its allotment to them (Gruen 2002: 10–24).

Özden Bilen, former head of the Turkish State Hydraulics Works (DSI), reports that Turkey contributes 31.6 billion cubic meters (BCM) or 90 per cent of the average 35 BCM annual flow of the Euphrates, as well as 21.3 BCM or 40 percent of the flow of the Tigris (Bilen 2000). Peter Beaumont, an international water authority, supports Ankara's position on the Euphrates, noting that since approximately 90 per cent of the river's flow originates in Turkey, in terms of both "international precedent" and "natural justice, it does not seem unfair that Turkey should be able to utilize up to one-half of the water which is generated within its borders" (Beaumont 1991).[1]

15.2 Özal's 'Peace Water Pipeline'

The concept of exporting Turkish water to promote regional peace and economic development in the Middle East has been a constant in Turkish foreign policy since the late President Turgut Özal in 1986 proposed an extensive 'Peace Water Pipeline'. This was a $ 21 billion project to bring vast quantities of water from the Seyhan and Ceyhan Rivers via two pipelines to supply the major cities in Syria, Jordan, and the Arab Gulf states. The pipelines could convey 10 million cubic meters of water every day, which was estimated as sufficient to meet the needs of 15 million persons. The original Turkish proposal also envisioned making some of this water available to Israel. However, when some Arab states objected, Ankara modified its proposal, saying that Israeli participation would have to be deferred until after the conclusion of peace treaties between Israel and its Arab neighbors. Although Jordan and Israel concluded a Peace Treaty in 1994, following the earlier Egyptian-Israeli Peace Treaty in 1981, Syria and Lebanon have not yet done so.

It should be noted that unlike the Tigris and Euphrates, the Ceyhan and Seyhan rivers originate and flow entirely within the sovereign territory of Turkey before emptying into the Mediterranean Sea. The pipeline idea was rejected by the oil-rich Gulf states, which Turkey hoped would finance the giant project. The Saudis contended that desalination was a cheaper solution, since they could fuel flash distillation desalination plants with surplus gas produced as a byprod-

1 For an analysis of Turkish projects utilizing Euphrates water, see: Kolars/Mitchell (1991).

uct of their oil production. In a conversation the author had with President Özal during his visit to Columbia University shortly before his death in 1993, the Turkish leader told him the Saudis failed to calculate the true cost of desalination since they did not assign any value to the natural gas being flared off rather than being liquified and sold. He was confident that eventually Saudi Arabia and other Gulf States would realize the value of the Turkish water for them. Alev Kiliç, Deputy Undersecretary in the Turkish Ministry of Foreign Affairs, recently told the author that Ankara was still hopeful that the long pipeline extending to Saudi Arabia would ultimately be built (Kiliç 2004).

Beyond the relative costs of desalination versus the water imports from Turkey, the Arab Gulf states were weighing the political risks. A major reason for rejecting the Turkish proposal was political: the Saudis feared disruption of the flow by one of the states through which the water pipeline passed before reaching them. Saddam Hussein's invasion of Kuwait in August 1990 reinforced this fear. However, the Kuwaiti experience also pointed out the vulnerability of desalination plants. When the retreating Iraqi forces set many Kuwaiti oilfields on fire, large quantities of oil spilled into the Persian/Arabian Gulf. The U.S.-led allied forces managed to cap the oil wells just before the oil spill reached the intake points of the desalination plants in Kuwait and Saudi Arabia. The recurring acts of sabotage against oil pipelines by terrorists in Iraq following the overthrow of Saddam Hussein in March 2003, have once again highlighted the vulnerability of pipelines to disruption.

Some political commentators in the Arab world in the mid-1980's had questioned the seriousness of the Turkish intentions with regard to the giant multi-billion dollar water pipeline project to the Arab states. Some contended that Ankara had only raised the proposal to deflect criticism in the Arab world over Turkey's failure to yield to Syrian and Iraqi demands for a greater share of the water resources of the Tigris and Euphrates rivers. In 1946, Turkey and Iraq signed a Protocol for the Control of the Waters of the Tigris and Euphrates and their Tributaries. They agreed that flood control dams and storage facilities would most effectively be built upstream on Turkish territory. They also promised to exchange hydrological and meteorological data daily during flood periods. The normal flow of the Tigris and Euphrates was adequate to meet the needs of the relatively small populations of Turkey, Syria and Iraq. However, in the mid-1960's the three countries began large-scale projects to build major dams to produce hydro-electric power and expand the areas of irrigated agriculture. The first of these was the Keban Dam and Power Plant on the Euphrates in Turkish territory. Ankara shared technical information on this project with Syria and Iraq. In a tripartite meeting in Baghdad, in September 1965, Turkey proposed the creation of a Joint Technical Committee (JTC) to study the entire Tigris-Euphrates basin. Syria at first endorsed this idea, but Iraq insisted that the flow of the Euphrates be considered separately from that of the Tigris. Turkey argued that the Iraqi position was not reasonable since there were already plans to develop canals to link the two rivers in Iraq. These have since been completed. Moreover, the Tigris and Euphrates in fact naturally flow together into the *Shatt-al-Arab* in southern Iraq, before emptying into the Persian/Arabian Gulf. After 1980. Syria adopted the Iraqi position. The JTC met numerous times but was not empowered to make major political decisions.

Meanwhile, the populations of the three countries have been increasing rapidly and the demand for water has increased exponentially. It has been estimated that the combined development plans of Turkey, Syria and Iraq, if fully implemented, would require more than 150 per cent of the normal total flow of the Tigris and Euphrates! Thus one can make a plausible case that Özal's 'Peace Water Pipeline' was not simply an exercise in public relations. It was a serious proposal made in good faith by Ankara to help Syria, Iraq and other Arab neighbors – as well as Israel – cope with the anticipated shortfall in available water resources to meet the growing domestic demands of their burgeoning populations and the expanding requirements for irrigated agriculture and industrial production.

15.3 Denial of the Nile Option

In theory, another potential source of water for Palestinians in Gaza and possibly also Israelis living along Israel's coastal plain is the Nile River. Some years back, Elisha Kally, an international water authority working at Tahal, Israel's water research institute, proposed an arrangement under which Israeli scientists would provide technical expertise in drip irrigation and other water saving technologies for application to agriculture in the Nile Delta. As a contribution to Arab-Israel peace, Kally suggested that 50 per cent of the water Egypt saved be exported by pipeline to meet the needs of the water-stressed Palestinians in the

Gaza Strip and possibly also for resettlement of some Palestinians in new communities either in Gaza or along the Sinai coast. Egyptian officials the author has spoken to about this, notably former United Nations Secretary-General Boutros Boutros-Ghali, dismissed the idea as impractical. In his previous post as Egyptian Minister of State for Foreign Affairs, Boutros-Ghali had been in charge of Egypt's negotiations with the Sudan and the other riparian countries. He also had chaired the UNDUGU organization of Nile riparians. He pointed out that Egypt was not free to export Nile water out of the basin without the approval of the other riparians. Ethiopia, which "alone supplies 84 percent of those waters, as well as the immense aluvium fertilizing the lower reaches of the Nile," had already on 6 February 1956 lodged a formal complaint with Egypt and the Sudan over their proposed agreement on allocation of the Nile waters (Text cited by Bilen 2000: 130–131). Other upper riparian states have also complained that the huge quantity of water being used by Egypt and the Sudan was stifling their own development needs.

At a conference of the *International Water History Association* (IWHA) in Alexandria, Egypt in December 2003, this author met with Hassan Wahby, head of the Institutional Reform Unit at the Egyptian Ministry of Water Resources and Irrigation. He confirmed that in the newly established agricultural settlements on lands reclaimed from the desert they were instituting the water-saving technologies developed by Israeli scientists. But he reiterated that Egypt would not be able to provide any Nile water to Israelis or Palestinians. To do so would arouse fierce opposition and would undermine the water sharing agreements that Egypt had so painstakingly negotiated with the nine upper riparian states (Wahby 2003).

15.4 Palestinians, Israelis and Jordanians Face 'Water Stress'

Malin Falkenmark (2000) of the University of Linkoping, Sweden, developed the concept of 'water stress'. According to her calculations, countries having more than 2,000 cubic meters (m^3) of fresh water available for all uses per person, per year were in the 'water abundance zone', while those having less than 500 m^3 per capita were in the 'water stress zone'. Ranking eight Middle Eastern countries in terms of per capita water availability in 1991, Falkenmark (2000) found only three with adequate supplies: Turkey (4,600), Iraq (4,400), and Lebanon (3,000). Syria (1,300) and Egypt (1,200) were in an intermediate position. Already under severe water stress were the Palestinians (165), Israel (300) and Jordan (300).

As regional population increases, per capita water figures will decline further. Deborah Sontag reported in *The New York Times* in February 2000: "The population explosion in the Palestinian-governed Gaza Strip appears to be unrivaled in the world. Its population of 1.1 million – half under 15 – is expected to double by 2014, which would "pose almost unimaginable strains" on an area with "almost no natural resources." She noted that the combined Palestinian population of over 3 million in the West Bank and Gaza was expected to rise to 5.5 million by then. And this is without return of any of the more than 800,000 Palestinian refugees now in Lebanon and Syria (Sontag 2000).[2]

While the high fertility rate of more than 7 per woman in Gaza is similar to that of Somalia, the crucial difference is that whereas infant mortality is still high and life expectancy is still very low in Somalia, infant mortality in Gaza is half the world average and life expectancy is 73 years, similar to that in the United States and Israel.

Amnon Rubinstein notes that within the territory of the State of Israel there has also been a dramatic decrease in infant mortality. The infant mortality rate in Mandatory Palestine in 1943–44 was almost 10 per cent for Muslims, 7 per cent for Arab Christians, and 3.5 per cent for Jews. In 2001, the infant mortality rate among Jews was 0.41 percent, among Muslims, 0.82 percent, and among Christians, 0.2 percent. The overwhelming majority of Muslims were members of Israel's Palestinian Arab communities. According to recent figures of the World Health Organization, the average life expectancy in Europe, in 2000, was 69.6 years. "The Israeli Arab male, with a 74.4-year life expectancy average, was very close to the figure for Germany, 74.9 years, and for the U.K., 75.6 years" (Rubinstein 2003: 5–6).

Jordan also faces a worsening crisis. Its population growth rate was officially estimated at more than 3.6 per cent per year. Natural increase in 1991 was swelled by more than 200,000 Jordanians, mainly of Palestinian origin, who returned from the Gulf States, having been expelled from Kuwait and Iraq as a result of the crisis following Saddam Hussein's invasion of Kuwait (Jordan 1991). According to the official *Jordan Diary* 2000, "the gravest environmental challenge that faces [the Hashemite Kingdom of] Jordan today is the scar-

2 Other sources believe the number of refugees in Lebanon and Syria is considerably less.

city of water." Current use already exceeds renewable supply, with the deficit covered by "the unsustainable practice of overdrawing highland aquifers, resulting in lowered water tables and declining water quality."

In March 2000 King Abdullah II went to Ankara to discuss water imports from Turkey. Joint Jordanian efforts under the 1994 Peace Treaty with Israel to develop additional water resources are also continuing. According to *Jordan Diary* 2000, with Jordan's population expected to continue to rise, the gap between water supply and demand "threatens to widen significantly. By the year 2025, if current trends continue, per capita supply will fall to only 91 cubic meters, putting Jordan in the category of having an absolute water crisis. The kingdom's capital, Amman, where almost half the population lives, has had to bear a water rationing program almost every summer since 1989" (Jordan 2000).

If Israel does not need all the 50 MCM of water it plans to import annually from Turkey, some of this amount could be used to fulfill Israel's pledge under its Peace Treaty with Jordan to help find additional water resources to ease Jordan's perennial water shortage. The additional water provided by Israel to Jordan need not be the actual water from Manavgat, but could be water drawn directly from the Jordan River or from storage in the Sea of Galilee. The Turkish water could be used to replace some of the Jordan River flow that is now pumped into the National Water Carrier to meet Israel's domestic needs.

15.5 The Shorter Pipeline to Syria and Jordan

Since the extensive and far-reaching original Özal Peace Water Pipeline had failed to win Saudi or other Gulf country support, senior Turkish officials have suggested that in the context of facilitating Arab-Israeli peace, consideration be given to a shorter pipeline from the Seyhan or Ceyhan, estimated a decade ago to cost some $5 billion, passing through Syria. Özden Bilen has suggested that "the terminal point could be Jordan where the problem of water shortage is felt most seriously and thus reduce costs by having a shorter line. The yearly water transfer capacity of this smaller pipeline project is 2.19 BCM, which is 1.6 times greater than the average annual water capacity of the Jordan river." Bilen concluded that "it is certain that the project could play an important role in closing the water gap of Jordan and Palestine in particular" (Bilen 2000: 115–116).

Extension of the pipeline to Israel would require the agreement of Syria, which in the past insisted on total Israeli withdrawal from the Golan Heights and the granting to Syria of riparian rights on the Sea of Galilee (*Yam Kinneret).* American efforts, including those of President Bill Clinton in 2000, failed to bring about a Syrian-Israeli agreement before the death of Syrian President Hafez al-Assad (Gruen 2000a: 11–14, and earlier works cited in notes 40–51). Shortly before his death, Hafez Assad selected his young son, Bashar, to succeed him, and the Syrian parliament quickly amended the constitution to lower the qualifying age for president to allow Bashar to be chosen. In an interview with a *New York Times* correspondent (MacFarouhar 2003) and more recently with *Al Hayat* in September 2004, Assad offered to resume peace talks with Israel "if Israeli Prime Minister Sharon is prepared to do so."[3] Most Israeli officials expressed skepticism as to whether this marked a significant softening of the Syrian position, contending that Bashar's immediate objective was to duck U.S. sanctions over Syria's backing of Hezbollah and other anti-Israel militants whom the U.S. has designated as terrorists. Sharon distanced himself from the positions taken by Prime Minister Ehud Barak regarding withdrawal from the Golan Heights. In interviews published on the eve of the Jewish New Year, Sharon called on Syria to withdraw all of its forces from Lebanon and stop supporting anti-Israel groups. He also noted that Israel and Syria had unresolved disputes over water issues.

15.6 Manavgat Water Exports to Israel

"Israeli 'Water for Arms' Deal with Turkey" was the headline in *The Guardian* on 6 January 2004, describing the agreement in principle signed in Jerusalem on 5 January 2004 by Israeli Prime Minister Ariel Sharon and visiting former Turkish Energy and Water Resources Minister Zeki Çakan. Reporter John Vidal termed the "water for arms" deal as "extraordinary." He added that the series of linked agreements were "expected to have long-term strategic implications throughout the Middle East." It was the Turkish government that had insisted on linking the two agreements. After years of negotiations, the two parties finally agreed that Israel would purchase 50 million cubic meters (MCM) of water annually for the next

3 As reported in a JTA dispatch from Jerusalem, *The Jewish Week*, 10 September 2004.

20 years from the Manavgat River near Antalya on Turkey's Mediterranean Coast. Special tankers would be built to transport the drinking water from Manavgat to Ashkelon on Israel's coast, a distance of some 325 nautical miles. From the Ashkelon port, special pipes would convey the water into the existing National Water Carrier for distribution where needed (Vidal 2004). Ankara had already invested $ 147 million to construct the necessary storage and water treatment facilities upstream on the Manavgat, and a pipeline and offshore facilities in the Mediterranean for tankers to load the water for export.

The 50 million cubic meters Israel will initially import from Turkey represent only about 3 percent of Israel's current annual consumption. However, because of the unpredictability of rainfall each season and Israel's recent experience of periods of multi-year drought, Israel is in dire need of additional dependable water sources, especially as it anticipates further increases in the country's population through native births and immigration. Even though Israel was blessed with above normal rainfall during the past two years and the Sea of Galilee (*Kinneret)*, Israel's primary storage reservoir, was overflowing in the Spring of 2004, this should not give Israelis a false sense of optimism. Israelis consume some two billion cubic meters (2,000 MCM) of water each year, while the country's water supplies are replenished at an average rate of only some 1.8 billion. This produces a yearly deficit of 200 MCM or four times the anticipated imports from Turkey.

A further step toward implementation of the Turkish-Israeli water agreement took place on 4 March 2004 at the Israel Foreign Ministry in Jerusalem with the signing of a detailed agreement by Turkish Foreign Ministry Undersecretary Uur Ziyal, and Yoav Biran, Director-General of Israel's Foreign Ministry. Turkish Foreign Ministry Spokesman Namik Tan told reporters in Ankara that this agreement "would bring a new dimension to the cooperation between the two countries," adding that "it would contribute to bringing stability and peace in the Middle East." He pointed out that the agreement "would be a good example for providing water to other regional countries which had a shortage of water," such as Cyprus, Malta, and the Greek islands. (Anadalu Ajans 2004). Tan said that details such as the cost of the water, transportation and the date for the initial shipments would be set out in a management contract that had yet to be concluded. This contract will also include provisions for monitoring the quality of the water in the export facilities in Turkey, in the transportation network, and in the unloading facilities in Israel (Cohen 2004).

According to Ömer Önhon, Turkey's Consul-General in New York, as of mid-September 2004 the two countries were still "more than a few cents apart" on the price per cubic meter, and no contract had yet been awarded to a commercial firm to implement the government-to-government agreement. Ambassador Önhon was familiar with regional water issues since he had served in Damascus (1998–2000), and headed Ankara's Middle East Department (2000–2002), before assuming his current post. He dismissed the arguments of proponents of desalination, such as Professor Dan Zaslavksy, who had been Israel's Water Commissioner and the Energy Ministry's chief scientist in previous right-wing Likud governments. Zaslavksy warned that inadequate management in Syria would result in environmental damage to vital water resources flowing down to Israel from the Golan Heights (Siegel/Rudge 2000). More recently Zaslavksy has argued that "I don't think it's in the state's interest to be in any way dependent on Turkey for a resource as sensitive as water." Even now, despite the growing number of major economic deals between Turkey and Israel in recent years, he contended, Turkey remained an unreliable source for such a vital commodity as water. He cited press reports that Ankara threatened to cancel some deals unless Israel bought the Manavgat water (Zaslavksy 2004). Moreover, relations have been strained because of the conservative Islamic background of the leadership of the ruling Justice and Development Party (AKP) and criticisms by Prime Minister Recep Tayyip Erdoğan of Israeli military actions in the Gaza Strip, and allegations – denied by Jerusalem – that Israel was aiding Kurdish nationalists in northern Iraq.

Ambassador Önhon (2004) insisted to me that Turkey's relations with Israel were fundamentally sound and that the occasional disagreements on specific issues were no different than those between Israel and the United States or the U.S. and its European allies. He emphasized that Turkey believes it can play an important and constructive role in the Middle East. "We have very good relations with Israel and also with the Palestinian side," he told me. Moreover, Turkey was in the unique position of serving as a bridge between Europe and the Middle East. Amiram Cohen, in his article on the agreement for the Israeli daily *Haaretz,* pointed out that it was categorized not as a commercial agreement but as a "political agreement" [*medini* in Hebrew can be translated either as 'political' or 'state to state']. The agreement obligates

Turkey to sell Israel 50 MCM of drinking quality water annually for 20 years, with an option to extend the contract for an additional five years. Implementation of the agreement was assigned to the national water authorities of the two countries. The agreement stipulates that a Turkish-Israeli binational commission will select the method of shipping and award the shipping contract.

Cohen reported that officials in the Israeli Ministry of Finance estimate the cost of the water at the loading point in Turkey at between 13 and 18 cents per cubic meter, to which needs to be added the transportation costs, which they estimate at between 70 and 80 cents, meaning that the total cost of the water at the unloading facility in Ashkelon would be around $ 1.00 per cubic meter. Israel's nationalist *Arutz Sheva News Service* reported on 4 March 2004 that the cost would be "at a minimum price of 70 cents per cubic meter. This is cheaper than desalinated water, but much more expensive than local water." But the true economic cost of water in Israel has been distorted by the subsidies provided to farmers and consumers. Finance Minister Binyamin Netanyahu had opposed the Turkish water deal, saying "it was too expensive. Prime Minister Sharon, however, said the importance of the deal surpasses merely the water issue, and affects the strategic relationship with Turkey" (Arutz Sheva 2004).

Some argue that the best long-term solution is to build a network of large-scale desalination plants. The first of four projected plants was opened in October 2005 in the coastal city of Ashkelon. It employs reverse osmosis to produce 100 million cubic meters of drinking quality water annually. However, even if additional desalination plants were approved quickly, these would take several years to be constructed. Commenting on the deal with Turkey, Raanan Gissen, a spokesman for Prime Minister Sharon, stressed: "Water, additional water, will never hurt Israel because we are at a very grave shortage." He pointed out that even if the Turkish water were not needed immediately, "Water is like money in the bank. You can use it in the future" (JINSA 2004). Joseph Paritsky, then Israel's National Infrastructure Minister, explained: "We are buying water from Turkey for two reasons: one, we need water, and two, to strengthen our ties with one of the most important countries in the world for us" (JINSA 2004). The idea of importing Turkish water was revived and expanded in April 2006 as part of a multi-million-dollar energy and water project that will utilize four underwater pipelines to transport water, electricity and high-speed data, natural gas and oil to Israel. Some of the water would be earmarked for Palestinian and Jordanian use. According to a joint announcement by Israeli and Turkish officials, the oil from Baku would be shipped by the new Baku-Tblisi-Ceyhan pipeline – which was inaugurated on July 13, 2006 – to the Turkish Mediterranean port of Ceyhan. From there it would be sent to Ashkelon, which is only 400 kilometers away, via the proposed new underwater pipeline or by tankers. The strategic advantage of this approach is that unlike a land-based pipeline that would require the approval of Syria and Lebanon, the sea route would be in international waters. From Ashkelon the oil could be pumped through an existing pipeline to the port of Eilat on the Red Sea; and from there it would be shipped by tankers to India and the Far East. The Luxembourg-based European Investment Bank is undertaking a $ 50 million feasibility study of this imposing project (Bushinsky 2006; Chossudovsky 2006; Lefkovits 2006). Ankara has also placed great value on water agreements with Israel, seeing it as the first tangible result of Turkey's regional 'peace water' policy.

References

Anadolu Ajans, 2004: "Turkey and Israel to Sign Water Agreement" (Ankara: 4 March).

Arutz Sheva News Service, 2004: "Israel to Buy Turkish Water" (4 March); at: <www.Israelnationalnews. com>.

Beaumont, Peter, 1991: "Transboundary Water Disputes in the Middle East", International Conference on Transboundary Waters in the Middle East: Prospects for Regional Cooperation, Bilkent University, Ankara, 2–3 September: 12.

Bilen, Özden, 2000: *Turkey & Water Issues in the Middle East* (enlarged and revised 2nd Edition) (Ankara: Republic of Turkey, Prime Ministry, Southeastern Anatolia Project (GAP), Regional Development Administration). Table 1: 35.

Bushinsky, Jay, 2006: "Turkey, Israel make undersea connections," in: *The Washington Times*, 30 April.

Chossudovsky, Michel, 2006: "The War on Lebanon and the Battle for Oil," in: *GlobalResearch.ca*, 26 July.

Cohen, Amiram, 2004: "Agreement Signed for the Acquisition of 50 MCM of Water from Turkey," [in Hebrew], in: *Haaretz*, 4 March.

Falkenmark, Malin, 1992: "Water Stress in the Middle East, 1991", in: *Water International*, 17: 134.

Gruen, George E. , 1993: "Recent Negotiations over the Water of the Euphrates and Tigris", International Water Resources Association. *Proceedings of the International Symposium on Water Resources in the Middle East.* (Urbana-Champaign, Ill: International Water Resources Association): 100–108.

Gruen, G. E. 2000a: "The Politics of Water and Middle East Peace", in: *American Foreign Policy Interests*, 22,2 (April): 1–21.

Gruen, G. E. 2000b: "Turkish Waters: Source of Regional Conflict or Catalyst for Peace?", in: *Water, Air and Soil Pollution* (Dordrecht: Kluwer), 123: 565–579.

Gruen, G. E.¸ 2002: "Turkey's Regional Role in the Aftermath of September 11, 2001", in: *American Foreign Policy Interests*, 24:1 (February): 3–29.

JINSA Online, 2004: "Israel-Turkey Water Agreement Near", 16 January.

Jordan, Hashemite Kingdom of, 1991: *National Environment Strategy for Jordan* (Amman: The Hashemite Kingdom of Jordan, August).

Jordan, International Press Office, 2000: *Jordan Diary* 2000 (Amman: The Hashemite Kingdom of Jordan): 107.

Kiliç, Alev, 2004: Conversation with the author, New York, 27 September 2004.

Kolars, John; Mitchell, W., 1991: *The Euphrates River and the Southeast Anatolia Development Project* (Carbondale, Ill.: Southern Illinois University Press).

Lefkovits, Etgar, 2006: "Israel and Turkey plan energy pipeline, in: *Jerusalem Post*, 11 May.

MacFarouhar, Neil, 2003: "Syrian Pressing for Israel Talks", in: *New York Times*, 1 December.

Önhon, Ömer, 2004: interview by the author, New York, 9 September 2004.

Rubinstein, Amnon, 2003: *Israeli Arabs and Jews: Dispelling the Myths, Narrowing the Gaps* (New York: The American Jewish Committee).

Siegel, Judy: Rudge, David, 2000: "Syria will steal Israel's water sources after Israeli withdrawal", in: *Jerusalem Post Weekly*, 11 February.

Sontag, Deborah, 2000: "Cramped Gaza Multiplies at Unrivaled Rate", dispatch from Jabaliya Refugee Camp, Gaza Strip", in: *New York Times*, 24 February 2000.

Wahby, Hassan, 2004: Head of Institutional Reform Unit, Egyptian Ministry of Water Resources and Irrigation, author's interview, Alexandria, Egypt, 13 December 2004.

Vidal, John, 2004: "Israeli 'water for arms' deal with Turkey", in: *The Guardian*, 6 January 2004.

Zaslavksy, Dan, 2004: "The management of our water resources is a national disaster", in: *The Jerusalem Report*, 5 April 2004: 48.

16 Water Transfer from Turkey to Water-Stressed Countries in the Middle East

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Abstract

The world as a whole has witnessed a substantial increase in water consumption during the last century stemming from rising affluence, rapid urbanization and population growth. This trend will continue in the decades to come as water resources are getting scarcer and more polluted in many parts of the world. It has been reported that some of the countries of the Middle East will suffer most and face serious water crisis during the next 25 years. In no other region is water considered as politically sensitive and strategic a resource as in the Middle East. Given the gradual worsening of hydrological and climatic conditions and the transboundary nature of the rivers of the region, water issues might lead to tensions and worsening of relations between States.

In this context, what role governments, international organizations and NGOs could play to properly address the anticipated water crisis? Turkey has made great strides in water resources development and management during the last three decades. It has the potential to play an important, constructive and beneficial role to this end. Turkey seems to be the only country where fresh water is available and it can be transported either by pipelines or tankers to the region. To this end we have introduced the concept of transfer of fresh water by sea and are planning to supply water by utilizing the unpolluted and unused waters of the rivers originating in the Taurus Mountains in the southern coast and feeding into the Mediterranean Sea.

An intergovernmental agreement between Turkey and Israel was signed concerning the purchase by Israel of treated water for a period of 20 years. The water will be shipped to Israel by purpose-built tankers. The provision of 50 million cubic meters per annum of water to Israel and the potential to transfer additional quantities might ease the pressure on the limited water resources in the Jordan River Basin. This agreement is currently 'on hold' but should it be implemented Israel might consider sharing more water with its neighbors.

Turkey has planned and realized various multi-purpose water infrastructures including the 32 billion US$ GAP project that is one of the world's largest and most comprehensive sustainable development projects in the basin of the Tigris and Euphrates rivers. It has been internationally recognized as an example of a successful passage form simple water development to efficient water management.

Another regional project which Turkey has developed is the 'Peace Pipeline Project' which seeks to provide freshwater to Syria, Jordan, Palestine, Saudi Arabia and other Gulf States from its rivers, namely the Seyhan and the Ceyhan. According to the project, an annual amount of 2.2 billion cubic meters of fresh water will be transferred by two large diameter pipelines. The pre-feasibility has shown that the project is feasible and applicable. In the view of this author that Turkey has the will and the capacity to contribute to the establishment of an enabling environment for socio-economic development of the people of the region which in turn could enhance peace and security in the Middle East.

Keywords: Turkey, water transfer, Manavgat River water project, Peace Pipeline Project

16.1 Introduction

Of all the planet's renewable resources, water may be the most unforgiving. Difficult to purify, arduous to store and impossible to substitute, water is essential to food, to socio-economic development and to life itself. Access to water is critical to all aspects of life whereas hundreds of millions of people do not have access to safe drinking water and sanitation. Throughout most of human history, the world's fresh water reserves were more than adequate to serve human needs while maintaining the integrity and biological diversity of the earth's ecosystems. But as populations have grown, water has become increasingly less available where and when it is needed.

The world population more than doubled, from 2.3 billion to 5.3 billion between 1940 and 1990. It has grown to 6.3 billion today and is increasing by almost 10,000 an hour. It is expected to reach 7.2 billion by 2015 according to UN reports. The same reports suggest that two-thirds of the world population shall experience lack of safe drinking water by 2030. Per capita use of water consumption doubled from about 400 to 800 cubic meters per person per annum between 1940 and 1990 due to increased affluence, rapid urbanization and industrialization.

Understanding the limits of renewable water resources requires an analysis of how little of the planet's 1.4 billion cubic kilometers of water fits into that category. Only 2.5 per cent of this 1.4 billion is fresh meaning suitable for drinking, growing crops and most industrial uses. Besides, 69 per cent of this 2.5 per cent is locked in polar ice caps and mountain glaciers or stored in aquifers too deep to tap under current and foreseeable technology.

Fresh water availability is dictated, to a large extent, by climate, and particularly by the timing and location of precipitation as well as by evaporative demand which is included in calculations in terms of hydrology. The amount of moisture that the atmosphere can absorb is chiefly determined by average temperature. Some arid countries in the Middle East and North Africa have such low precipitation and high evaporation that only a small amount of water can be captured for human use. By contrast, countries such as Sweden, Norway, Denmark, Great Britain, Iceland, Canada as well as the Benelux countries, where precipitation high and evaporative demand low, enjoy abundant water resources year long.

Water availability can vary tremendously from season to season, causing wet and dry seasons even in well-watered regions. For example, Bangladesh is inundated with rainfall during its two-to-three month monsoon season, but lacks rainfall for much of the rest of the year. Water availability also varies from year to year, making even semi arid-regions vulnerable to a succession of dry years, as was the case with 20 sub-Saharan countries from 1981 to 1984 as well as California and more recently east and southeast Turkey from 2000 to 2002.

To serve the purpose, water resources must be in close proximity to the populations that need them. Three quarters of Mexico's population lives in its dry central highlands, while four-fifths of the surface water lies in the wetter coastal regions. In calculating how much fresh water is available for human use on average terms, what counts is not the sum total of global fresh water supplies, but the rate at which fresh water resources are renewed or replenished by the global hydrologic cycle. Powered by the sun, this cycle each year deposits about 113,000 cubic kilometers of water on the world's continents and islands as rain and snow. Of that, 72,000 cubic kilometers evaporates back into the atmosphere. That leaves 41,000 cubic kilometers a year to replenish aquifers or to return by river or other run-off to the oceans.

Moreover, not all of these 41,000 cubic kilometers of water can be captured for human use. More than half flows unused to the sea in floodwaters and as much as one-eighth falls in areas too far for human habitation to be used. It is suggested that the upper limit of the world's available renewable fresh water resources lies between 9,000 and 14,000 cubic meters per year. An uncertain yet significant proportion of this amount is needed to sustain ecosystems in and around rivers, wetlands and coastal waters and the millions of living species they contain.

The critical fresh water availability limits, as a matter of fact, are not at the global level but at local, national and regional levels. In measuring a country's water resources, hydrologists refer to the term *endogenous precipitation*, or internal, and *exogenous*, or external, resources. Internal supply refers to the precipitation that falls on national territory, minus that portion lost to evaporation. Endogenous water supply is that which flows into a country from rivers or aquifers originating in neighbor countries. While most of both kinds of renewable fresh water would be available for a country's use under ideal conditions, many countries can only mobilize a part of their water resource potential, depending on the suitability of their land for water storage in reservoirs and the extent and the condition of their water infrastructure. Some developing countries can currently mobilize only 20 to 30 per cent of their potential water resources.

16.2 Turkey's Water Potential

A common misconception that needs to be dispelled at the outset is the idea that Turkey has abundant water and Iraq suffers from water scarcity. In fact, contrary to the general perception, Turkey is neither a water rich country nor the richest country in terms of water resources in the region.

The annual average precipitation in Turkey is estimated at 643 mm, corresponding to a volume of 500 cubic kilometers or 500 billion cubic meters. The annual run-off in the aftermath of natural events is calculated as 186 billion cubic meters. Subtracting from this figure the minimum flow requirements for pollution control, aquatic life as well as the amounts happen to be constrained as useless within topographic and geologic conditions, the annual available water potential emerges as 98 billion cubic meters. If the extractable groundwater potential of 12 billion cubic meters is added to the above mentioned figure, the total annual water resource potential in Turkey is computed as 110 billion cubic meters. The amount of available water per capita per year is then 1,486 cubic meters based on the population of Turkey, which is 72 million as of mid-2004.

Precipitation differs considerably both from year to year and among the river basins. The annual depth of precipitation is as high as 250 cm in the Eastern Black Sea region and as low as 30 cm in some parts of Central Anatolia. Most of the country's water potential lies in the south-east. The contribution of this region to the country's total water potential is 28 per cent. On the other hand, Turkey has also considerable hydropower potential, among the highest in Europe. The feasible hydropower energy potential is estimated at 125,000 GWh/year (Giga Watt hour/year). The installed capacity potential for hydropower is 35,000 MW (Mega Watt).

16.3 Water and Sustainable Development

Turkey attaches importance to the elimination of regional disparities in the socio-economic development of the country. This concern originates from the sound diagnosis that mobilizetion of the development potential of the least developed regions would contribute greatly to the realization of such national goals as economic growth, social stability and a rise in export capacity. In this context, Turkey has developed one of the world's largest sustainable development projects in the Tigris-Euphrates River basin.

The region is also named as the 'Fertile Crescent' or 'Upper Mesopotamia', and known to be the cradle of civilization in human history. Throughout history, the region has served as a bridge ensuring passage from Anatolia to Mesopotamia. The Tigris and the Euphrates, two important transboundary rivers, flow trough the region. Both originate from Eastern Anatolia and reach the sea in the Persian/Arabian Gulf. Southeastern Anatolia receives less precipitation compared to the other regions of the country. Hence the utilization of the rich water potential of the two rivers for the realization of GAP. This project has started an economic revolution in southeast Turkey. The high potential generated in both agriculture and industry by the GAP has already tripled the average income in some areas and will increase the income level of the other areas in the region fivefold when the remaining components of the GAP project are put in operation and will generate employment opportunities for 3.8 million people living in a region whose total population is projected to be over 9 million in 2005.

16.3.1 Turkey's Water Resources Policy

Turkey has developed its water resources policies over the years taking into consideration recent developments at global and regional levels, its contractual obligations, the on-going EU accession process, as well as Turkey's present and future water needs for its fast-growing population. Priority has been given to fully utilize Turkey's water potential in an efficient manner through necessary measures and projects. To this end, the focus has been on protection of quantity and the quality of the available resources but more importantly on building new water storage capacities in the deep canyons of Anatolia where water can easily be utilized not only for irrigation but also for hydropower generation.

16.3.2 Turkey's Accession to the European Union

Turkey is a candidate for admission to the European Union (EU). In this context, a *National Environmental Strategy and Action Plan* sponsored by the World Bank has been adopted. The Plan was identified as a comprehensive one by the OECD's Environmental Performance Review. Turkey has also started harmonizing its domestic legislation with that of the EU in the field of environment and water resources.

As regards the harmonization in the field of water resources the Ministry of Foreign Affairs has established two working groups with the participation of representatives of relevant institutions, legal experts, experts and representatives of the private sector. One of the working groups will prepare the new water legislation taking into consideration Turkey's basic needs, the EU Water Framework Directive, other relevant EU legislation and regional conventions.

The second working group will carry out the work necessary for the restructuring of the Turkish water institutions. The working group may propose a reassignment of responsibilities among relevant ministries and institutions and the establishment of new bodies to meet EU standards. The harmonization of the Turkish legislation and the restructuring of the institutions will be accelerated with the accession talks. The EU Commission is expected to do its part to reach the set objectives in due course.

16.3.3 Transboundary Waters

In the view of this author water is not necessarily a source of conflict. On the contrary, it could be used as a catalyst and bridge-builder. History suggests that there are more tendencies to cooperate for water rather than to fight for it. However, the use of water as a bridge-builder and a source of cooperation require visionary thinking. It entails enhancing awareness. It should be kept in mind that water is a social problem therefore public awareness of its value and its limited availability needs to be stimulated.

As regards transboundary water, Turkey is an upstream as well as a downstream country. Given the high altitude of Turkey which is 1100 meters on average (world's average altitude is 900 meters) it has fast running rivers with irregular natural flows. They should be regulated for their efficient use and flood control. The Tigris and the Euphrates are a case in point.

Turkey's transboundary water policy has always been consistent and transparent. This is acknowledged by international experts. Turkey's policy is aimed to efficiently utilize and share the benefits of water resources through cooperation among riparian states. Contrary to certain allegations, Turkey has never overlooked the needs of the downstream riparian states even during drought periods. For example, 1988 and 1989 were the driest years of the last half century. At the height of the summer, the flow of the Euphrates was around 100 cubic meters per second. In spite of the unexpected low natural flow Turkey was able to go on releasing water to downstream neighbors at a rate of more than 500 cubic meters per second. It follows that Syria and Iraq benefit from the water infrastructures that Turkey has built on the Euphrates.

In view of the economic crisis faced in the aftermath of the Gulf War and the ensuing budget measures recommended by the IMF, Turkey has unfortunately not been able either to build the Ilsu Dam on the Tigris river, which is essential to regulate the flow, or to complete the planned irrigation systems. Turkey is for the utilization of the water of the Euphrates and the Tigris rivers in an equitable, reasonable and optimal manner. The combined water potential of the Tigris and Euphrates rivers is sufficient to meet the needs of the three riparian States to achieve sustainable development, provided that water is used in an efficient way and the benefits are maximized through new irrigation systems and technologies throughout the basin, Syria and Iraq included.

By the same token, the riparian States should adopt a comprehensive approach to the matter. Such an approach calls for determination to discuss all water-related issues in a transboundary context. It entails sharing of responsibility as well as the benefits. Cooperation between riparian States should take into consideration the existence of ' two rivers and a single basin' as well as the variations in the natural hydrologic conditions of the basin.

Moreover, efficient use of water in a transboundary context requires proper and detailed information exchange between the riparian States. Such an exchange is also essential for a sound integrated basin management. In the case of the Tigris-Euphrates Basin, the three riparian States should, as a starting point, express their political will at the highest level to engage in a meaningful cooperation.

16.3.4 Confidence Building Measures (CBMs) in the Context of Transboundary River Basins

Water issues are not only of a technical nature but also have certain political and social aspects. It follows that among riparian states and their people water problems can not be resolved without building mutual trust and confidence among all concerned riparian states. Parties concerned need first and foremost free themselves from nationalist rhetoric, clichés, emotions and prejudices.

Confidence building measures needs to be taken in order to dispel mistrust and create the appropriate environment for meaningful cooperation. Information and data should be shared at basin level. Riparian states should have the political will to engage in genuine cooperation. Such cooperation could lead to reaching a common understanding on the utilization of the water of transboundary basins in the interest of all. Confidence building efforts could be initiated through informal exchange of information and data at the expert level. Such a dialogue can be further developed by discussions on general principles to be applied in the utilization of the water resources of the basin. Another form of confidence building can be developed through sharing the benefits of water among riparian states by means of cross-border projects having to do with agriculture, irrigation, hydropower generation, provision of safe drinking water and water for sanitation, last but not least, projects designed to protect the environment.

In short, the issue of water in the Middle East region is complex, emotional and political. It should be the will of all riparian states to try to resolve the existing problems. If we cannot solve them, we should at least continue to talk and exchange information so that we could manage them by peaceful means.

16.4 Water Transfer in and to the Middle East

The Middle East is historically a water-stressed region. It becomes clear that sustainable supplies of clean water is a major issue of social, economic and even political dimension in the Middle East. The Jordan River basin in particular suffers serious water shortage and the situation is expected to worsen in the near future.

According to Abdel Rahman Sultan, a representative of Friends of the Earth Middle East (FOEME), Jordan has water service for only 12 hours each day and most Palestinian villages do not have access to uninterrupted water supply. He adds that the growth rates of Palestinian annual population run at the level of 4 per cent on average and the corresponding figure for Israel is not less than 3.5 per cent. Therefore, the water demand of this ever-growing population in the region surpass a water supply that will grow only slightly in spite of a main thrust of building desalination plants. Furthermore, the level of the Dead Sea is falling by a meter each year.

Given its economic and industrial potential and the regional economic cooperation projects it has so far developed, Turkey has the potential to play an important, constructive and beneficial role in the region.

16.4.1 The Manavgat River Water Supply Project

Given the anticipated water shortage in the Middle East in the near future, Turkey introduced the concept of water transfer by sea to water stressed countries from its national rivers flowing to the Mediterranean where there is for the time being a surplus of fresh water.

The Manavgat Water Supply Project on the Manavgat river has been developed with a view to providing fresh water to Mediterranean countries. The water treatment capacity of the Manavgat Water Supply Project was designed to supply high quality bulk water. The capacity of the facility is 180 million cubic meters per annum (500.000 cubic meters daily), 90 million cubic meters of which is treated water.

The Manavgat Water Supply Facilities are at the estuary of the Manavgat River, 80 km east of Antalya on the Mediterranean coast, is 600 km (324 sea miles) from Israel's Ashkelon port, where the water is to be shipped. Water will be shipped to Israel by purpose-built tankers, although a shipping company has yet to be chosen. Israel plans to equip its ports with a suitable water storage facility. A trilateral agreement between the two governments and the eventual shipping company will be negotiated at a later stage.

The water extracted from this river is carried by steel pipelines all the way to the treatment plant. Half of the water extracted from the river, or 250.000 cubic meters daily, is treated in the facilities, which are fully equipped with aeration, coagulation, filtration and disinfection units to internationally accepted standards. The Manavgat River has an annual water potential of 3.6 billion cubic meters. It follows that more water could be drawn from the river by increasing the capacity of the installations, when necessary. Following treatment, the water will be carried to the two Single-Point Mooring (SPM) loading terminals situated three kilometers off-shore by the pipes laid on the sea bottom. Each terminal is able to load two tankers with capacities of up to 250.000 tons simultaneously.

16.4.2 Water Sale To Israel from the Manavgat River

Israel has been the only country to date which expressed desire to purchase treated water from the Manavgat River. Water shortage in Israel was more visible in 2002. The drought experienced in the Jordan River Basin as well as other considerations led to the expression of the political will by the Prime Minister of Israel to purchase water from Turkey despite opposition from the Ministry of Finance and the desalination lobby. Accordingly, the then Prime Minister of Israel, Ariel Sharon and the Former Minister of Energy and National Resources of Turkey, Zeki Çakan held a meeting on 6 August 2002 in Jerusalem to discuss the Manavgat Water Supply Project to Israel. During the meeting, the Israeli side expressed its interest in purchasing 50 million cubic meters of treated water per year from Turkey for a period of 20 years. Following that a "Joint Committee for the Manavgat Water Supply Project to Israel" was established.

The First Joint Committee Meeting was held in Ankara on 14 October 2002. During the Joint Committee Meeting, various shipping companies from Turkey, Israel and third countries presented their projects on the transportation of water from Manavgat to Israel by tankers. It became clear during the meeting that treated water cannot be transported by converted oil tankers and that purpose-built tankers have to be used to maintain the quality of the water. The Israeli experts have also included the amount to be imported from Turkey in their water budget. It was made public during the Stockholm Water Week in August 2003.

Finally, an intergovernmental agreement (IGA) between Turkey and Israel was signed. Under this agreement, Israel will buy 50 million cubic meters of treated-water a year from Turkey for a period of 20 years. This would account for about three percent of Israel's present annual freshwater consumption of 1.5 billion cubic meters. The most important aspect of the agreement will be the recognition by the two States of water as an internationally traded commercial commodity. Though the implantation of this agreement is now 'on hold' it provides a possible model for other such agreements with Mediterranean countries in the future.

However, given the very good precipitation of the winter and spring of 2004 and the rising water level of the Dead Sea which usually dictates the behavior of Israeli water authorities. The Israelis have been reluctant to speed up the process regarding water imports from Turkey. It seems that there is no sense of urgency on the part of Israel to conclude the necessary trilateral agreement without which the signed framework agreement shall not enter into force. The Israeli authorities should in the author's view engage in long-term planning and open an international tender without further delay in consultation with Turkey in order to nominate the company or group of companies which will undertake the transport of the water.

This project, if executed, will contribute to efforts toward enhancing peace and stability in the Middle East as well as to the socio-economic development of the region. Turkey's unused waters flowing into the Mediterranean could contribute to reducing the tensions on this politically sensitive resource by way of making it possible for Israel to share more water with the Palestinians and possibly Jordan, especially in the context of a comprehensive and durable settlement in the region. Water sale from Turkey to Israel could help the efforts that are deployed towards iro-ning out the water problems experienced by Israel, Jordan, Syria and the Palestinians in the Jordan River basin.

It could be argued that desalination may be an alternative for supplying additional fresh water to the region. However, the quality of water of Manavgat River is far superior to desalinated water in terms of mineral content and other qualities. In addition, it is environment friendly, contrary to desalination plants, which use various chemicals and release mountains of salt.

It has been decided that Manavgat Water Treatment and Loading Facilities will be privatized. The Manavgat Water Supply Project has the capacity to supply water to other needy countries and it is Turkey's hope that it will eventually be possible to supply water to other Mediterranean countries suffering from water shortage, including Syria, Jordan and Greece.

16.4.3 Water Transfer to the Republic of Northern Cyprus

16.4.3.1 Water transfer by plastic bags to TRNC

In view of the water shortage, a protocol was signed between the Ministry of State responsible for Cyprus Affairs, Ministry of Energy and Natural Resources of Turkey and the Ministry of Interior and Rural Affairs of the TRNC with a view to supplying water to the northern part of the island from Turkey in 1997.

A project was developed to feed the water network grid established among Güzelyurt-Lefkoa-Gazimagosa from an outside source and to meet the drinking water requirements of Lefkoa and Gazimagosa in the total amount of 7 million cubic meters per year by way of transportation of water from Turkey.

In the framework of this protocol, the Ministry of Interior and Rural Affairs signed an agreement and made a contract for a period of 10 years with a company established and titled *Mediterranean Water Distributor* by the *Nordic Water Supply*, the Norwegian producer of navigable plastic bags, in Turkey in 1997. The price of water was determined as 55 cents per cubic meter in accordance with the provisions of the said agreement. However, the operation started by Nordic Water Supply in 1998 lasted only 4 years. They managed to transport a total of only 4 million cubic meters due to technical deficiencies experienced under rough sea conditions in that duration. The contract of the Nordic Water Supply has been cancelled because of the failure to fulfill the commitment.

Consequently, it has been announced that the Ministry of Interior and Rural Affairs of the TRNC signed the "Agreement of Water Transportation to the Turkish Republic of Northern Cyprus from Turkey" with *Inbar Water Distribution Company*, an Israeli company on 24 October 2003. The agreement sets the price to be paid to the Israeli company as 60 cents per cubic meter according to the agreement. DSI officials have declared that the agreement has been concluded under their domain of knowledge and they have been informed that the Israeli company would utilize a new technology to transport the water.

16.4.3.2 Water Transfer by Pipeline from Turkey to the TRNC

The project of water transfer by pipeline from Turkey to North Cyprus was approved by Government decree No. 98/11202, dated 27 May 1998. It has three conditions: first of which foresees the realization of the said project covering facilities for the extraction, transportation and the storage of water, it is to be implemented as a turn-key project, it must be by a consortium comprised of domestic and foreign companies under the leadership of Alsim-Alarko A.

Alsim-Alarko prepared the feasibility report which was approved by the DS on 1999. According to the feasibility report, 75 million cubic meters of water per year could be drawn from the lake of Alaköprü Dam. The extraction is to be done on the Souksu (Coldwater) Creek in close proximity of the Anamur district. The water is to be transferred by a high density polyethylene (HDPE) pipe having a diameter of 1,600 mm (1,6 meter) to be laid down in natural-flow undersea conduit, up to a special existing storage facility. After this facility is rehabilitated it will impound the water in Geçitköy near Girne.

Almost 21 per cent or 15 million cubic meters out of 75 million is planned to be earmarked for treatment at a facility to be built near Lefkosa. This will be used as drinking water. The rest of the 60 million cubic meters are to be directed to the irrigation systems of the Mesarya Plain which covers an area of 7,650 hectares that would provide the Turkish Cypriot islanders with the fruitful opportunities of irrigated agriculture. Irrigation will end the burden of dry farming which they have endured for decades.

In spite of its dryness, the Mesarya Plain is the largest and the most valuable agricultural land of the Turkish Republic of Northern Cyprus (TRNC). Even with the current processes of dry farming, the agricultural output amounts to 2.3 million US $ per year.

The total cost of the project, including the construction of the Alaköprü Dam in Turkey, the Geçitköprü storage facility in TRNC, the natural-flow conduit undersea pipeline, other storage facilities, the necessary nationalization and the total interest to be charged within the duration of the works, is 340 million US $.

The text of the agreement regarding the engineering services of the project as well as the proposal of the financial package were concluded by DS and approved by the Ministry of Energy and Natural Resources in May 2002. The foreign-based credit of the engineering services has received the approval of the Under Secretariat of Treasury. The cost of the engineering services which is foreseen to be provided for a period of 18 months is estimated at 9.5 million US $.

DS officials have made it clear that they would open an international tender to select a consulting company to survey and control the underwater conduit pipeline construction. They added that the total cost of the project could amount to 500 million US $

covering the construction of the loading facilities on the Souksu Creek, the underwater conduit pipeline, the habilitation of the storage structure and water treatment plant in Geçitkale, the construction of the irrigation systems in Mesarya Plain and the necessary drinking water network.

16.5 Peace Pipeline Project

16.5.1 Introduction

The Middle East and the Gulf countries in particular are likely to suffer most from the anticipated water crisis. According to a recently completed study, the Gulf countries would have to spend a total of 35 billion US $ during the next 10 years to meet their increasing water demands and related infrastructure. The situation in the Jordan River Basin may continue to worsen during the same period.

The Peace-Pipeline Project seeks to supply water from Turkey's excess and deliver it to regions of need in Syria, Jordan, Saudi Arabia, and other Arabian Gulf States. A feasibility study is proposed to enable a thorough technical and economic analysis to ensure that such a project can be fully realized. The water delivered through the Peace Pipeline is not intended to replace, but rather supplement, existing water supplies in the countries served.

16.5.2 Water Supply

Water for the project will be obtained from excess water in the Seyhan and Ceyhan rivers. DSI have developed master plans for the ultimate use of the water of both rivers and have made calculations on the quantity of the surplus water that will flow into the Mediterranean after all projected agricultural, industrial and domestic utilization has been satisfied. Major irrigation projects exist and are planned in the Adana area with inter-basin transfers of water from the Seyhan River to the Ceyhan River via a tunnel from the Asagi Catalan dam. Inter-basin transfer of the Ceyhan River is also planned for the Menzelet Irrigation Project.

DSI have calculated that the average flow in the Seyhan and Ceyhan rivers is 39,17 million cubic meters per day. The planned use of this water in Turkey is approximately 23,04 million cubic meters per day. Thus, an average of 16,1 million cubic meters of water per day remains available for other human uses. Extensive development in the watersheds of the two rivers has already occurred and many dams have been constructed. Dam construction is ongoing and will continue into the future.

16.5.3 Water Quality

DSI has recorded the water quality in the Seyhan and Ceyhan Rivers since 1978. These records show the availability of good quality water. At present the extent of water treatment (if any) has not been determined, but this question will be investigated in the feasibility study.

16.6 Pipeline Routes

16.6.1 Western Pipeline

The 'Western Pipeline' involves the diversion of water from the Seyhan River downstream of the existing Seyhan Dam near Adana and the diversion of water from the Ceyhan River downstream of the existing Aslantas Dam near Ceyhan. The water will be pumped via pipeline following the existing railroad route from Ceyhan to the Osmoniye, crossing over the Nur Mountains via a tunnel, at an elevation of 700 metres, through a mountain pass near the town of Bahce. The route continues south passing near the towns of Aleppo, Hama, and Hams. Water flows by gravity from the Bahce Pass to Homs. From Homs the topography gradually rises from an elevation of 300 meters to 900 meters above sea level on the plateau between Damascus, and Amman. Beyond Amman, the route continues via Tabuk to Medina, Saudi Arabia. A major mountain range separates Medina from the coastal centers of Yanbu and Jeddah and pump stations will lift the water via a pipeline and tunnel through these mountains. Water would then flow by gravity to Mecca, Jeddah and Yanbu. There is a potential for recovery of some of the pump station energy by the installation of a hydroelectric facility on the Red Sea side of the mountain range to utilize excess head. The total route length of the Western Pipeline is approximately 2,650 kilometers.

16.6.2 Gulf Pipeline

The 'Gulf Pipeline' follows the same route as the Western Pipeline to Hama where it diverges from the Western Pipeline. Water is pumped from Hama to an elevation of 900 meters, crossing the high plateau of Eastern Jordan parallel to the lraq-Jordan border until it intersects the route of the existing Trans-Arabian Oil Pipeline (TAPLINE).The water then flows by gravity along a route that continues along the TAPLINE alignment to the Arabian Gulf coast and then along the coastline of the Arabian Gulf to Ras Al Khaimah. Should water be required in Muscat in Oman, a small pumping station would be added to cross the mountains separating the Gulf of Oman from the Arabian Gulf. The total route length of the Gulf Pipeline is approximately 3,900 kilometers.

16.6.3 Water Quantity

The technical feasibility study was based on a flow of 3,500,000 cubic meters per day for the Western Pipeline and a flow of 2,500,000 cubic meters per day for the Gulf Pipeline. This water was distributed to the main population centers along each route by assigning flows in approximate proportion to their respective populations. After discussions with each country, these water delivery quantities will be revised to suit their requirements and hydraulic design varied accordingly.

16.6.4 Pipe Size and Type

The main pipeline routes will require pipe that varies in size from 3 to 4 meters. Branches into the various points of delivery will vary from 1 meter to 2 meters in diameter. A more detailed evaluation of the pipe diameter, length, and pipe material will be made in the feasibility study when more information has been developed on the topography, pumping station locations, water storage locations, geology and other route constraints.

The type of pipe varies from steel fabricated pipe in the high pressure pumped sections of the pipeline, to pre-stressed concrete cylinder pipe in the gravity and low pressure pumped sections and ductile iron, concrete and rolled steel pipe in the small diameter branches. The major portion of the pipeline will be buried about 2 meters below the ground level or located in tunnels in the mountain areas.

16.6.5 Cost Estimate

The Western Pipeline has been estimated to cost approximately 8.5 billion US $ and the Gulf Pipeline has been estimated to cost approximately 12.5 billion US $. All costs are based on 1986 dollars. The construction period is estimated to be approximately from 8 to 10 years. The construction cost estimate and the unit cost of water will be further refined during the feasibility study as more data become available.

16.6.6 Feasibility Study

The feasibility study will evaluate key technical criteria relative to the pipeline route location, hydraulics, sourcing, and delivery of the water and other elements of the Peace Pipeline Project. The study will develop the project costs and provide the information necessary to authorities in the participating countries to make informed judgments as to the economic, and technical viability of the Peace Pipeline Project.

In short, Turkey has the capacity to contribute to the establishment of an enabling environment by realizing these two projects for socio-economic development of the people in the Middle East which in turn could enhance peace and security in the region. This water supply could create interdependency among the countries of the region and eventually enhance economic and commercial relations in the interest of all.

References

Bilen, O., 2000: *Turkey and Water Issues in the Middle East: An Examination of the Indus, Colorado, Danube and Jordan-Israel Water Treaties and the Water Agenda of the 21st Century*, Republic of Turkey, Southeastern Anatolia Project Regional Development Administration (Ankara: Afarolu Printing House).

Biswas, Asit (Ed.), 1997: "Water Resources Development in a Holistic Socioeconomic Context - The Turkish Experience", in: *International Journal of Water Resources Development*, 13,4 (Abingdon Oxfordshire, UK - Cambridge, MA: Carfax Publishing Company).

Population Action International, 1996, *Sustaining Water: Population and the Future of Renewable Water Supplies* (Washington: Population Action International).

Shiklomanov, Igor A., 1995: "World Fresh Water Resources", in: Gleick, Peter H. (Ed.): *Water in Crisis: A Guide to the World's Fresh Water Resources* (New York: Oxford University Press).

17 Manavgat River Water: A Limited Alternative Water Resource for Domestic Use in the Middle East

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Abstract

The water potential of the Mediterranean part of Turkey including the Aegean coastal zone is at a level of mean annual about 8.2 x 10^9 m^3. The size of irrigable land, in this part of the country is about 1.8 x 10^6 ha, and there is very high tourism potential in the region. The main water courses along the Mediterrenean coast of Turkey, from east to west, include the Ceyhan, Seyhan, Goksu, Koprucay, Manavgat, Aksu, and Esencay rivers. All together they have 35 x 10^9 m^3 annual outflow.

Starting from 1992, the Turkish State Hydraulics Work (DSI) was authorized to develop a water supply project for domestic use, from the Manavgat river which has an average 147 m^3/sec runoff rate. The project consists of a river intake structure of 5.8 m^3/sec of water from the Manavgat river, and a pumping station having 7 booster pumps each with 967 l/sec capacity, and a set of two supply pipes of 1200 mm diameter, of 1057 m length, reaching to a water purification plant situated at 67 m above msl (medium sea level). The plant does both chemical and physical water treatment to meet WHO standards. The total storage capacity of the project is 500 000 m^3, half of it is treated-purified- and the second half as raw water. The annual source of fresh water available at present, of 180 x 10^6 m^3 water can also be transported as raw water. There are two pipes of 1600 mm diameter, and about 11 km length, to transport water to a control station located along the coast. From there on, the water is transferred 2 SPM (Single Point Mooring) – one for purified and the other for raw water- filling floats.Till now, water has been transported to northern Cyprus. On 4 March 2004 an agreement for water purchase was signed in Tel Aviv (see chapters by Gruen and Rende above). Pursuant to this agreement, Israel may purchase 50 x 10^6 m^3/year water from Turkey for 20 years. It is hoped that the neighbouring Middle Eastern states will benefit from this limited alternative water source for their domestic needs.

Keywords: Manavgat River water supply project, Middle East, Turkey, water transportation by sea, water sale.

Figure 17.1: Alternatives Recipients of the Water from the Manavgat River Water Supply Project. **Source**: DSI 2001.

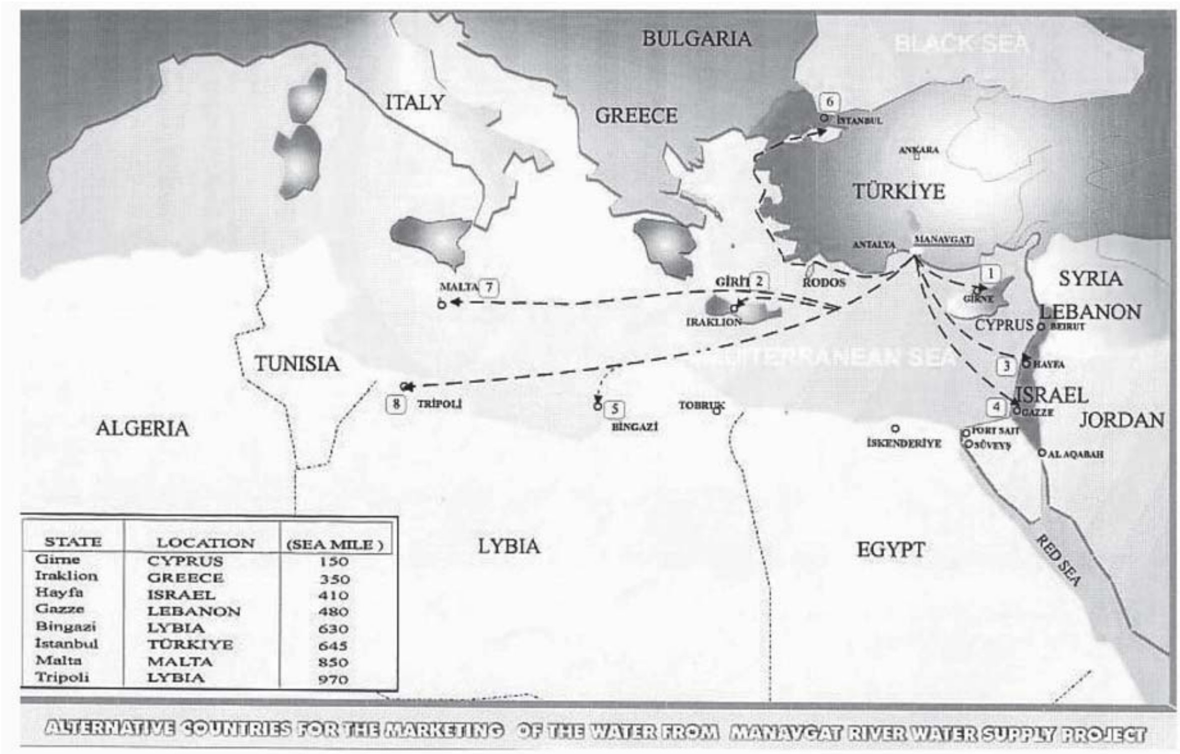
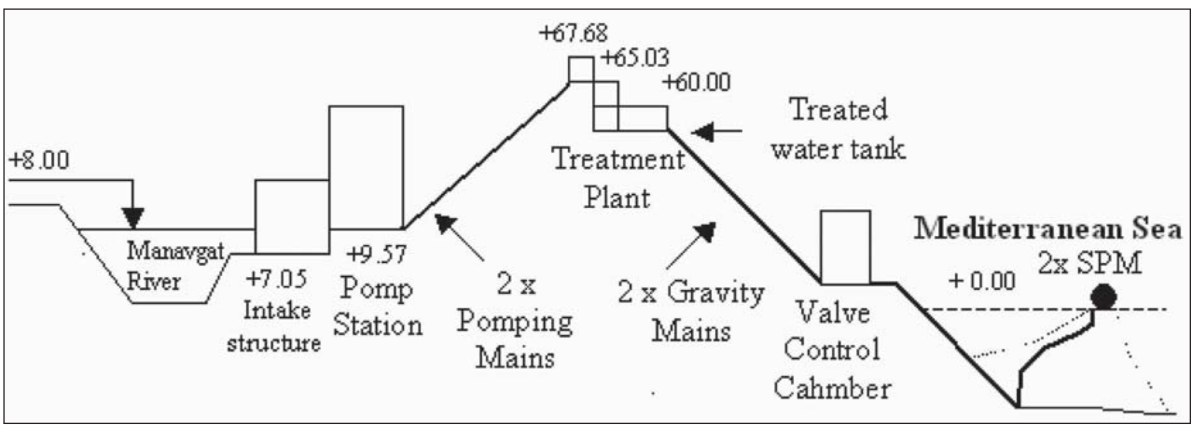


Figure 17.2: Hydraulic Flow Diagram of the Manavgat River Water Supply Project. **Source**: DSI (2001).



17.1 Introduction: The Manavgat River Water Supply Project

The Manavgat River, which starts in the eastern slopes of the Western Taurus Mountains flows into the Mediterranean Sea after going about 90 km south. The Oymapýnar and Manavgat Dams are over the Manavgat River. The *Manavgat River Water Supply Project* is located near the town of Manavgat, in the province of Antalya, in the Mediterranean Region. The project was started in 1992, cost approximately 150,000,000 US $ and was completed in 1999. With this project, 250,000 m^3 of refined and 250,000 m^3 of raw water, totaling 500,000 m^3 of water will be transported down to the sea coast by means of pipelines where it will be loaded into tankers. This water is expected to meet the partial water need of some coastal towns and tourist investments in this region of Turkey, some Middle Eastern countries and of Northern Cyprus (DSI 2001).

17.2 Water Export from the Manavgat River

Maximum flow of the Manavgat River is 500 m^3/sec and its minimum flow is 36 m^3/sec with an average of 147 m^3/sec (DSI 1999). When the average flow is taken into account, annual capacity of the Manavgat River corresponds to approximately 5×10^9 m^3. Since the export water will amount to 180×10^6 m^3/year, this amount is a very small proportion of the water that flows into the Mediterranean.

17.2.1 Water Problems in the Middle East

The Middle East is one of the poorest areas of the world in water supply and this problem is increasing. These countries try to meet the need for drinking water by refining seawater and ground water at a large cost. According to the 1992 data, 15.6×10^6 m^3 of salty water is refined per day (WDRTS 1994).

17.2.2 Marketing Water from the Manavgat River Water Supply Project

As a result of the negotiations with Israel (2002–2004), an agreement for water purchase was signed in Tel Aviv on 4 March 2004. Pursuant to this agreement, Israel may purchase 50×10^6 m^3/year water from Turkey for 20 years (see at: <www.mfa.gov.tr>). While the cost of the water has not yet been specified, the facility outlet price is 0.25 US$ (Yıldız 2003), transportation cost is thought to be 0.80 US$. It is uncertain which country will award the contract for transportation. Later in May, 2006, both sides decided to suspended the contract and decided to cooperate for more alternatives for future.

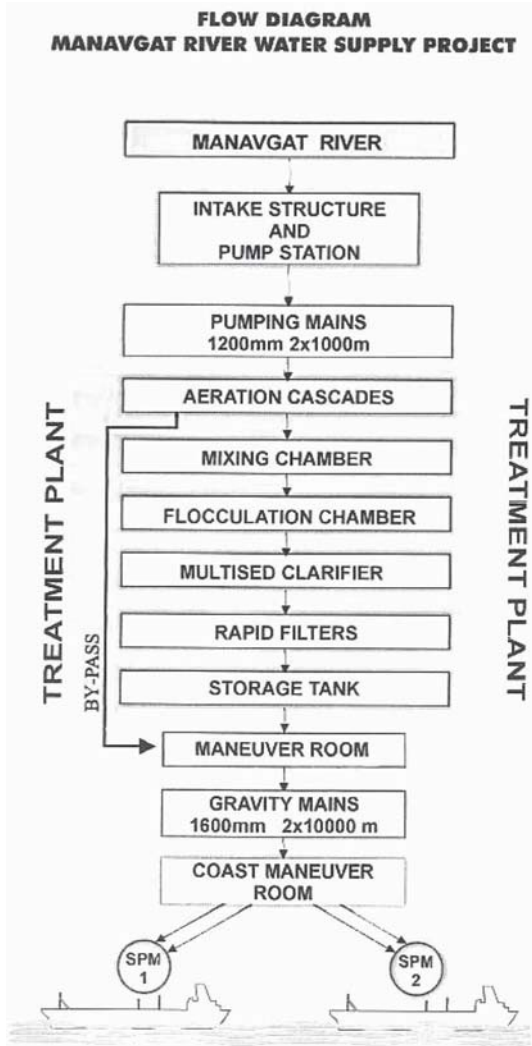
Turkish officials believe they could provide water to other countries. A memorandum of understanding was signed with the Saudi Arabia Mixed Economic Commission. Algeria and Morocco have also shown interest in purchasing MRWSP water (figure 17.1).

17.3 Components of the Project

The project is mainly composed of the following work units:

- Water Intake Structure and Raw Water Pumping Structure (17.3.1);
- Pumping Mains (17.3.2);
- Treatment Plant (17.3.3);
- Gravity Mains (17.3.4);

Figure 17.3: The Flow Chart of the Manavgat Project. **Source:** DSI (2001).



- Valve Control Chamber and Pumping Station (17.3.5);
- SPM (Single Point Mooring) Structure (17.3.6).

A hydraulic flow diagram of the Manavgat project is given in figure 17.2 and figure 17.3 offers a flow chart of the Manavgat water supply project.

17.3.1 Water Intake Structure and Raw Water Pumping Structure.

The water intake structure of the Manavgat Dam is situated approximately 800 m downstream. Water taken from the level of + 8.00 m is compressed into a balancing and aerating tank that is approximately at the level of + 68 m (DSI 2001). The water intake struc-

Figure 17.4: The Water Intake Structure. **Source:** Ülger (2004)

Figure 17.5: Clarifiers. **Source**: Ülger (2004).

ture is shown in figure 17.4 and details of the unit are given in table 17.1.

17.3.2 Pumping Mains

Water taken from the raw water pumping mains is transferred to the balancing and aerating tank by means of an elevation line (table 17.2).

17.3.3 Treatment Plant

The treatment plant is in the Bardaklar Beleni quarter of the Ulukapı Village in the province of Manavgat and situated on a hill that is 84 m high. Some 250,000 m^3 of the water brought to the balancing and aerating tank by the elevation line is sent directly to the coast facilities after the ventilation and pre-chlorination.

Figure 17.6: Pumping Station. **Source:** Ülger (2004).

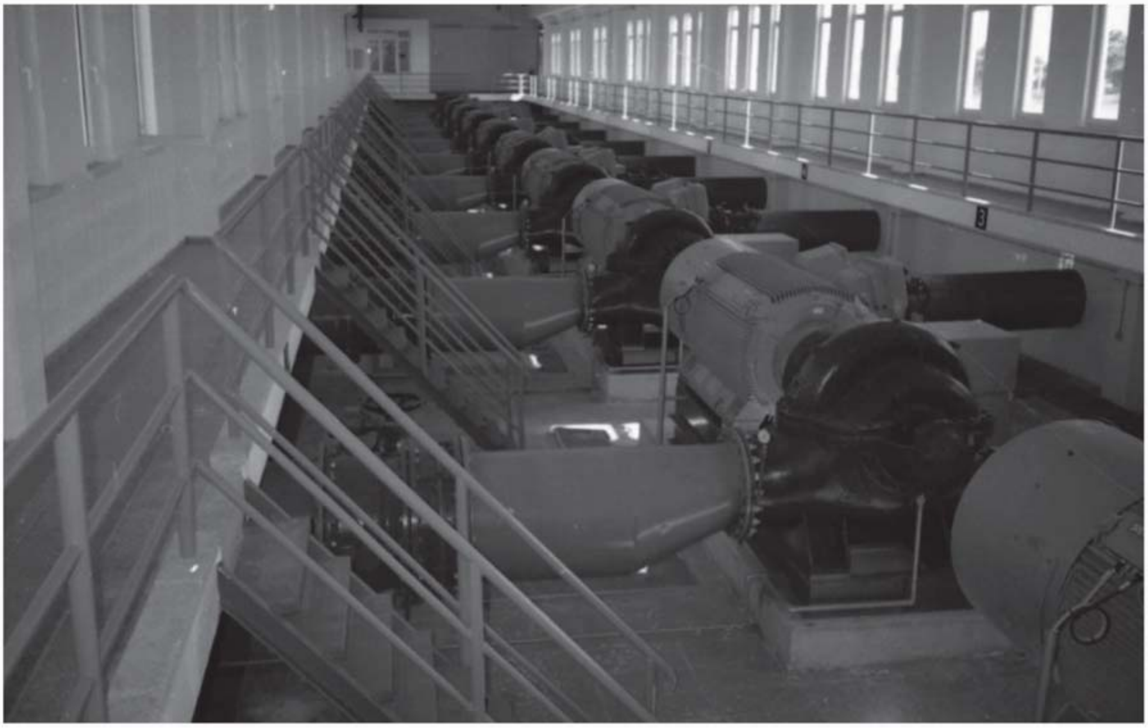


Table 17.1: Details of he Water Intake and Raw Water Pumping Structure. **Source**: DSI (2001).

Number of Pumps	7 (1stand-by)
Capacity of Pumps	967 lt/sn
Effective Power	900 Kw
Total Pumping Head	75 m
Number of Air Tanks	2
Suction Head	2.15 m
Number of Suction Pipes	7
Diameter of Suction Pipes	800 mm
Diameter of Pumping Pipes	700 mm
Capacity of Air Tanks(2)	100 m³

Table 17.2: Pumping Mains Details. **Source:** DSI (2001).

Number of Pipes:	2
Diameter of Pipes:	Ô 1200 mm
Wall Thickness:	8.8 mm
Length of Pipeline:	1057 m
Type of Pipes:	Spiral Welded Steel Pipe
Inner Coating of Pipes:	Icement Added Concrete
Outer Coating of Pipes:	PE

The remaining 250,000 m³ is processed by both physical and chemical refining phases. Below sections of the refinery are shown (DSI 2001) .

Table 17.3: Gravity mains details. **Source:** DSI (2001).

Number of Pipes:	2
Diameter of Pipes:	F 1600 mm
Wall Thickness:	12 mm
Length of Pipeline:	10 000 m
Type of Pipes	Spiral Welded Steel Pipe
Inner Coating of Pipes	Icement Added Concrete
Outer Coating of Pipes	PE

- Balancing and aeration chamber;
- Rapid mixers and flocculation tanks;
- Clarifiers (clarifiers are given in figure 17.5);
- Rapid sand filtration units;
- Chlorination contact tank and clean water tank

17.3.4 Gravity Mains

The gravity mains are found between the treatment plant and valve control chamber and the pumping station (see details in table 17.3). .

Figure 17.7: Off-Shore Pipelines. **Source:** see at: <www.infar.com.tr.

Figure 17.8: SPM Structure. **Source**: DSI (2001).

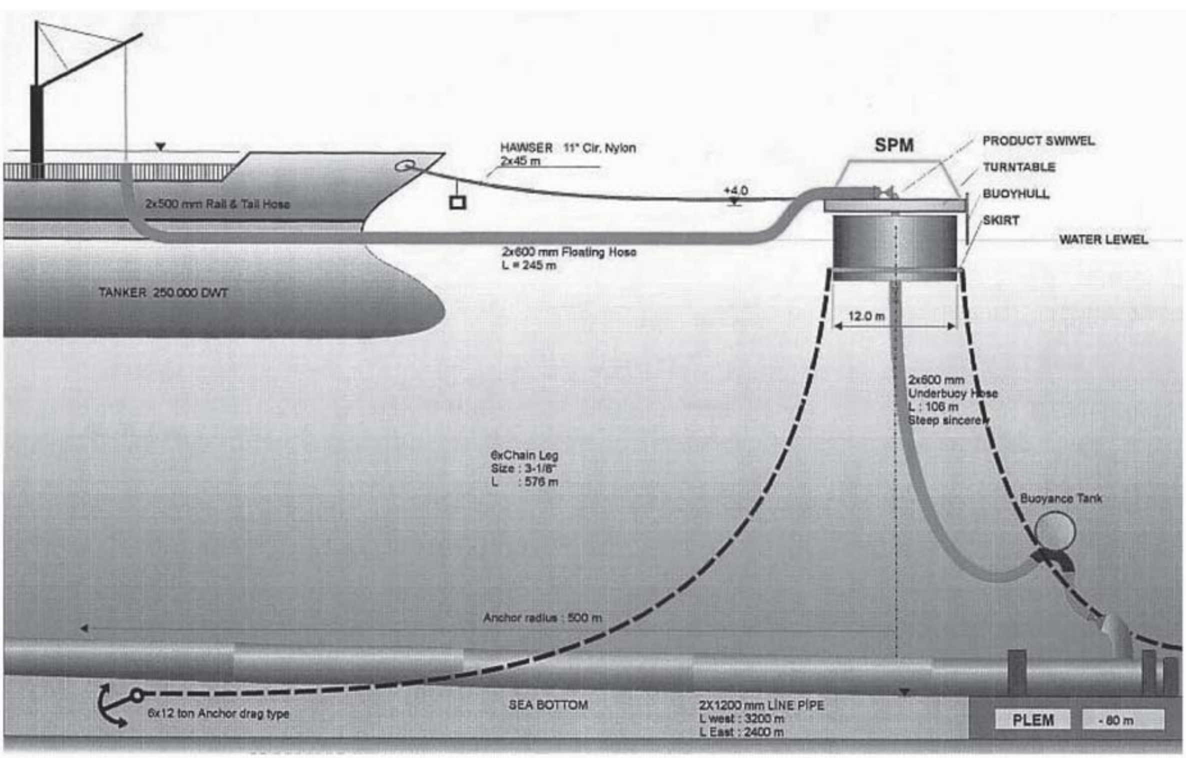


Table 17.4: Raw Water Analysis Report: February 1993 - April 1999. **Source:** DSI (1999).

Parameter	Unit	Symbol	Average	Min	Max.
Flow rate	m^3/sn	Q	147.2	35.78	500.0
Temperature	ºC	T	16.5	8.0	29.0
pH		PH	7.7	7.3	8.0
Electrical Conductivity	µmhos/cm	EC	284	200	350
Total Dissolved Solids	mg/l	TDS	164	110	210
Suspended Solids	mg/l	SS	9	1	17
Turbidity	NTU	Turb	2.3	0.3	9.5
Color	Pt-Co	Col	5	5	10
Methyl Orange Alkalinity indicator	mg/l CaCO3	M-Al	128.8	76.0	157.5
Phenolphtalein Alkalinity indicator	mg/l CaCO3	P-Al	0.0	0.0	0.0
Chlorine	mg/l	Cl	11.89	6.39	19.9
Nitrogen of Ammonia	mg/l	NH4 – N	0.10	0.00	0.54
Nitrogen of Nitrite	mg/l	NO2 – N	0.000	0.000	0.010
Nitrogen of Nitrate	mg/l	NO3 – N	0.47	0.00	2.39
Dissolved Oxygen	mg/l	DO	9.63	7.00	13.0
Permanganate Value	mg/l	PV	1.14	0.32	10.72
Biological Oxygen Demand	mg/l	BOD5	1.36	0.80	2.3
Total Hardness	mg/l CaCO3	TH	158	101	192
Orto Phosphate	mg/l	o-PO4	0.12	0.00	1.1
Sulphate	mg/l	SO4	15.41	3.50	23.9
Iron	mg/l	Fe	0.06	0.00	0.2
Sodium	mg/l	Na	1.77	0.69	7.2
Potassium	mg/l	K	0.33	0.10	0.8
Calcium	mg/l	Ca	48.91	24.85	64.1
Magnesium	mg/l	Mg	8.71	2.19	19.2

17.3.5 The Valve Control Chamber and Pumping Station

The valve control chamber is designed to load 250,000 m^3 refined water and 250,000 m^3 of raw water or 500,000 m^3 of raw water simultaneously into two different tanks. There is a total of 12 pumps with the capacity of 1 m^3/sec, 10 mains and 2 substitutes to pump water to the tanks (DSI 2001). The pumping station is shown in figure 17.6.

17.3.6 Off-Shore Pipelines

The valve control chamber and the SPM terminals consist of 4 pipes whose diameter is 1200 mm, which are placed upon the sea floor. Two of these four pipes go to the eastern SPM (Single Point Mooring), which is 2,400 m away from valve control facilities. The other two go to the western SPM, which is 3,200 m away (DSI 2001). The off-shore pipeline is shown in figure 17.7 .

Table 17.5: Manavgat River Water Supply Project Comparison of Selected Parameters of Raw Water and Treated Water by Various Water Quality Standards. **Source**: DSI (1999).

Parameters	Manavgat River Raw Water	Treated Water	EC Drinking Water Standard	WHO Drinking Standard	TS2666 Drinking Water Standard
PH	7,7 – 8,0	PHs-0,2	6,5-8,5	6,5-9,5	6,5-9,2
Electrical conductivity	284-350		400		400-2000
Permanganate Value, mg / l	1,14-10,72		2-5		2-5
Total Hardness , mg / l CaCO3	158-192		min.150	100	150
Cholorine , mg Cl / l	11,9-19,9		25	250	25-600
Ammonium , mg NH4 / l	0,1-0,54*		0,05-0,5	0,2	0,05-0,5
Nitrite, mg NO2 / l	0,0-0,1**		0,1		0,1
Nitrate, mg NO3 / l	0,47-2,39***		25-50	50	25-50
Phosphorous, mg P2O5 / l	0,0-1,1****		0,4-5,0		0,4-0,5
Turbidity, NTU	2,3-9,3	0,4	0,4-4,0	5	5-25
Iron , mg Fe / l	0,06-0,2	0,1	0,05-0,2	0,3	0,05-0,2
Aliminium, mg Al / l		0,05	0,05-0,2	0,2	0,05-0,2
Manganase, mg Mn / l		0,05	0,02-0,05	0,1	0,02-0,05
Coliform Bacteria, MPN /100 ml		none	None	none	None

* NH4 –N, Ammonium nitrogen, mg/l
** NO2-N, Nitrite, mg/l
*** NO3-N, Nitrate nitrogen, mg/l
**** PO4-P, orto phosphate, mg/l

17.3.7 The SPM Structures

The water coming through two pipes shall be transferred to the SPM terminals and to tankers with the capacity of 60,000–250,000 dwt (dead weight ton) by means of floating hoses here. The movement of the SPM terminals is limited by 6 anchors of 12 tons. The ships are attached to the SPM terminals at their nose parts (DSI 2001). Since the ship-connected parts of the SPM terminals can rotate 360, the movements of ships conform to the movements of SPM terminals in various weather conditions (Cengiz 2004). The SPM structure is given in figure 17.8.

Loading from the SPM terminals to the tankers can be performed according to the following options:

- From one SPM 250,000 m^3/day of refined, from the other SPM 250,000 m^3/day of raw water;
- From each pontoon, 250,000 m^3/day of raw water;
- From each pontoon, 125,000 m^3/day of refined water and a total 250 000 m^3 of refined water.

17.4 The Raw Water Analysis Report

The water quality standards of the refined water from Manavgat water supply project is given in table 17.4 and those standards are compared with other international standards in table 17.5.

17.5 The Current State of the Project

All units of the project are now ready to work and supply water. The Privatization High Council Decision dated 23.02.2004 mandates that privatization procedures would be completed in 12 months (see at: <www.oib.gov.tr>). Later, due to some unexpected reasons, the project was removed from the list of the projects of "The Privatization High Council", and it was decided to transfer the project to the ownership of Antalya Municipality. The transfer process still continues (DSI 2006).

17.6 Conclusion

The *Manavgat River Water Supply Project* can be viewed as an alternative but partial solution to the water scarcity problems of Middle Eastern countries.

The quality of the refined water conforms with all specified requirements of the *Drinking Water Quality Guide* of the TSE (Turkish Drinking Water Standard) and of the WHO (World Health Organization).

References

Cengiz, K., 2004: *Master Engineer of Manavgat River Water Supply Projec*t, (Personal comminication at Antalya).

DSI, 1999: *Managed Project Information Booklet* (Antalya, Turkey: General Directorate of the State Hydraulic Works (DSI) XIII. Regional Directorate).

DSI, 2001: *Manavgat Water Supply Project, Information Booklet* (Antalya, Turkey: General Directorate of the State Hydraulic Works (DSI) XIII. Regional Directorate).

Infar Construction Industry and Trading Company, at: <www.infar.com.tr>.

Republic of Turkey, Prime Ministry Privatization Administration, Turkey, at: <www.oib.gov.tr,>.

Turkey, Ministry of Foreign Affairs, at: <www.mfa.gov.tr,>.

Ülger, M., 2004: *Term Project IM575 Advance Hydrology Course* [Unpublished] (Ankara: Gazi University, Institute of Science and Technology).).

"Worldwide Desalination Research and Technology Survey," The Ministry of Foreign Affairs, Sultanate of Oman (History of Desalination), April, 1994

Yildiz, D., 2003: *Water problems in the Mediterranean basin and Turkey* (Ankara:Turkish Chamber of Civil Engineers).

18 Socioeconomic Development and Benefit Sharing in the Euphrates-Tigris River Basin

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Abstract

Futile negotiation processes over water allocation and related disputes over water rights in the Euphrates-Tigris river basin demonstrate that there is a need to create new cooperative frameworks that enable links between cooperation and development. Hence, this chapter commences with the description of the origins and the evolution of the dispute in the region. There are discussions on the merits of the principle of 'equitable utilization' and 'the needs-based approach' with a specific reference to the Three Stage Plan of Turkey. After analyzing the limitations and shortcomings of existing water allocation mechanisms a more workable solution of 'sharing the benefits rather than sharing the water itself" is put forward. The Joint Technical Committee meetings are reviewed, suggesting the broadening of its agenda.

Keywords: Euphrates-Tigris river basin, socio-economic development, cooperation, GAP, Three Stage Plan, benefit-sharing

18.1 Introduction

Being one of the vital water resources in southwest Asia, the Euphrates and Tigris rivers constitute a single transboundary watercourse system. They are linked not only by their natural course when merging at the Shatt-al-Arab, but also as a result of a man-made Thartar Canal connection between the two rivers in Iraq. Turkey, Syria and Iraq are the three major riparians of this river system. Annual mean flow of the Euphrates is 32 billion cubic meters per year (bcm/year). Approximately 90 per cent of the mean flow of the Euphrates drains from Turkey, whereas the remaining amount of 10 per cent originates from Syria. As for the Tigris and its tributaries, the average total discharge is determined as 52 bcm/year. Turkey contributes approximately 40 per cent of the total annual flow, whereas Iraq and Iran contribute 51 per cent, and 9 per cent, respectively (Anderson 1986).

The water question emerged on the regional agenda when the three riparians initiated major development projects. It is only since the 1960s that Turkey and Syria have put forward ambitious plans to develop the waters of the Euphrates-Tigris river system for energy and irrigation purposes. At the same time, Iraq also announced new schemes for an extension of its irrigated area. The uncoordinated nature of these supply-led developments as well as inefficient and ineffective demand management practices within the framework of national water policy and management of the co-riparians continue to be the principal causes of water imbalance in the Euphrates-Tigris river basin.

Adequate solutions to this problem are often premised on coordinated regional action. The chapter is largely devoted to discussions of the origins and the evolution of the water dispute in the Euphrates-Tigris river basin. It includes analyses on the merits of the principle of 'equitable utilization' and 'the needs-based approach' with a specific reference to the Three Stage Plan of Turkey.

After showing the limitations and shortcomings of existing water allocation mechanisms a more workable solution of 'sharing the benefits rather than sharing the water itself' is put forward. The Joint Technical Committee meetings are reviewed, suggesting the broadening of its agenda. The chapter incorporates analyses of recent developments and prospects for co-operation in the Euphrates-Tigris river basin. Here, the idea is to tackle water resource management as part of a larger framework of overall socio-economic development of the region by drawing attention to the role model of the *Southeastern Anatolia Project* (GAP) and to the recent rapprochement between the *GAP Regional Development Administration* (GAP RDA) and the *General Organization for Land Development* (GOLD) of the Irrigation Ministry of Syria.

18.2 Endured Negotiations

Since the early 1960s there have been attempts to foster dialogue and information exchange in the region through a series of technical water negotiations. One could observe that the riparians had adhered to stringent positions, which hardly changed during the course of the negotiations in three decades until the suspension of the negotiations in the early 1990s. Thus, Iraq as the downstream riparian was keen to preserve into perpetuity its senior-in-time uses and showed great anxiety towards the progress of the water development projects in Turkey and Syria. Iraq, later joined by Syria in the early 1980s kept insisting on concluding immediate sharing agreements. Yet, Turkey as the new user had presented the exigency of its planned measures and offered a joint study to find out the irrigation needs of the riparians before agreeing to any basin wide allocation in the river basin. Below some highlights of these endured negotiation processes are given (Beaumont 1992).

The three riparians entered a new phase of their relationship over water upon the decision by Turkey to construct the Keban Dam on the Euphrates. The downstream riparians, particularly Iraq, insisted on guaranteed flows to be released by Turkey during the impounding of the dam. Hence, a first meeting was held in June 1964 with the participation of Turkish and Iraqi experts. The Turkish delegation asserted that it was impossible to reach a single and final formula for the pattern of water to be released from the Keban Dam reservoir before impounding by the dam. This pattern, according to the Turkish delegation, depended upon the natural conditions that would prevail during the filling, and on the exact evaluation of the concerned countries' needs. At the end of the negotiations, Turkey guaranteed to undertake all necessary measures to maintain a discharge of 350 m^3/sec immediately downstream from the dam, provided that the natural flow of the river was adequate to supply the above discharge. This was confirmed by Syria and Iraq the same year. Moreover, during this meeting, Turkey proposed to establish a Joint Technical Committee (JTC), which would inspect each river at its source to determine its average yearly discharge. The JTC would determine the irrigation needs of the three countries through joint field studies and would be authorized, by calculating the needs of the riparians for present and future projects, to prepare a statement of main principles and procedures in order to facilitate an agreement on water rights (Kibaroğlu/Ünver 2000).

Following this first technical meeting between Turkey and Iraq, a few more ad hoc meetings were held in the region. Yet, among these meetings the most notable one: the first tri-partite negotiation was held in Baghdad in 1965. In that meeting, the three delegations exchanged technical data with regard to the Haditha (Iraq), Tabqa (Syria) and Keban (Turkey) dams. The delegations then moved to discuss the question of setting up a JTC. The Iraqi delegation submitted a draft agreement, which covered, among others, the issue of forming a permanent JTC to be entrusted with supervising the implementation of the agreement. The Turkish delegation strongly rejected the Iraqi draft agreement, and expressed that the JTC could only be authorized to maintain coordination of the current and future projects in the river basin (Kibaroğlu 2002).

In line with the Turkish proposal, Syria suggested it would be convenient to include among the functions of the JTC a study of the water requirements of the irrigable lands in the three countries, and subsequently to examine the possibility of covering possible shortages of water supplied by the Euphrates through diverting a part of the Tigris River's water to the Euphrates. Iraq strongly opposed this proposal and insisted on negotiating only the waters of the Euphrates.

During the course of the 1970s, delegations from the three countries gathered on several occasions to exchange information about the technical issues pertaining to the Keban, Tabqa and the Habbaniye reservoirs. No agreement was achieved at the end of numerous technical meetings, and Turkey and Syria went their own ways in determining impounding programs for the two reservoirs (Kliot 1994).

18.3 Joint Technical Committee Meetings

In the early 1980s, the imminent use of the Euphrates and Tigris by Turkey created new demands for cooperation. Because the issues involved in water development schemes along the Tigris and Euphrates are so complex and far-reaching, the three riparians had to find ways of structuring the dialogue among them. Hence, this time Iraq took the initiative of forming a permanent Joint Technical Committee. At the end of the first meeting of the Joint Economic Commission between Turkey and Iraq in 1980, a new JTC was established to discuss and finalize the water issue among the riparians. Syria joined the JTC in 1983 whereupon Turkey, Syria, and Iraq held sixteen meetings up to 1993.

The essential mandate given to the JTC was defined as determining the methods and procedures, which would lead to a definition of the reasonable and appropriate amount of water that each country would need from both rivers. The major items on the agenda of the JTC were the exchange of hydrological and meteorological data, information on the Euphrates-Tigris Basin, the sharing of information on progress achieved in the construction of dams and irrigation schemes in the three riparian countries and the discussion of initial plans for filling the Karakaya and Atatürk Reservoirs.

However, after sixteen meetings, the JTC could not fulfill its objectives and the talks became deadlocked, failing to produce even outlines of its meetings. The major issues that led to the deadlock were related to both the subject and the object of negotiations: whether the Euphrates and the Tigris be considered a single system or whether the discussions could be exclusively limited to the Euphrates. The wording of the final objective of the JTC, i.e. reaching a common terminology, was also problematic; whether to formulate a proposal for the *'sharing'* of *'international rivers'*, or to achieve a trilateral regime for determining the *'utilization of transboundary watercourses'*. Iraq and Syria consider the Euphrates an *international* river and insist on an immediate sharing agreement under which the waters of the Euphrates would be shared on the basis of each country stating its water needs. On the other hand, Turkey has regarded the Euphrates and Tigris as forming a single *transboundary* river basin where the waters should be *allocated* according to the objective needs (Kut 1993).

18.3.1 Rethinking the Mandate of the JTC

The role of the Joint Technical Committee should not be underestimated. Although its meetings were infrequent and appear to have made little substantive progress on the question of water allocation, it was a useful channel for communication. Unfortunately, the JTC meetings could not sustain and produce fruitful outcomes to foster broader cooperation in the region. Even though the JTC originated from the Joint Economic Commission, it had focused solely on water issues as its ultimate aim of ensuring cooperation and coordinated management of water resources in the region it could not be fulfilled because of the limiting approach which the riparians had taken to maintain their water rights. The mandate of the JTC could be expanded and diversified in a way that it could act with a broader agenda where the parties could tackle water resource management as part of a larger framework of overall socio-economic development of the river basin, thereby showing a new potential framework for water based cooperation.

Aware that sustained cooperation in the region requires a development focus, a permanent institution, and a forum for a process of legal and institutional dialogue, JTC could be designed to provide a platform for discussions on water related multisectoral development issues along with the establishment of the principles of the equitable water use.

18.4 Water Use Rules in the Euphrates-Tigris River Basin

18.4.1 The Protocol of 1987 between Turkey and Syria

The Turkish-Syrian Joint Economic Commission meeting on 17 July 1987 had an important outcome regarding negotiations on the water issue. The Protocol of Economic Cooperation signed by Turkey and Syria at the end of the meeting included provisions for water. It is important to note that this Protocol was regarded as a temporary arrangement. It embodies several articles pertaining to the water issue. Specifically, Article 6 of the Protocol reads as follows: "During the filling up period of the Atatürk Dam reservoir and until the final allocation of the waters of the Euphrates among the three riparian countries the Turkish side undertakes to release a yearly average of more than 500 m^3/sec at the Turkish-Syrian border and in cases where monthly flow falls below the level of 500 m^3/sec, the Turkish side agrees to make up the difference during the following month." As a basis for comparison, the long-term average flow of the Euphrates is approximately 1000 m^3/sec at the Turkish-Syrian border.

18.4.2 Water Allocation Agreement between Syria and Iraq: The Protocol of 1990

Syria and Iraq perceived the interruption to the flow of the Euphrates, due to the impounding of the Atatürk Dam, as the beginning of many such interruptions that would result of the envisaged projects within the framework of GAP happened. During the 13th meeting of the Joint Technical Committee in Baghdad on 16 April 1990 a bilateral accord between Syria and Iraq was reached according to which 58 percent of the Euphrates waters coming from Turkey would be released to Iraq by Syria.

These bilateral accords were interim measures, which were largely products of the then-prevailing political atmosphere in the basin. However, they have not served the goal of achieving an efficient and equitable allocation and management of the water resources in the Euphrates-Tigris river basin.

18.5 The Three-Stage Plan of Turkey

As a product of his empirical research on water negotiations that have taken place in various transboundary river basins, A. T. Wolf concludes that in almost all of the disputes that have been resolved, particularly on arid or exotic streams, the paradigms used for negotiations have not been 'rights-based' at all – neither on relative hydrography nor specifically on the chronology of use – but rather 'needs-based'. 'Needs' can be defined by one or a combination of the following: irrigable land, population, or the requirements of a specific project or sector (Wolf 1999).

The Three Stage Plan was drafted with a *needs-based* approach. The Plan encompasses joint inventory studies of land and water resources of the region and the estimation of the water needs for the competing sectors in the region, for agriculture in particular. This, will then provide the basis for an optimum allocation of the available water to the determined needs.

During the negotiations there emerged the fact that the water potential was unable to meet the declared demands of the three riparians. And, more importantly, there have been rooted uncertainties and inadequacy relating to the data on water and land resources. In response to Syrian and Iraqi demands for the formulation of urgent 'sharing arrangements' depending on the criteria that they put forward, Turkey proposed the "Three Stage Plan for Optimum, Equitable and Reasonable Utilization of the Transboundary Watercourses of the Tigris-Euphrates Basin."

The creators of the Plan asserted that by quantifying the needs, the water issue could become more manageable. With the Plan, Turkey calls for the establishment of a joint body for collecting, handling and exchanging data regarding water and land resources so that annual and seasonal variations can be incorporated in the estimates made to determine the allocations. In this respect, data sharing would facilitate the negotiation process and foster the creation of many cooperative structures. Hence, data gathering through joint efforts would enable the riparians to become accustomed to cooperation and to proceed with the discussions over water allocations. Along with reaching a set of agreed upon criteria in data-sharing, negotiations could move on to talks on project coordination and the creation of joint projects.

The Plan is evolutionary and forward-looking in nature; it could be revised according to prevailing conditions and developed further through an interdisciplinary dialogue with the inclusion of the relevant stakeholders.

18.6 Cooperation Prospects in the Euphrates-Tigris River Basin

The Three Stage Plan was coolly received by Iraq and Syria. Nonetheless, it is asserted in this study that the needs based approach is conducive to cooperation and with its particular emphasis on a legal settlement the Plan will retain its innovative status in transboundary water coordination. Indeed, establishing a coordinated regional action in the Euphrates-Tigris River Basin presents a great challenge. This is an example for an opportunity in the region for initiating innovative actions in transboundary water management coordination.

Hence, the GAP *Regional Development Administration* (RDA) took some useful steps in 2001 to initiate contacts with Syria by sending a delegation to that country following the invitation of the *General Organization for Land Development* (GOLD), Ministry of Irrigation, Syria. Following this mission, a Syrian delegation headed by the Minister of Irrigation paid a visit to Turkey. As a result of these bilateral relations, a Joint Communiqué was signed between the GOLD and the GAP RDA on 23 August 2001. This agreement envisions the cooperation of both sides on training, study missions, technology exchange and conduct of joint projects. The agreement intends to improve the relations between the two countries further, through training of staff from both countries, by hosting specialists from Syria in Turkey and organizing specific training activities. Once such training is institutionalized, courses are planned either in Syria or in Turkey for other Arab speaking countries as well. In fact, further steps have already been taken, and a technical team from Syria has been invited to the region to discuss the principles of implementation. This agreement between GAP and GOLD also includes provisions about 'twin protection areas'. This would involve one project from each country to be studied, planned and implemented as a *Twin Development Project* that can be implemented in both countries. In June 2002 the GAP Minister visited Syria with a delegation from the GAP RDA. Talks were held regarding the GAP-GOLD cooperation and an implementation document was signed that defines the principles for cooperation envisioned in the joint communiqué. This document identifies the projects, training programs, and activities to be conducted jointly. A Syrian delegation headed by the Syrian Irrigation Minister later reciprocated this visit, attending the inauguration of the wastewater treatment plant built by GAP RDA at the Turkish side of the border, and visiting the project-related sites in the GAP.

The GAP-GOLD Protocol comprises a limited range of essential but effective activities to create a coordination mechanism between both government agencies. The overall goal of this agreement and its subsequent implementation protocol (2002) has been to provide sustainable utilization of the region's land and water resources, and to deal with water management within a larger picture of overall socio-economic development and integration of the under developed regions in Turkey and Syria.

The agreement was drafted with the objective of establishing a dialogue between both countries and strengthening inter-riparian engagement by building 'intergovernmental networks' which could open new opportunities for realizing *win-win* solutions. Under this promising developments between Turkey and Syria, the GAP, which once constituted a bone of contention in the regional politics, is becoming a source of gradual cooperation for development related activities (Ünver/Gupta/Kibaroglu 2003). The following section briefly presents the GAP as a unique water based development endeavor in the region. This section is intended to provide insights for future cooperative initiatives which should aim at specific goals of development and poverty reduction related to wider socioeconomic development.

18.7 GAP: A Paradigm Shift in Water Resources Development

GAP has been conceived and implemented as a means of integrating the development of water resources with overall human development in one of the underdeveloped regions of Turkey. The project area lies in Southeastern Turkey, covering nine provinces corresponding to approximately 10 per cent of Turkey's total population and an equivalent surface area. The Project area includes the watersheds of the lower Euphrates and Tigris rivers and the upper Mesopotamian plains. The water resources development program of GAP includes 13 groups of irrigation and energy projects, seven of which are on the Euphrates River and six on the Tigris. The project includes 22 dams, 19 hydropower plants, and irrigation networks, on the Euphrates and Tigris river basins, to irrigate 1.7 million hectares of land. The total cost of the project is estimated at US $ 32 billion, 16 billions of which had been invested until 2004.

As an integrated regional development project based upon the concept of sustainability, the GAP covers investments in such fields as urban and rural infrastructure, agriculture, transportation, industry, education, health, housing and tourism, as well as dams, power plants and irrigation schemes on the Euphrates and Tigris rivers. This massive launch for development has special emphasis on and priority for the economic, social and cultural advancement and well-being of the whole country in general, and of the people of the region in particular. The basic objectives of the GAP are: to remove interregional disparities in the country by alleviating conditions of abject poverty and raising the income levels and living standards in the region; to enhance productivity and employment opportunities in rural areas and to improve the population absorbing capacity of larger cities.

As the GAP has shifted over the years from an infrastructure development project, into a project that coordinates social, cultural, economic and environmental efforts, its changes have followed the changes in global thinking about development. In recent years there has been an increased focus on reducing poverty as a key responsibility of the government for development. International conferences such as the 1992 United Nations Conference on Environment and Development in Rio de Janeiro and the 1995 World Summit for Social Development in Copenhagen have put forward ideas about sustainability, gender equity, encouraging grassroots involvement, protecting the environment, and so on. These initiatives were reinforced at the UN Millennium General Assembly when the Millennium Development Goal of halving the proportion of the world's population living in extreme poverty by 2015 was agreed by all member countries of the United Nations. Other goals and targets specific to water and poverty were adopted at the Millennium Assembly and at the World Summit on Sustainable Development (2002).

These international attempts have generated some consensus about the priorities for development – reaching the poorest, targeting marginalized groups and involving target groups at all stages in the project cycle. This has led to the adoption of policies in support of sustainable development in countries in both North and South. The GAP has attempted to incorporate these ideas into its activities, and has learned first hand about the tension between how development should look, and how it is actually carried out.

Water based development is a catalyst for economic, social and environmental changes. The GAP, as such, is defined as a sustainable human development project, where water resources development is not an end in itself; it is, indeed, a means to an end. The end is to alleviate poverty, improve quality of life, and to maintain the integrity of environment and ecosystems.

The concept of sustainability is very relevant to any analysis of water policy. Hence, in the case of GAP, the notion of sustainability is captured in the larger context of the sustainability of society, the economy as well as the environmental services provided by water in the region. Sustainable human development, as applied by the GAP for Southeastern Anatolia, encompasses such goals as reaching the poorest, gender equity, capacity building for local institutions, and environmental protection. It is from this philosophy that the GAP derives its human-centered focus, using the momentum gained from hydropower and irrigation infrastructure projects to bring opportunities for more sustainable livelihoods to as many in the GAP region as possible.

The main components of sustainability for the GAP are: social sustainability, physical and spatial sustainability, environmental sustainability as well as economic and agricultural sustainability. In accordance with the sustainable development approach of GAP, special programs and projects have been initiated to emphasize the human dimension of development through project implementations concerned with basic social services (education, health, housing), gender equity, urban management, irrigation facilities, agricultural and environmental sustainability, institutional and community capacity-building, and public participation.

The GAP case illustrates that in the field of water development and management the three countries mentioned can exploit the potential areas for cooperation and benefit from the experience and practices of one another, and develop these more toward common practice.

18.8 Conclusion: Broadening the Cooperation Agendas

Water disputes in the Euphrates-Tigris River Basin clearly stem from the mismatch between demand and supply coupled with the uncoordinated nature of water development projects. Adequate solutions to this problem are often premised on coordinated regional action. Hence, it is a high time to scrutinize the factors that prevent conflict from occurring, even when stakes are high concerning water allocations. As recommended above, reconsidering a revised version of the *Three Stage Plan* would enable all parties to determine their objective needs. Discussions concerning water needs would better take place within the Joint Technical Committee with its broadened agenda whereby equitable usage could be determined along with the handling of water related multisectoral development issues such as infrastructure (energy, telecommunication, transport), agriculture, trade, industry, health and environmental issues.

Based on the status of the relations among the riparians of the Euphrates-Tigris system and the recent political developments in Syria, along with projections with respect to Iraq in the new era, one can predict better cooperation and more productive conditions that would make use of the existing mechanisms and modalities, namely the recent collaboration between GAP and GOLD. Transboundary water coordination in the region should depend on sustainability captured in a larger context just as it has been implemented in the GAP. The chapter suggests that cooperation in the region needs to be based on wider development concepts; cooperative processes need to be geared to specific goals of development, and poverty reduction related to wider socio-economic development.

References

Anderson, E. W., 1986: *Water Geopolitics in the Middle East: Key Countries*. Conference on U.S. Foreign Policy on Water Resources in the Middle East: Instrument for Peace and Development (Washington D.C.: CSIS): 18–19.

Beaumont, P., 1992: "Water: A Resource Under Pressure", in: Nonneman, G. (Ed.): *The Middle East and Europe: An Integrated Communities Approach* (London: Federal Trust for Education and Research): 183.

Kibaroğlu, A.; Ünver, O., 2000: "An Institutional Framework for Facilitating Cooperation in the Euphrates-Tigris River Basin", in: *International Negotiation: A Journal of Theory and Practice*, 5,2: 311–330.

Kibaroğlu, A., 2002: *Building a Regime for the Waters of the Euphrates-Tigris River Basin* (London - The Hague - New York: Kluwer Law International).

Kliot, N., 1994: *Water Resources and Conflict in the Middle East* (London: Routledge).

Kut, G., 1993: "Burning Waters: the Hydropolitics of the Euphrates and Tigris", in: *New Perspectives on Turkey,* 9: 3.

Ünver O.; Gupta, R. K.; Kibaroğlu, A., 2003: *Water Development and Poverty Reduction* (London - The Hague - New York: Kluwer Law International).

Wolf, A. T., 1999: ìCriteria for Equitable Allocations: the Heart of International Water Conflictî, in: *Natural Resources Forum*, 23,3: 30.

Part V Water Co-operation and Conflict Resolution

19 Why States Co-operate over Shared Water: The Water Negotiations in the Jordan River Basin

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Abstract

The focus of this chapter is on foreign policy decision-making in circumstances of water scarcity. It focuses on how the issue of water has been treated in the negotiations within the peace process between Israel and the Palestinians and Israel and Jordan respectively. It also analyzes the implementation phase. The aim is to explain why and under what conditions co-operation between Israel, Jordan and the Palestinian Authority has occurred and how it has functioned in the water sector. Based on an overall actor-structure framework of analysis the factors identified as being important in affecting the process and outcome is identified. The development of a shared system of norms, rules and procedures (herein labeled a water regime) for how to manage the water resource are seen as a vital explanatory variable for the water co-operation in the Jordan River Basin.

Keywords: conflict, cooperation, Israel, Jordan, Palestine, water regime

19.1 Introduction

Water is the source of life. In many religions it is portrayed as something sacred – a gift from God. Water is required for almost all a society's activities, such as the very visible ones of washing and cooking, but also in less visible areas such as food production. While in certain areas access to clean water is plentiful, in many parts of the world this is not the case. It is therefore no surprise that increasing attention is being given to the importance of the world's water resources and aquatic systems.

1 This paper is based on Jägerskog, A. (2003), *Why States cooperate over shared water: The water negotiations in the Jordan River Basin*, (Linköping Studies in Arts and Science, No. 281, Linköping University). For further development of the ideas in this chapter see: Jägerskog, A. (2006) "Functional water co-operation in the Jordan River Basin: Spillover or spillback for political security" in Brauch, H. G., Grin, J., Mesjasz, C., Chadha Behera, N., Chourou, B., Oswald Spring, U., Liotta, P.H., Kameri-Mbote, P. (Eds.): *Facing Global Environmental Change – Environmental, Human, Energy, Food, Health and Water Security Concept*, (Berlin, Heidelberg, New York, Hong Kong, London, Milan, Paris, Tokyo: Springer Verlag)

Today, more than 45 per cent of the world's population lives in internationally shared river basins. The increasing pressure on the limited freshwater resources in places such as the Middle East and Southern Africa makes greater and deeper knowledge of how to manage transboundary waters essential. While it was previously assumed that shared waters could and would be a source of conflict and even war, it has been demonstrated more recently, through a compilation of a database at the Oregon State University, comprising all water agreements on international watercourses[2] that states tend to find ways to reach agreement rather than to engage in violent conflict over shared water resources.

The aim of this chapter is to analyze why and under what conditions cooperation between Israel and the Palestinians and between Israel and Jordan has taken place and how it has functioned in the water sector. It identifies the differences of opinions, obstacles to be overcome and how these have been addressed. Furthermore it draws some policy implications. While many analyses and textbooks on water in the Middle East have focused their attention on analyzing the agreements on water *per se* in detail, this chapter will focus on what has happened to the agreements after their signing. In order to put the analysis into a theoretical context, regime theory is used. The regime theory is applied within the overall framework of an actor–structure approach. This overall framework is not used as a specific analytic instrument but rather as a description of a general approach to the way in which particular changes from conflict behavior towards more cooperative behavior have occurred.

19.2 Israeli-Palestinian Water Relations

As stipulated in the Interim Agreement between Israel and the Palestinians, a *Joint Water Committee* (JWC) was established after the signing of the agreement. This committee is supposed to implement the undertakings of the parties in Article 40 of the Interim Agreement, which deals with water and waste water. It is to be composed of an equal number of participants from each side and to reach decisions through consensus, which means that each side has a veto. This is a much stronger tool for the Israelis as the projects that are discussed in the JWC are to do with the occupied Palestinian areas. Each side can call in experts to the committee as it sees fit. It should be noted that, while the actual decisions implementing the Interim Agreement are to be taken in the JWC, the committee is still under the political leadership of the State of Israel and the *Palestinian National Authority* (PNA). This means that when a sensitive water issue of political importance surfaces in the JWC it is passed up to a higher political level. This underlines the fact that water is very much connected to the politics in the region.

While regime theory is not an approach that encompasses all the issues at stake it does increase our understanding of the institutional aspects of the cooperative behavior that the parties have engaged in within the JWC. A regime analysis deals with well-defined issues around which parties create and subscribe to means of self-regulation in the international arena. The JWC could be described as such a regime. Besides the bilateral JWC there is also activity on water issues within the multilateral track that was established at the Madrid peace conference in 1991. In a subgroup under the Multilateral Working Group on Water Resources a group, named *Executive Action Team* (EXACT), which involves Israelis, Palestinians and Jordanians have met under US auspices without interruption since 1992. This group has, by and large, focused on technical matters of importance for all parties and has refrained from discussing political issues. The members of the EXACT team have however been almost always the same people that have participated in the JWC. This has contributed to the building of trust between the parties (for more see at: <http://exact-me.org/>).

As already mentioned, the JWC is to take decisions with regard to water projects in the West Bank by consensus. Palestinian participants in the JWC have stated that there was an expectation that the Palestinians would be able to get approval for projects in the JWC without much problem so that implementation of the Interim Agreement could proceed. However, according to the Palestinians taking part in the JWC and its subcommittees, there have been delays in decisions with regard to decisions on permits to drill wells and so on (Jarrar 2002; Barghouti 2002). At the same time it has also to be acknowledged that some of the implementation problems – for example, the building of a pipeline in Gaza to receive 5 mcm water from Israel per year – are due to the fact that the Palestinians have not been able to build the transmission line in Gaza (Jarrar 2002). While the Palestinians attribute many problems and delays in decisions regarding Palestinian projects to Israeli unwillingness, the Israelis

2 See at: <http://www.transboundarywaters.orst.edu/>.

maintain that they have hydrological reasons for turning down Palestinian proposals (Cantour 2001). However, well-informed sources admit that Israel's refusals to agree on project proposals with the Palestinians are sometimes due to political rather than technical reasons.

A further reason, which is delaying the implementation of the Interim Agreement, is the fact that the protocols/minutes from the JWC meetings need to be signed by all four members of the JWC (two Israelis and two Palestinians). This is a lengthy process that can take months to finalize. While this can be seen as normal committee procedure it is also possible for either side to withhold a signature as a political tool. According to Ihab Barghouti at the Palestinian Water Authority (PWA), the Palestinians have raised the problems of getting approvals for projects with their Israeli counterparts in the JWC, who are mainly technical people, and maintain that many problems were due not to them but rather to the political leadership. (Barghouti 2002). Another problem for the JWC is that the Interim Agreement has an inbuilt ambiguity (Shamir 2001). While it can be helpful when working towards an agreement to keep it ambiguous as regards particular points, the ambiguities become obstacles in the implementation stage, particularly if they involve politically sensitive issues.

Another impediment to implementation is the problem of Palestinian project funding. This problem is only minor since there are willing donors active in the Palestinian water sector. The ongoing Al-Quds Intifada, which started in autumn 2000, has also had a negative impact on the implementation of the agreement since there are various problems associated with the movement of PWA personnel as a result of closures, Israeli refusals to grant permits and so on (Jarrar 2002). The Palestinians also highlight the fact that there is a difference depending on whether Likud or Labor is in power in Israel. According to Anan Jeusi (2002), more project proposals are accepted in the JWC if Labor is in power in Israel than if Likud is. Thus, internal Israeli politics are intimately linked to what it is possible to do in the JWC.

Although various problems have hampered the implementation of the agreement, both parties acknowledge the importance of it being in place. Indeed, even in the midst of the tensions during the current Intifada, the work of the JWC continues. A joint statement of 31 January 2001 from the Israeli and the Palestinian heads of the JWC reaffirmed their commitment to continue their cooperation. In the declaration the parties, represented by the head of the PWA, Nabil el-Sharif, and the head of the Israeli delegation to the JWC, Noach Kinarty, promised to take all necessary steps to keep water out of the conflict and also appealed to their respective constituencies to refrain from damaging water infrastructure (Schiff 2001).

In the regime literature it is argued that regimes function as learning processes and can hereby also be a place for the policies of parties in a regime to converge, thus creating fertile ground for increased cooperation (Mayer/Rittberger/Zürn 1993). Behavior along these inherently constructivist lines of thinking are not immediately apparent in the Israeli-Palestinian water relations. However, both parties acknowledge that the joint mechanism for dealing with their transboundary waters is necessary (Barghouti 2002; Ben-Meir 2001). This is a result of an appreciation on both sides of the fact that they are linked by their hydrological interdependence. It is acknowledged that a level of trust has been built in the JWC, in particular on a professional level. The impediments to implementation seem to be related more to politics than to problems on a professional (meaning technical) level.

According to regime theory there are various ways in which regimes come into existence. The realist argument – that regimes are created by powerful hegemons because it serves their interests – seems to have some bearing in this case as it can be argued that the USA has seen a stabilization of the region and cooperation over water as fitting its interest. In addition, Israel, which can be portrayed as a regional hegemon, also views agreement with its Arab neighbors as something that would serve its interests, both from a strategic and from an economic perspective. At the same time, the neo-liberal argument for regime creation, which pinpoints the *demand* for regimes as the most important factor, also has a bearing in this case. This stems from the idea that by creating a regime the parties to the regime can more accurately estimate the costs and benefits of action. In other words the parties to the regime are in a better position to avoid suboptimal outcomes (Hasenclever/Mayer/Rittberger 1997). In the case of Israel and the Palestinians the common appreciation of their hydrological interdependence has spurred a demand for joint management of the shared waters.

It is concluded that the water relations between Israel and the Palestinians resemble a water regime. There exist principles, norms, rules and decision-making procedures (more or less well established), which are deemed necessary for a regime (Krasner 1983). These features are influenced by the power asymmetry, identified by Keohane and Nye as a source of power for affecting outcomes, by which Israel is able to exercise a strong influence on the direction implementation takes (Keohane/Nye 1989). In terms of *effectiveness* it is concluded that the members have generally abided by the rules of the regime. However, an impediment to the effectiveness of the regime is that, while the Interim Agreement was supposedly negotiated in 'good will' the political relations that inevitably affect the JWC have substantially slowed its implementation (see Interim Agreement, Article 40). In terms of *robustness* and *resilience* the Israeli–Palestinian regime is a strong one. In spite of all the political problems during the current Intifada, the JWC and its subcommittees have continued to meet and coordinate water-related activities. Fadl Kawash, the director general of the Palestinian Water Authority, stated in late October 2002 in an interview in the *Jerusalem Post* that Palestinians were working together with their Israeli counterparts to prevent pollution of water through the JWC in spite of the Intifada (Muscal/Lahoud 2002).

Two underlying questions in this chapter are how and why change occurs in the water relations in the Jordan River Basin. It is argued that we need to look at both actors involved in the management of the water resources as well as the structures in which they are working. When assessing the water negotiations and the work of implementing the agreement in the JWC it is clear that, if the professionals involved in the JWC were not subject to guidance by politicians (which is of course impossible), working relations would be much better and it would be possible to look at the various project proposals and so on from a purely technical perspective. Yet, as Hay points out, agents/actors are never to be analyzed apart from their context. He calls this the contextualization of agency, which means that the social and political action of agents should be analyzed within the structural context in which it takes place (Hay 1995).

Thus, while the level of technical understanding between the people participating in the work of the JWC is high, the Israelis as well as the Palestinians are situated in a structural context (meaning, for example, the ongoing political conflict), which affects what they can and cannot do. Indeed, the structures work as a sort of 'boundary' for action. Still, the actors also affect the structures. For example, although almost all of the cooperation between Israel and the Palestinians has been suspended as a result of the Intifada, the shared understanding among the participants in the JWC – that it is imperative to continue to have a functioning joint mechanism for water issues between the parties – has resulted in cooperation. The meetings of the JWC and its subcommittees have continued in spite of the political tension.

In terms of structures it is important to note that the structure – agency issue is a matter of power as well. Hay has pointed out that structures can be enabling as well as constraining. He maintains that structures provide resources and opportunities to the powerful while at the same time they constrain the weaker party (Hay 1995). This issue, which can be seen as an issue of asymmetry in power, is emphasized by the Palestinians as a constraining factor since it is, according to their view, possible for Israel to pressure them in the sphere of water because they are more powerful in terms of economic size, military strength and so on (Jarrar /Awayes 2002). Still, Israel as well can be seen as being constrained by the international structures (meaning, for example, influence and pressure from the international community), which demand a resolution of the conflict, including a settlement of the water dispute.

19.3 Israeli-Jordanian Water Relations

Like the Interim Agreement between Israel and the Palestinians, the Peace Agreement between Israel and Jordan stipulates that a Joint Water Committee should be established. The JWC is to be composed of three members from each side and be able to call in experts whenever it is deemed necessary.[3] The JWC is responsible for the implementation of the water clauses of the Peace Treaty. Thus, in order to be able to assess the pace and quality of the implementation of the treaty, it is relevant to study the work of the JWC.

Before embarking on an analysis of the actual work of the JWC it is important to view the history of Israeli-Jordanian water cooperation and coordination. Water has been portrayed by some as a reason for conflict and even war in the Jordan River Basin. However, authors who focus on the potential for war, apart from ignoring the ameliorating factor of virtual water, have also tended to neglect that something that might be called a water regime has been in place regulating the water relations between Israel and Jordan since the early 1950s. The common understanding, reached in UN-led talks that started in the 1950s, on the use of the disputed waters of the Jordan River Ba-

3 See: *Treaty of Peace between the State of Israel and the Hashemite Kingdom of Jordan*, Article 6, at: <http://www.mfa.gov.il/mfa/go.asp?MFAH00pa0>.

sin between Israel and Jordan during a period when they were *de jure* in a state of war, is a good example of a water regime that greatly reduced the tension between two adversaries. Dinar (2000) argues that the USA viewed cooperation on water issues in the Jordan Basin as a tool for the creation of peace in the region. Consequently, the realist argument that the interests of hegemons create regimes seems to have some bearing in this case. However, there was also a *demand* for the regime from the countries, which fits the neo-liberal argument, regarding the nature of coordination of the shared water resources (Haddadin 2002).

Regardless of how the regime came about, it has provided a means to build trust between the states and has facilitated the development of friendly relations. Furthermore, the 1955 Johnston plan for the water management in the Jordan River Basin, which was facilitated by a US team of experts, can be seen as a part of a water regime (or the beginning of a regime), despite the fact that it was not formally recognized by the states (Wolf 1993). The plan has been used as a sort of baseline for water relations in the basin. It shall be noted that, while some of the recommendations in the Johnston Plan were adhered to, many were not, which is quite in contrast with what many of the textbooks on water in the Middle East say. The water agreement between Israel and Jordan, which is a part of the Peace Agreement signed 1994, can be seen as having enhanced and formalized the regime cooperation between the two states. The treaty, however, stipulates the rights and obligations of the two parties, while the regime concerns mainly the actual behavior of the parties to the regime.

Consequently the work of the JWC and the implementation of the water clauses of the Peace Treaty should not be viewed as separate from the history of water cooperation and coordination. Even before the actual treaty, principles and norms for the water relations between the parties existed. *Principles* involve goal orientation and beliefs at a general level in areas such as the environment and security. *Norms* describe general rights and obligations, which operate mainly on the level of issue areas but are still at a very general level. Hence the basics of the regime were in place before the peace negotiations started. In a fully-fledged regime there are also *rules* which are specific prescriptions and proscriptions for action that are often stated in a formal agreement such as the water clauses in the Israeli–Jordanian treaty. In addition, there are *decision-making procedures* in a regime, which are prevailing practices for making and implementing collective choices. These can be seen to be manifest in the form of the JWC and its procedures for taking decisions (Levy/Young/Zürn 1995).

The ways in which the water-related parts of the Jordanian-Israeli Peace Treaty and the Palestinian-Israeli agreement are being implemented are similar in some senses but at the same time very different since in the former case there exists a final peace treaty while in the latter there is only the Interim Agreement. Allan (2001) argues that the implementation of the water parts of the Israeli–Jordanian Peace Treaty is not unproblematic but is happening at a reasonable pace.

Among the issues with which the JWC has had to deal are a number that have caused disagreements and thus delays. According to Haddadin (2002), there has been a slippage of dates' on the part of Israel in the implementation of its commitments to Jordan. For example, according to the agreement Jordan shall be entitled to equal amounts of water in relation to Israel from the lower Jordan River. However, in order to decide the exact amount a survey of the existing Israeli use had to be conducted and agreement has not been reached about how to conduct it. Thus, the Jordanian argument is that Israel is deliberately delaying action that is needed as background for the implementation of the water clauses of the treaty. Furthermore joint studies on water resources that were to benefit data exchange financed by the European Union (EU) were, as seen from a Jordanian perspective, delayed in part by Israel through its bureaucratic procedures. Dureid Mahasneh, who was the Jordanian head of the JWC from 1996 to 1999, argues even that the Israelis were obstructing the implementation of the treaty (Mahasneh 2002). One of the heads of the JWC from Israel, Meir Ben-Meir, also maintained that there were problems in the implementation of the agreement and the work of the JWC, although even so both parties recognized that it was imperative that the committee stay in place (Ben-Meir 2001).

Furthermore, Haddadin (2001) also attributes implementation problems to ineffectiveness on the Jordanian side, thus recognizing that Israel was not the only problem. While the donors, in particular the EU, acted fast in securing financial support for joint projects, there were sometimes disagreements over which firms should carry out studies and also delays in processing agreed terms of reference for consultancies owing to the bureaucratic procedures of the parties. In addition, work to identify the additional water of 50 mcm per year for the benefit of Jordan has not seen much progress. This is because there is disagreement as to who should bear the cost of the additional water. According to Israel it is Jordan that should bear the cost since the water is for its benefit. Not surprisingly, Jordan does not agree (Shamir 2001). While Jordan has proposed that the additional 50 mcm should be taken from Lake Tiberias, Israel has proposed a scheme for reclamation of the Jordan River coupled with desalinated water from the saline springs of the Lake Tiberias and Bissan area. Until this is implemented Israel has agreed, on a temporary basis, to supply Jordan with 25–30 mcm per year of Tiberias water (el-Nazer 1997).

It should also be noted that, from a Jordanian perspective, the changes in the political scene in Israel, which brought Likud to power in 1996, also affected its water relations with Israel (Mahadin 2002). According to Haddadin the meetings became intermittent and less productive, although some studies were implemented. On technical matters, however, the working relations between Israel and Jordan still functioned reasonably well (Alem 2002). Having noted the problematic aspects of the implementation process, it is also important to discuss the positive aspects. For example, the canal for storage of Yarmuk water from Jordan in Lake Tiberias was built quickly and was inaugurated by King Hussein at the beginning of July 1995. However, there are no provisions for what to do when there is a drought. This is a serious issue for the parties. Apart from the problems of 1999 when Israel did not want to supply Jordan with what was stipulated (although it eventually did), there has been no problem in the transfer of water from Israel to Jordan (Alem 2002; el-Nazer 2002; Mahadin 2002). There has been a fear on the Jordanian side that the quality of the water that Israel releases to it in the summer is of much worse quality than what it receives from Jordan in the winter from the Yarmuk River (Trottier 1999). However, according to Jordanians involved in the JWC, who are responsible for the water that comes from Israel, the water released has been of high quality (Alem 2002; el-Nazer 2002). The joint project to bring water from the Red Sea to the Dead Sea, announced on 1 September 2002 at the World Summit for Sustainable Development in Johannesburg, can also be counted as evidence of positive tendencies. The aim of the project is to reverse the decline in the water table of the Dead Sea (Mutaz 2002).

The *effectiveness* of the regime between Israel and Jordan has been limited since conflicts between them (not over water) have forced them not to abide by the rules of the water regime at all times. That said it is apparent in the agreement from 1994 that many of the principles existing on the international level, such as the provision not to cause 'significant harm', have been used. Furthermore, a joint institution (the JWC) has been established in order to implement and monitor the principles agreed upon. It is positive to see that emphasis has been put on cooperation in the maintenance of the common resource. It is concluded that the regime is a rather strong one in terms of its *robustness* and *resilience*. The last time it was severely challenged was during the drought in 1998–2000, which produced a disagreement over allocations between the parties. This was partly because no provisions had been made for drought in the agreement from 1994. The conflict was, however, resolved and the norms, rules and principles that existed in the water regime contributed to this end.

The working relations within the JWC, on a professional level, can be seen as functioning rather well (e. g. Mahadin 2002; Ben-Meir 2001). This stems from a joint professional understanding of the importance of having a function in place that enables cooperation on the shared waters. At the same time the institutionalization of the JWC as an arena for discussion, coordination and cooperation can be seen as a structure that enables the professional understanding to grow. However, there are also 'external' structures that can effectively constrain or enable the work in the JWC and, consequently, the implementation of the agreement as well. As mentioned above, the change in government in Israel from Labor to Likud affected the work of the JWC and was perceived by the Jordanian side as having delayed implementation. While the actors within the JWC (from both parties) had a wider range of avenues for action under a Labor government in Israel, the room for maneuver decreased during the Likud period. Thus, the surrounding political environment effectively sets the boundaries for what has been feasible in the water sector.

19.4 Policy Relevance

In particular, two areas of importance from a policy perspective are identified through the research.

First, the research shows that water (and water cooperation) is intimately linked to politics. For those who come from a political science background this is perhaps to state the obvious, but from a water practitioner's perspective it is seldom well understood. While donor agencies and international organizations sometimes see water as separated from other fields, this research suggests that such an approach will lead to misunderstandings and disappointments, for example, with regard to why support activities do not accomplish the expected results in the estimated time.

Second, observations have been made with regard to the evolution of cooperation on transboundary water. My conclusion is that by long-term support for the processes of establishing cooperation on a shared water resource, donor agencies and international organizations can play an important role. In the Israeli-Jordanian case it is evident that the role of the *UN Truce Supervision Organization* (UNTSO), which worked as an 'umbrella' for discussions on water coordination in spite of the absence of a peace agreement, was important. The activities, involving many meetings between Israelis and Jordanians, started as early as the 1950s and continued up until the Peace Treaty in 1994. As in this case, the process of developing a water regime is often a long one and it meets setbacks on occasions. It must be remembered that the institutionalization of cooperation requires time (and not just a signed agreement). The financial support that international donor institutions could provide to bring about water cooperation is seldom rewarding to the donor in the beginning and can be seen as a high-risk investment. However, if cooperation is achieved and institutionalized the rewards are great since cooperation and coordination over a shared body of water are prerequisites for many other water development projects as well as rural development projects. The involvement of donor institutions should not be too far from the national interests of their clients (the riparians) but should stimulate collective action, albeit stopping short of trying to impose it. Thus for a donor or organization to engage in building cooperative structures in a shared river basin demands courage and a vision that will have to go beyond the lifetime of a single project.

19.5 Conclusions

The focus of analysis of this chapter has been on the actual implementation of the agreements (both final and interim) between the parties in the Jordan River Basin. The case of Israel and the Palestinians is different from the Israeli–Jordanian case in that the agreement to be implemented is an interim one, while Israel and Jordan are working with the implementation of a final agreement. Within an overall actor – structure theoretical framework, regime theory has been used to analyze the implementation process, which has mainly taken place within the respective Joint Water Committees. It is concluded that it is imperative to analyze the actions of actors in the committees within their proper structural context, which means that an account of linkages between water and other political issues have been incorporated into the analysis.

With regard to the implementation of the various parts of the agreements it is concluded that they are often being implemented somewhat painfully. That said, it is also evident that in the Israeli-Palestinian case many parts of the interim agreement awaiting implementation are being delayed despite a general understanding on part of the professionals (among experts) that implementation should be carried through. Politically sensitive issues, such as the locations for the drilling of Palestinian wells in the West Bank, are generally blocked by Israel for hydrological reasons but it seems that there are often political reasons for those decisions. Israeli officials also unofficially acknowledge this. Furthermore, while the ambiguities that exist in the agreements are useful when trying to reach an agreement, they work as obstacles in the post-agreement phase when they are to be implemented. It is concluded that the power asymmetry between the parties, which is particularly evident in the case of Israel and the Palestinians, effectively gives Israel the upper hand in the decisions with regard to the implementation of the agreements.

Furthermore, it is noted that, in comparison, the Israeli-Jordanian cooperation and implementation of the agreement can be described as fairly smooth while the Israeli-Palestinian cooperation and implementation of the Interim Agreement have encountered obstacles. These obstacles cannot be attributed to problems of cooperation on a professional level. They are rather the result of the surrounding political circumstances which are much more sensitive and problematic in the case of Israel and the Palestinians than in the case of Israel and Jordan.

In spite of the problems in implementation there exists a kind of contained mechanism that guides the action of the parties. This can be called a water regime. While this does not imply that there are no problems in the sector, it is concluded that the evolving principles, norms, rules and decision-making procedures resemble a water regime. In addition, during times of pressure on the regime, such as the drought in 1999, which resulted in strained relations between Israel and Jordan, or the Intifada between Israel and the Palestinians that started in September 2000, the water regime has shown robustness and resilience although its effecttiveness has been hampered. Hence it is concluded that the international water regimes that exist might be seen as a conflict-mitigating factor since they promote basin-wide interstate cooperation and thereby increase water security. The analysis of the water cooperation in the Jordan River Basin through the prism of regime theory has been helpful in explaining why cooperation has occurred in spite of the significant political conflict. When a convergence of values has occurred within a regime and the cooperation has been institutionalized it is more difficult than one might think to reverse or end this cooperation.

References

Alem, Z., 2002: Personal communication, Amman, Jordan, 10 March.

Allan, J. A., 2001: *The Middle East Water Question: Hydropolitics and the Global Economy* (London - New York: I. B. Tauris).

Barghouti, I., 2002: Personal communication, Ramallah, 27 November.

Ben Meir, M., 2001: Personal communication, Kfar Masorik, Israel, 29 April.

Cantour, S., 2001: Personal communication, Tel Aviv, Israel, 30 April.

Dinar, S., 2000; "Negotiations and international relations: a framework for hydropolitics", in: *International Negotiation*, 5,2 (33): 375–407

El-Nazer, H., 1997: "The partition of water resources in the Jordan River Basin: history and current development", Paper presented at the Conference on Water in the Mediterranean Countries: Management Problems of a Scarce Resource, Naples, 4–5 December.

El-Nazer, H., 2002: Personal communication, Amman, Jordan, 11 March.

Feitelson, E., 2001: Personal communication, Jerusalem, 24 May.

Haddadin, M., 2001: *Diplomacy on the Jordan: International Conflict and Negotiated Solution* (Boston, Mass. - London: Kluwer Academic).

Haddadin, M., 2002: Personal communication, Delft, The Netherlands, 20 November.

Hasenclever, A.; Mayer, P.; Rittberger, V., 1997: *Theories of International Regimes* (Cambridge: Cambridge University Press).

Hay, C., 2002: "Structure and agency", in: Marsch, D.; Stoker, G. (Eds.): *Theory and Methods in Political Science* (London: Macmillan).

Itzkovitvz, N., 2002: Personal communication, Antalya, Turkey, 2 November

Jarrar, A., 2002: Personal communication, Delft, The Netherlands, 22 November.

Jarrar, A.; Yousef, A., 2002: "Water from conflict to cooperation: Palestine and Israel case", Paper presented at the UNESCO-GCI PCCP-Water for Peace Conference in Delft, 21 November.

Jeusi, A., 2002: Personal communication, Amman, Jordan, 9 March.

Keohane, R.; Nye, J., 1989: *Power and Interdependence* (New York: HarperCollins).

Krasner, S., 1983: "Structural causes and regime consequences: regimes as intervening variables", in: Krasner, S. (Ed.): *International Regimes* (Ithaca, N.Y.: Cornell University Press).

Levy, M. A.: Young, O. R.; Zürn, M., 1995: "The study of international regimes", in: *European Journal of International Relations*, 1,3: 267–330.

Mahadin, K., 2002: Personal communication, Amman, Jordan, 9 March.

Mahasneh, D., 2002: Personal communication, Amman, Jordan, 9 March.

Mayer, P.; Rittberger, V.; Zürn, M., 1993: "Regime theory: state of the art and perspectives", in: Rittberger, V. (Ed.): *Regime Theory and International Relations* (Oxford: Clarendon Press): 391–430.

Muscal, T. and Lahoud, L., 2002: Eitam suspends approval for PA well drillings. In: *Jerusalem Post*, 23 Oct.

Mutaz, M., 2002: "Future of the Dead Sea: history will judge us", in: *Jordan Times*, 18 December.

Schiff, Z., 2001: "Unlikely cooperation", in: *Ha'aretz* (English version), 13 February.

Shamir, U., 2001: Personal communication, Haifa, Israel, 30 April.

Trottier, J., 1999: *Hydropolitics in the West Bank and Gaza Strip*.Jerusalem: PASSIA

Waterbury, J., 2002: *The Nile Basin: National Determinants of Collective Action* (New Haven, Conn. – London: Yale University Press),

Wolf, A., 1993: "Water for peace in the Jordan River watershed", in: *Natural Resources Journal*, 33,3: 797–839.

20 Joint Mismanagement: Reappraising the Oslo Water Regime

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Abstract

This chapter offers a critique of the Oslo II regime for the joint management of the West Bank's water resources, systems and supplies, arguing that this regime should more accurately be thought of as evidence of 'joint mismanagement'. The argument is threefold. First, that the Oslo II regime was premised on a chimera of 'cooperation', which differed in little more than name from the occupation regime that predated it. Second, that the Oslo II regime was a license for environmental destruction, especially of the West Bank's Eastern Aquifer. And third, that the structure of the Oslo process as a whole militated against the development of effective institutions and against 'good governance', in the water sector as elsewhere. The collapse of Oslo should not blind us to the fact that the Oslo II regime does not represent a good model for joint Israeli-Palestinian water management

Keywords: Oslo, Israel, Palestinian, cooperation, governance

20.1 Introduction[1]

At the time of the first Israeli-Palestinian-International conference on water in December 1992, there was much talk of the need for joint management of regional water resources (Isaac/Shuval 1994). Yitzhak Rabin had just six months previously been elected as Israeli Prime Minister, a Labor-led coalition was in power in Israel for the first time since 1977, and peace was in the air (even if the situation on the ground in the West Bank and Gaza continued to deteriorate). Secret negotiations were about to commence which would culminate, in September 1993, in the signing of the Oslo Accords and the onset of the Oslo peace process. The hope and expectation was clearly that, with a peace process firmly on the horizon, Israelis and Palestinians might soon be cooperating in the joint management of shared water resources, and in ameliorating the growing Palestinian water crisis.

And these hopes were not without foundation. Within a month of the famous handshake on the White House lawn, international donors had pledged over $ 2 billion for the reconstruction and development of the West Bank and Gaza, in what was to become, in per capita terms, amongst the largest donor efforts ever undertaken by the international community (Brynen 1996: 46; World Bank 2002: v). Water was recognized as a priority sector from the outset, with over 10 per cent of all aid money to the Palestinians between 1993 and 2000 being dedicated to water and wastewater projects (Rouyer 2000: 229). Israel and the PLO had agreed in their Declaration of Principles to co-operate in managing the water resources of the West Bank and Gaza.[2] And within a couple of years this hoped-for co-operation started to take prac-

1 This article draws heavily upon Selby (2003) and on certain other articles referenced below. I concentrate here especially on the West Bank, saying very little about the situation in the Gaza Strip, this being because it is the West Bank which has supposedly been the home of 'joint management' in the water sector.

tical effect, with the September 1995 Oslo II Agreement committing the parties to the establishment of a *Joint Water Committee* (JWC) and several *Joint Supervision and Enforcement Teams* (JSETs), and to the 'co-ordinated management' of the West Bank's water and wastewater systems and resources.[3] This, most commentators ventured, represented a "breakthrough" – "a major step towards a permanent Israeli-Palestinian accommodation over water."[4] Israeli-Palestinian water co-operation seemed to be a shining example of the potential for peaceful co-existence and for a two-state solution to the Israeli-Palestinian conflict.

The collapse of the Oslo process since September 2000 does not, of course, disprove these hopes and expectations, since – while continuing Palestinian water shortages can hardly have helped the cause of peace – the peace process collapsed for reasons that had little to do with the distribution of water supplies or the management of water resources. Yet 14 years on from the first Israeli-Palestinian-International conference on water, and with the Oslo process now dead, there is urgent need for a reappraisal of the successes and failures of joint water management under Oslo. Most discussions of Israeli-Palestinian water cooperation under Oslo still portray it in largely favorable terms. The joint management agreement, goes the usual story, was a significant "step in the direction of an equitable water sharing agreement" (Rouyer 2000: 207). There was, as Fadel Qawash, deputy head of the *Palestinian Water Authority* (PWA) puts it, "nothing wrong with the agreement", the problems having lain to the contrary in the Netanyahu government's unwillingness to implement the agreement fully.[5] And notwithstanding this, continues the orthodox narrative, the water sector remains one of the few areas where the parties are still cooperating, as evidenced by the fact that the JWC continues to meet in spite the collapse of the broader peace process.[6] Most discussions of the Oslo water agreements hold that, whatever else was wrong with the Oslo process, the water agreements themselves were a model for coordinated management and cooperation.

This assumption is in this author's view misplaced for at least three reasons: *firstly*, because the much-lauded 'joint management' regime established under Oslo was, and remains, an illusion; *secondly*, because the Oslo water regime was a license for environmental destruction; and *thirdly*, because the nature of the Palestinian political system created under (and as a bi-product of) Oslo inevitably led to weak governance and mismanagement in the Palestinian water sector. Unfortunately, these issues have consistently been obscured through a mixture of nationalist discourse and expert oversight. Palestinian nationalist discourse, for instance, has led *Palestinian Authority* (PA) water policy makers to downplay the extent to which they were already cooperating with Israeli water authorities prior to 1993, and has thus led them to overstate the novelty of joint management under Oslo. International experts, for their part, have typically approached the Oslo water agreements as if they were an obvious 'good', and without a sufficiently in-depth or critical understanding of the problems inherent in the structure of the peace process and of Israeli-Palestinian relations. Of course, 'cooperation' is in general preferable to 'conflict', but we should not assume that any particular instance of 'cooperation' is good simply because it gives itself that name. And when we look at the Oslo water accords in detail, this author would argue, we do not find a broadly positive model of 'joint management'. What we find, to the contrary, is a recipe for 'joint mismanagement' of the water sector, with little potential either to rectify the structure of Israeli-Palestinian relations or to ameliorate the Palestinian water crisis. It is this case that the author sets out below.

20.2 The Chimera of 'Cooperation'

The Oslo II agreement of 1995 committed Israel and the PA, as already noted, to establishing a *Joint Water Committee* (JWC), with responsibility for overseeing

2 Israel and the PLO, *Declaration of Principles on Interim Self-Government Arrangements* (13 September 1993), Annex III, Article 1.

3 Israel and the PLO, *Interim Agreement on the West Bank and Gaza Strip* (28 September 1995), Annex III, Appendix 1, Article 40.

4 "Negotiators achieve breakthrough on water rights", in: *Israel-Line* (25 August 1995); Shapland (1997): 35.

5 Quoted in *Al Quds* (16 April 1998): 22; PWA Press Conference (22 August 1998).

6 During the first few months of the second intifada there were no meetings of the JWC. In January 2001, however, the JWC made a joint declaration urging people to keep water infrastructures "out of the cycle of violence" (JWC, "Joint declaration for keeping the water infrastructure out of the cycle of violence", 31 January 2001). Between then and the formation of the new Hamas Palestinian government in March 2006, the JWC continued to meet, albeit irregularly.

the management of all of the West Bank's water and sewage resources and systems.[7] The JWC would operate in seemingly egalitarian fashion: it would comprise an equal number of Israeli and Palestinian representatives, and decisions within it would be reached by consensus.[8] The JWC would have overall authority for surveying and protecting existing resources, for developing new supplies, for maintaining existing infrastructures, and for constructing new ones.[9] It would not, however, be responsible for the day-to-day management of resources and systems; it would function, rather, as a coordinating body, with most on-the-ground work being undertaken separately by one or other of the parties. Thus particular water and sewage systems would be controlled by either Israel or the PA: those systems "related solely to Palestinians", which until then were "held by the military government and Civil Administration", would be transferred to the PA, while all other systems would remain under Israeli control.[10] Irrespective of its name, the JWC would be a "coordinated" rather than a "joint" management structure.[11]

On the surface, this sounds eminently sensible and impressively cooperative. In reality, however, the JWC system merely formalized a discriminatory management regime that was, for the most part, already in existence. During the course of the occupation, Israel had constructed an integrated water supply network across the West Bank which conjoined Israeli settlements and Palestinian towns and villages within a single integrated supply network, but at the same time discriminated sharply between the two populations. Supply lines, many of them from within Israel, typically fed both existing Palestinian communities and the many new and expanding illegal Israeli settlements. But the lines feeding Palestinian communities were generally of much narrower diameter than those feeding Israeli settlements, and Palestinian storage reservoirs were likewise much smaller than those of their Israeli counterparts. Come the onset of the Oslo process in 1993, the West Bank's water supply systems had become clear testimony to the Israeli state's colonial and apartheid ambitions – on the one hand facilitating the territorial integration of the West Bank into Israel and the creeping colonization of Palestinian lands, whilst on the other hand ensuring that the Israeli settler population received a disproportionate share of water supplies (for details see: Selby 2003: 83–91).

Just as significantly, during the course of the occupation Israel had also established a delegated institutional regime for managing the Palestinian water sector. This institutional regime was premised on the Palestinian-staffed West Bank Water Department, as well as Palestinian municipalities and village councils, being responsible for liaising with Palestinian water users. While the Israeli Military Government (later Civil Administration) and its Water Officer retained overall regulatory control, and while Mekorot, after 1982, owned the water supply infrastructures, it was the Water Department and local Palestinian authorities which were responsible for maintaining distribution lines, for opening and closing supply valves to Palestinian communities, and for billing Palestinian communities. None of these Palestinian institutions had any power over or responsibility for Israeli settlers, however; the Water Department was not allowed to close water supply valves to Israeli settlements, for instance, and had no role in billing Israeli settlers.[12] These Palestinian institutions and the Water Department in particular, thus functioned as a key institutional interfaces between the Military Government and the occupied Palestinian population, enabling the Israeli state to effect its colonial and apartheid water policies without having any direct contact with Palestinian users.

The implications of the management regime established under Oslo II should by now be clear. The Palestinians would henceforth be responsible for maintaining and operating internal systems within Palestinian towns and villages, as well as those connections to such internal systems which did not feed Israeli settlements. Yet given that by 1995 Israeli and Palestinian water supply networks were thoroughly integrated, this did not promise the Palestinians a great deal. Israel would continue to control the vast majority of supply lines, and would also continue to control all of the numerous deep wells which had been drilled by Mekorot since 1982, since these all supplied at least some Israeli settlements. Moreover, given that most local water supply and infrastructure management

7 Israel and the PLO, *Interim Agreement*, Annex III, Appendix 1, Article 40 (11, 12).
8 Ibid., Article 40 (13 14).
9 Ibid., Article 40 (12); Schedule 8.
10 Ibid., Article 40 (4); Schedule 8 (2.a, b).
11 Ibid., Article 40 (12); Schedule 8.
12 Interviews with Taher Nassereddin, West Bank Water Department (12 April 1998), and Abdul Rahman Tamimi, Palestinian Hydrology Group (19 April 1998). For more details on the structure and functioning of this institutional regime, see: Selby (2003): 80–83.

within the West Bank was already being undertaken by Palestinians – both by the West Bank Water Department, and by municipalities and village councils – the seeming novelty of Oslo II's co-ordinated management system was largely illusory. To the contrary, the water accords of the Oslo II Agreement merely formalized a supply management system which had been in operation for years, presenting it, misleadingly, as part of an egalitarian-sounding 'joint' and 'co-ordinated' management system.

Very much the same can be said regarding two other management issues, resource monitoring and water prices. The Oslo II agreement stipulated that the two sides would establish, under the supervision of the JWC, "no less than five *Joint Supervision and Enforcement Teams* (JSETs)", for the monitoring and policing of the West Bank's water resources, systems and supplies.[13] As with the JWC itself, the JSETs would operate according to strictly egalitarian principles: each of them would be comprised of "no less than two representatives from each side", and each side would have its own vehicle and cover its own expenses.[14] The JSETs teams would be responsible for locating unauthorized water connections, for supervising infrastructure developments, and for monitoring well extractions, spring discharges and water quality.[15] Three such teams were immediately established, each of them responsible for hydrologic monitoring.[16] The twist lies, though, in the fact that these three JSETs followed precisely the same monitoring system as had been followed since the early 1970s by the West Bank Water Department. Monitoring was conducted by the same Palestinian technicians and in line with the very same procedures and schedule; and data was recorded on forms which barely differed from those which had been used prior to the Oslo II Agreement.[17] The only significant differences post-Oslo were that the monitoring process became significantly more time-consuming (owing to the difficulty of organizing security convoys in the territorially fragmented West Bank), and that the Palestinians became entitled, like their Israeli counterparts, to use JSETs data (and while this latter change was in principle significant, it was in practice nullified by Israel's refusal to transfer key historic and contemporary data, which meant that, throughout the Oslo period, Palestinians remained heavily reliant on Israeli databases, plans and models). From 1995 onwards, there did exist a formal mechanism for the joint supervision of the West Bank's water resources, but it was one which continued to enshrine overall Israeli control over politically-sensitive water-related information (Selby 2003: 108–112).

As for water prices, Oslo II stipulated that "in the case of purchase of water by one side from the other, the purchaser shall pay the full real cost incurred by the supplier, including the cost of production at the source and the conveyance all the way to the point of delivery."[18] At first glance this would appear fair and reasonable. As noted above, however, the Israeli authorities would continue to exercise control over the West Bank's water resources, and over all 'upstream' facilities, such that the Israeli authorities would always be the 'suppliers', Palestinian authorities and communities the 'purchasers'. Moreover, the terms of this article applied only to transactions between Israelis and Palestinians, placing no constraints on purchases by Israeli settlers. And settlers receive their water at highly subsidized rates: by one source, during the mid-1990s settlers were paying $ 0.40 per cubic meter for domestic water and $ 0.16 for agricultural uses, while Palestinians were paying $ 1.20 for both domestic and agricultural supplies (this differential pricing being rendered possible because settlers are billed by the Israeli water supply company Mekorot rather than by the West Bank Water Department, as Palestinians are; see Isaac/Selby 1996: 18–20). Thus under the reasonable-sounding terms of Oslo II, Palestinians had no option but to pay the 'full real cost' of production and supply to the Israeli authorities, while these same authorities were free to continue supplying settlers at rates well below the real cost of production and supply. As with the management of systems and supplies,

13 Ibid., Schedule 9 (1).
14 Ibid., Schedule 9 (2, 3).
15 Ibid., Schedule 9 (4).
16 Interviews with Mustapha Nuseibi, West Bank Water Department (27 June 1998); and Taher Nassereddin (15 August 1998).

17 Prior to the Oslo II Agreement, water data was recorded on forms headed 'State of Israel, Ministry of Agriculture, Water Commission, Hydrological Service', to be signed by an Observer and a District Engineer. Thereafter, the forms were re-headed 'Joint Water Committee, JSETS – Joint Supervision and Enforcement Team – Israeli-Palestinian', and were to be signed by an Observer, a District Engineer, and representatives of the Israeli and Palestinian Teams (in practice, the Observer and District Engineer once again). In all other respects these two sets of forms were identical.
18 Israel and the PLO, *Interim Agreement*, Annex III, Appendix 1, Article 40 (18).

Oslo II simply legitimized a discriminatory pricing mechanism which had existed since well before 1995.

Beyond this, the Oslo II arrangements had one extra benefit for Israel. Since the onset of the intifada in 1987, the West Bank Water Department had been facing increasing levels of non-payment by Palestinian municipalities and individuals, such that by 1995 it had debts of around NIS 18 million ($ 4.5 million). With the inauguration of a formal 'joint management' system, these debts suddenly became taken on by the Palestinian side, being covered by the Palestinian Ministry of Finance. By 2002, these Water Department debts had risen to NIS 110 million ($ 24 million).[19] The formalization of Israeli-Palestinian co-operation had enabled Israel to divest itself of some of the most onerous burdens of occupation, without losing control of either water resources or supplies to Israeli settlements, and without having to forego its discriminatory pricing policy.

So much one might be willing to concede; but didn't the Oslo II Agreement also hold out the promise of additional water supplies for the West Bank's Palestinian communities? Indeed it did: 23.6 mcm/y would be made available within the West Bank in order to meet the "immediate needs of the Palestinians ... during the interim period", while a further 41.4–51.4 mcm/y would be developed to meet the "future needs" of West Bank Palestinian communities.[20] Yet significant as these provisions undoubtedly were, their overall import needs to be qualified in a number of regards.

Firstly, these provisions placed only a minimal burden on Israel. Of the total promised new and additional supply to the West Bank of 65–75 mcm/y, Israel would be financially responsible only for the development of 4.5 mcm/y, with the Palestinians bearing the capital costs of developing the remaining 61.5–71.5 mcm/y. Moreover, Israel would have to sacrifice only a minimal loss of water, since of the planned additional West Bank supply of 65–75 mcm/y, Israel would only have to supply 3.1 mcm/y from its national water system.[21] In these respects, the Oslo II Agreement simply enabled Israel to divest itself of the burden of developing much-needed additional water for the Palestinians, transferring the financial burden for improving Palestinian water supplies from Mekorot to the international donor community and in turn the PA (which will at some point have to start repaying its soft loans to international donors).

Secondly, the PA under Oslo was not entitled to unilaterally amend or abrogate any of the water-related military orders which were put in place by the Israeli authorities in the wake of the 1967 war.[22] As a result, ultimate decision making authority over water resources and systems continued to lie with the Water Officer of the Civil Administration, who could in theory veto any Palestinian infrastructure development proposal, even after it has received the consent of the JWC. Such in fact did occur on numerous occasions within the Israeli-controlled Area C (which constituted 60 per cent of the West Bank), especially when proposed well locations and supply lines clashed with Israeli plans for new settlements and bypass roads.[23]

Thirdly, the structure of the JWC set significant constraints on Palestinian development of the West Bank's water resources. We have already seen that decisions within the JWC operate by consensus. Yet given that all infrastructure development works "require the prior approval of the JWC" (and this includes every pipeline of greater than 2 inch diameter or 200 m in length, and includes every well that needs constructing or rehabilitating), it so follows that each of the parties has an effective veto over the other's proposals.[24] While in principle this applies equally to both sides, in practice it places by far the biggest constraints on the Palestinians, simply because they are so much more needful of new and additional supplies. As it has turned out, Israel has generally vetoed the Palestinian development of "other agreed sources in the West Bank".[25] It has rejected several proposed well locations on the grounds of their being too close to Israeli settlements.[26] Moreover, the PA has only

19 Interviews with Taher Nassereddin (12 April 1998), and Mohammed Jaas, West Bank Water Department (18 August 1999, and 1 June 2002).

20 Israel and the PLO, *Interim Agreement*, Annex III, Appendix 1, Article 40 (7), (7.b.vi).

21 Ibid., Article 40 (7).

22 Israel and the PLO, 'Interim Agreement', Article 18 (4.a).

23 Interviews with Ayman Jarrar, Palestinian Water Authority (17 August 1999), and Omar Zayad, Palestinian Water Authority (17 August 1999); also Rouyer (2000): 225–226, 232; and Ze'ev Schiff: "Sharon suggests taking over water sources in West Bank", in: *Ha'aretz* (21 May 1997).

24 Israel and the PLO, *Interim Agreement*, Annex III, Appendix 1, Schedule 8 (1.b). The same point is made by Elmusa (1997): 131; and Rouyer (2000): 223. Bureaucratic details from interview with Mohammed Jaas (26 August 1999).

25 Interview with Taher Nassereddin (15 August 1998); Rouyer (2000): 225, 228.

26 See Rouyer (2000): 228, 232; Schiff, 'Sharon suggests taking over water sources in West Bank'.

succeeded in avoiding the Israeli veto on its infrastructure development proposals by entering into a tacit *modus vivendi* with the Israeli authorities, one in which Israel has been willing to grant licenses for Palestinian development of the Eastern Aquifer, but only in return for permission to construct new and enlarged water supply systems from within the Green Line to Israeli settlements in the West Bank (the Oslo II Agreement places no limit on new supplies to Israeli settlements).[27] While the PA assented to this new construction work only on condition that it was not taken as implying recognition or acceptance of Israeli settlements, the fact remains that the PA had in practice little option, under the seemingly egalitarian terms of Oslo II, but to assent to the extension and entrenchment of Israel's illegal settlement building program.[28] Given that the settlements are the central impediment to Palestinian statehood, it can quite reasonably be concluded that the Oslo II water accords, by licensing (and forcing the Palestinian authorities to assent to) continued settlement growth, were a regressive rather than progressive development, decidedly not a step in the right direction.

In each of these regards, the promises of new and additional supplies contained in the Oslo II Agreement were much less significant than they at first appear. What must also be emphasized is that these limitations follow directly from the terms of the Oslo II Agreement, not from their post-hoc interpretation and implementation. There were indeed problems of implementation during the Oslo period: there was, for instance, a relative breakdown in Israeli-Palestinian water relations during the early part of Netanyahu's tenure as Israeli Prime Minister; and Israeli pipelines were on several occasions laid to West Bank settlements without having first received JWC permission (and in some cases where Israeli proposals have been rejected by Palestinian JWC officials).[29] But the central problems with the 'joint management' regime established under Oslo lay with the terms of the regime itself, rather than with their inadequate implementation. The Oslo water agreements did not transfer significant authority to the Palestinians: as under the occupation, they were responsible for local supply management and administration, but had no control over resources. Equally, the accords did nothing to amend the discriminatory water distribution and water pricing systems established under occupation: the only difference now was that Israeli water apartheid was granted official Palestinian consent. As during the occupation, countless Palestinian communities would go three or more months without piped supplies each summer. Indeed, the main consequences of the Oslo water accords were not any significant transfer of power to the Palestinians, or any amelioration of Palestinian water shortages, but rather three things: the construction of extra layers of bureaucracy (the JWC, the JSETs, the PWA) which above all served to dissimulate Palestinian autonomy; a transfer of power from Palestinian 'insiders' to PLO 'outsiders' returning with Arafat from Tunis; and a transfer of some of the major burdens of occupation (the costs of investing in new infrastructures, and of coping with non-payment) from Israel to the PA and the international donor community.

It is true, as the standard account has it, that Israeli-Palestinian 'co-operation' over water issues has continued since the breakdown of the peace process. However, in light of the above this should come as no surprise. Israeli and Palestinian water managers were 'cooperating' before Oslo, and equally, they have continued to 'cooperate' since its collapse, despite Israel's renewed oppression of the Palestinians, and colonization of the West Bank Palestinian land. The PWA is still approving new supply lines to Israeli settlements: during early 2002, for instance, approval was granted for an 11 km and 32 inch pipeline from the Green Line to Gush Etzion.[30] For many, the very fact that the JWC is still meeting is a positive sign. But this author begs to disagree. A 'joint management' system in which one party has no option but to assent to the colonization of their own land is little more than a "dressing up of domination as 'cooperation'" (Selby 2003a).

20.3 A License for Environmental Destruction

One further problem with the terms of the Oslo II water accords, not discussed thus far, was that the main water resource granted to the Palestinians was simply not fully there for the taking. The Oslo II agreement stipulated that all of the Palestinians' im-

27 Interviews with Ayman Jarrar (17 August 1999), Omar Zayad (17 August 1999), and Mohammed Jaas (18 August 1999).

28 Interview with PA water official, to remain anonymous.

29 Interviews with Karen Assaf, Palestinian Water Authority (13 July 1998 and 17 August 1999), Mohammed Jaas (26 August 1999 and 1 June 2002), and Taher Nassereddin (15 August 1998); also Rouyer (2000): 247.

30 Interview with Mohammed Jaas (1 June 2002).

mediate and future water needs (estimated at 70 to 80 mcm/y) would be met through development of "the Eastern Aquifer and other agreed sources in the West Bank," the Eastern Aquifer being one of the three major West Bank aquifers, and the only one, according to Oslo II, that was not yet being exploited to its fullest.[31] Handily, there remained, according to Oslo II, an as-yet unexploited 78 mcm/y within the Eastern Aquifer, an annual yield that was uncannily close to meeting all of the Palestinians future needs.[32] It was on the strength of these figures that, in the wake of the 1995 agreement, international donors started pouring money into the development of the Eastern Aquifer. The sites for sixteen production wells were agreed upon shortly after the signing of the accords, with donors, led by USAID, seeing the development of the Eastern Aquifer as the key to ameliorating the water supply crisis in the West Bank. What few of them realized and still fewer were prepared to admit, however, was that the Eastern Aquifer did not have nearly the potential claimed.

The data for the Eastern Aquifer contained within the Oslo II agreement was arrived at by two Israeli hydrologists at the Israeli water planning company, Tahal, who, following a recharge methodology, calculated the safe yield and remaining potential of the Eastern Aquifer by totaling the yearly volume of spring discharges and well extractions from it.[33] In their view, the significant discharge from the Ayn Fashkha springs along the Dead Sea shore provided strong evidence of significant remaining potential in the aquifer. The relevant figures were passed to Israel's Oslo II water negotiators, who in turn annexed them to the Oslo II agreement. Palestinian negotiators, lacking any precise figures of their own, could hardly rebut the Israeli data.

Yet the problem is that there is compelling evidence that the agreement vastly overstated the remaining potential of the Eastern aquifer (Selby 2003: ch. 5). In the first place, and as one of the two Israeli hydrologists who produced the Oslo II data admits, if the Eastern Aquifer were fully exploited, then salt water from the floor of the Jordan valley would flow up into the lower stretches of the aquifer, possibly contaminating existing wells: as the hydrologist in question suggests, a minimum 20 mcm/y would have to be allowed to continue flowing from the Dead Sea springs in order to negate this possibility.[34] Secondly, the volume of existing discharge from the Dead Sea springs appears to have been over-estimated within the Oslo II calculations, these calculations having been premised on monitoring work undertaken by the Israeli Hydrological Service during 1992, on the back of heavy rainfall during the previous winter (the IHS calculated discharge at 80 mcm/y), rather on the more conservative and, in most experts' views, representative findings of Tahal in the late 1980s (which put discharge at only 40 mcm/y).[35] Thirdly, it seems likely that much of the seeming remaining potential of the Eastern Aquifer is inaccessible, both because it comes from deep saline aquifers (some of the water emerging from the Dead Sea springs fell as rain 25,000 years ago, as far away as the Atlas Mountains), and because it flows so thinly through the upper, non-saline parts of the aquifer as to render exploitation economically, and perhaps even technologically, unfeasible.[36] For all of these reasons, it seems clear that the Eastern Aquifer has nowhere near the potential claimed in the Oslo II agreement.

More startling still, however, water table levels are already rapidly declining in certain parts of the Eastern Aquifer and have been doing so for years. Water table levels in one of the wells, Herodian 3, just south of Bethlehem, have been declining at a rate of 5 meter per year since 1981 (Aliewi/Jarrar 2000: 6). Moreover, according to the Israeli Hydrological Service, the water table of the Herodian Aquifer (as they call the Herodian area of the Eastern Aquifer) dropped by 1.75 meters between 1972 and 1996 (IHS 1998: 192). Extraction was excessive even before Oslo, but since then "the drilling of more wells into an already depleted aquifer [has] exacerbated the problem of unsustainability" (Scarpa 2004). As a study conducted in 1998 for the PWA concluded, if all of the then planned wells were to be drilled and brought into op-

31 Israel and the PLO, *Interim Agreement*, Annex III, Appendix 1, Article 40 (7.b.vi).

32 Ibid, Schedule 10.

33 Interviews with Yossi Guttman, Tahal (4 August 1998); and Ze'ev Golani, Mekorot (6 August 1998).

34 Interview with Yossi Guttman (4 August 1998).

35 Interviews with Dvor Gillad, Israeli Hydrological Service (16 August 1998); Yossi Guttman (4 August 1998); David Scarpa, Water and Soil Environmental Research Unit, Bethlehem University (30 March 1998); and Abdul Rahman Tamimi (19 April 1998).

36 David Scarpa, personal communication (3 September 2000). On the composition and origins of the Eastern Aquifer waters see Kronfeld et al, (1992): 71–6; and Mazor/Molcho (1971): 37–47. On the problem of accessing dispersed waters see Guttman (18 January 1998). Thanks also to David Scarpa on this latter issue (interview, 25 August 1998).

eration, there would be an estimated decline in the Herodian well field of up to 120 meters over only a four-year period (CDM/Morganti 1998).

The Oslo II water accords were a recipe for the environmental destruction of the Eastern Aquifer. Unwilling to forgo all but a smattering of their existing water supplies, the Israeli authorities "fabricated the facts about aquifer yields," and through so doing managed to conjure up a sparkling new and until then barely noticed resource (Aliewi/Jayyousi 2000: 14). Given the prevailing power dynamic, Palestinian negotiators had little option but to accept the Israeli data. And once this data was embedded within the Oslo II agreement, it became the standard and unquestioned reference point for Israelis, Palestinians and international donors alike. The Israeli authorities had little political interest in the fate of what would at some point become an internal West Bank aquifer; the Palestinian water authorities were likewise unwilling to recognize or to forego development of the one water resource they had been offered under Oslo; and international donors, with eyes only on propping up the peace process, generally did not conduct environmental assessments of their own (Palestinian Hydrology Group 2000). As two leading Palestinian water experts write, "the consequences might be disastrous" (Aliewi/Jarrar 2000: 3). Under the Oslo regime, the environment was endangered for the short-term purposes of political expediency – hardly evidence of progressive joint management in action.

20.4 The Promotion of Bad Governance

Third and finally, the character of the Palestinian political system created under Oslo made it impossible for the Palestinian water authorities to manage their water sector adequately. To understand why this was so, we need to turn away from water issues for a moment, and consider the structure of the peace process more broadly. The Oslo process was driven all along by three things: first, by Israel's desire to subcontract many of the more onerous burdens of occupation, particularly in relation to policing and security; second, by Israel's desire to achieve this without making too many territorial sacrifices, and without divesting overall control of the economies of the West Bank and Gaza, or of its natural resources, most importantly water; and third, by the political desperation of the Tunis-based PLO, and of Yasser Arafat in particular. For Yitzhak Rabin, the security considerations were paramount: "Palestinians will be better at it [imposing order] than we are," he observed with brutal candor, "because they will allow no appeals to the Supreme Court and will prevent the Israeli Association of Civil Rights from criticizing the conditions there by denying it access to the area. They will rule by their own methods, freeing, and this is most important, the Israeli army soldiers from having to do what they will do."[37] In line with this fundamental security principle, Israel sought to enable and increase Arafat's security powers over Palestinian society. It raised few objections to the proliferation of Arafat's security agencies, or to the ever-growing numbers of police and security officers employed by him – both in contravention of signed agreements.[38] Instead it sought to deepen his powers over the Palestinian population, both by allowing his security agencies to enforce order in areas outside the PA's formal control, and by topping up his personal finances and hence powers of patronage (until 1999, remittances from Palestinian laborers in Israel and the settlements were being forwarded by Israel not into an official PA bank account, but rather into a personal Bank Leumi account held by Arafat).[39] For his part, Arafat faced strong challenges from opposition forces and local political elites within the West Bank and Gaza, and was therefore more than willing to accept those extra security responsibilities and powers of patronage granted him by Israel. At the heart of the Oslo process, in sum, lay a convergence of interests between Yasser Arafat and the Israeli state: these were, as Chomsky puts it, the "Israel-Arafat agreements" (Chomsky 1999: ch. 10).

The consequence of all this was that the Palestinian political system created under, and necessitated by, Oslo was dominated by Arafat's powers of patronage and security services, and, as an inevitable corollary, had weakly developed institutions and rule of law. In Michael Mann's terms, the PA system was "despotically strong" but "administratively weak" (Mann 1993: 59). For Arafat, as well as for Israel, doing Israel's security bidding was more important than building the institutional infrastructure for statehood.

The impact of this pattern of rule on the water sector was as evident as in any other arena of Palestin-

37 *Ha'aretz* (7 September 1993); quoted in Usher (1999): 74.

38 Usher (1996):. 21–34; Danny Rubinstein, 'Protection racket, PA-style', *Ha'aretz* (3 November 1999).

39 R. Bergman, 'Israel deposited NIS 1.5b in Arafat's personal account', *Ha'aretz* (8 October 1999); Amira Hass, 'Chairman Arafat straightens out his financial accounts', *Ha'aretz* (13 January 2000).

ian life. Under Oslo, the Palestinian water sector was characterized by violent local water conflicts, by high levels of water theft, by thriving black markets, by the misallocation of scarce resources, and by further environmental despoliation. In the southern West Bank, in particular, there were regular violent conflicts between Palestinian communities, with local municipalities and village councils competing for scarce water supplies, and with the central Palestinian water authorities being generally unable to control these local authorities and impose the rule of law. Municipalities in control of important wells (Hebron, for instance) would use these as a source of local political leverage, charging exorbitant water prices to surrounding towns and villages. Communities on major supply lines would tap into them illegally, while powerful downpipe communities (of which Hebron is, once again, a shining example) would take matters into their own hands in order to secure their supplies. Individual theft and non-payment were also high. Individuals, sometimes it seems with the connivance of local authorities and security agencies, would steal water from supply lines before delivering it by tanker at exorbitant black market prices. Local supply inequalities would result, with the quality of supply differing wildly from one Palestinian town or village to the next. And in those areas, most notably the Gaza Strip and Jenin district, where groundwater could be readily accessed through shallow wells, unregulated drilling promised the further destruction of aquifers. All of this occurred because the central Palestinian water authorities, and indeed the PA at large, lacked the administrative capacity to govern the Palestinian water sector adequately. And this, in turn, was no less than embedded in the structure of the Oslo process. Palestinian mismanagement of the water sector was in large part the product of a defective peace process that prioritized short-term Israeli security, and that not only permitted but also supported the creation of a corrupt and fragmented Palestinian Authority.[40]

20.5 Conclusions

In autumn 2000, the Oslo process collapsed. Unable to fulfill the security functions for which it had been established, the PA and Arafat were declared "irrelevant", first by Ariel Sharon and later by the Bush administration. Unable to rely upon its client police force in the West Bank and Gaza, Israel has since March 2002 largely destroyed the PA's policing capacity and re-established direct occupation. Israel and the international community now insist that "reform" of the Palestinian Authority must take place before negotiations can recommence. But we should not interpret this as a sudden conversion to the principles of "good governance": the main thing that has changed from the days when Israel was priming Arafat's personal bank account is that the language of reform now suits the Israeli right's interest in delaying the re-start of negotiations.

Until there is a serious commitment to Palestinian good governance from the Israeli state and the Palestinian Authority alike, it is highly unlikely that internal Palestinian water management will improve. Equally, until there is a serious commitment to proper 'joint management', in which powers and responsibilities are meaningfully restructured rather than merely re-presented in the language of 'cooperation', it is highly unlikely that the Palestinian water crisis will be ameliorated. In this author's view it is a mistake, to think that Oslo and its water accords failed because of electoral changes in Israel, or because of some failure to fully implement agreements that were in essence sound. To the contrary, the Oslo accords, and the Oslo II water agreements too, were rotten from the very beginning. The lessons are clear: future final status talks and agreements need to construct a proper joint management regime, as distinct from ongoing Israeli domination; they must not be reached at the expense of precious natural resources; and they must do all that they can to enable Palestinian authorities to create a well-regulated Palestinian water sector. Unless this happens, the mistakes of Oslo are more than likely to be repeated.

40 These issues regarding the internal Palestinian water arena are discussed further in Selby (2003): ch. 7; as well as in: Selby (2003b): 118–134. For a related analysis, see also Trottier (1999).

References

Aliewi, Amjad; Jarrar, Ayman, 2000: *Technical Assessment of the Potentiality of the Herodian Wellfield Against Additional Well Development Programmes*. Report for the Palestinian Water Authority (Ramallah: PWA, April).

Aliewi, Amjad; Jayyousi, Anan, 2000: *The Palestinian Water Resources in the Final Status Negotiations: Technical Framework and Professional Perception*. Report for the PWA (Ramallah: PWA 4, May).

Brynen, Rex, 1996: "International aid to the West Bank and Gaza: a primer", in: *Journal of Palestine Studies*, 25,2: 46–53.

CDM/Morganti, 1998: *Task 18: Study of the Sustainable Yield of the Eastern Aquifer Basin*. Final Report' (Ramallah: PWA.

Chomsky, Noam, 1999: *Fateful Triangle: The United States, Israel and the Palestinians* (London: Pluto).

Elmusa, Sharif, 1997: *Water Conflict: Economics, Politics, Law and the Palestinian-Israeli Water Resources* (Washington DC: Institute for Palestine Studies).

Guttman, Yossi, 1998: *Hydrogeology of the Eastern Aquifer in the Judea Hills and the Jordan Valley*. Report for the German-Israeli-Jordanian-Palestinian Joint Research Program for the Sustainable Utilization of Aquifer Systems (18 January).

IHS, 1998: *The Development, Exploitation and Condition of Groundwater Sources in Israel up to the Fall of* 1997 (Jerusalem: IHS).

Isaac, Jad; Selby, Jan, 1996: "The Palestinian water crisis: status, projections and potential for resolution", in: *Natural Resources Forum*, 20,1: 17–26.

Isaac, Jad; Shuval, Hillel (Eds.), 1994: *Water and Peace in the Middle East* (Amsterdam: Elsevier).

Kronfeld, J.; Vogel, J; Rosenthal, A; 1992: "Natural isotopes and water stratification in the Judea Group aquifer (Judean Desert)", in: *Israel Journal of Earth Sciences*, 39,2: 71–76.

Mann, Michael, 1993: *The Sources of Social Power, Vol. II: The Rise of Classes and Nation-States,* 1760-1914 (Cambridge: Cambridge University Press).

Mazor, Emanuel; Molcho, Magda, 1971: "Geochemical studies on the Feshcha Springs, Dead Sea basin", in: *Journal of Hydrology*, 15,1: 37–47.

Palestinian Hydrology Group, 2000: *Water for Palestine: A Critical Assessment of the European Investment Bank's Lending Strategy in the Rehabilitation of Water Resources in the Southern West Bank*. Report for the Reform the World Bank Campaign (Ramallah: PHG).

Rouyer, Alwyn¸ 2000: *Turning Water into Politics: The Water Issue in the Palestinian-Israeli Conflict* (London: Macmillan).

Scarpa, David, 2004: "Hydropolitics in recent Israeli-Palestinian relations", Paper presented at conference on Hydrology: Science and Practice for the 21st Century, London, July 2004.

Selby, Jan, 2003: *Water, Power and Politics in the Middle East: The Other Israeli-Palestinian Conflict* (London: IB Tauris).

Selby, Jan, 2003a: "Dressing up domination as 'cooperation': the case of Israeli-Palestinian water relations", in: *Review of International Studies*, 29,1: 121–138.

Selby, Jan, 2003b: "Governance and resistance in Palestine: simulations, confrontations, *sumoud*", in: Cochrane, Feargal; Duffy, Rosaleen; Selby, Jan (Eds.): *Global Governance, Conflict and Resistance* (Basingstoke: Palgrave): 118–134.

Shapland, Greg, 1997: *Rivers of Discord: International Water Disputes in the Middle East* (London: Hirst & Co.).

Trottier, Julie, 1999: *Hydropolitics in the West Bank and Gaza* (Jerusalem: PASSIA).

Usher, Graham, 1996: "The politics of internal security: the PA's new intelligence services", in: *Journal of Palestine Studies*, 25,2 (issue): 21–34.

Usher, Graham, 1999: *Dispatches From Palestine: The Rise and Fall of the Oslo Peace Process* (London: Pluto).

World Bank, 2002: *Fifteen Months – Intifada, Closures and Palestinian Economic Crisis – An Assessment*, Final Report (18 March).

21 Violations, Opportunities and Power along the Jordan River: Security Studies Theory Applied to Water Conflict

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> Next the statesman will invent cheap lies, putting the blame upon the nation that is attacked, and every man will be glad of these conscience-soothing falsities, and will diligently study them, and refuse to examine any refutations of them; and thus he will by and by convince himself that the war is just, and will thank God for the better sleep he enjoys after this process of grotesque self-deception.
>
> Mark Twain (2004 [1916]: 228). "History of War", in: Twain, Mark: *The Mysterious Stranger* (New York: Harper & Brothers).

Abstract

This chapter examines the applicability of recent developments in the field of security studies to water conflict issues in the Jordan River basin. Neumann's contribution to the Copenhagen School of security studies, particularly the concept of the 'violization' of politics, is discussed alongside Warner's contribution of the concept of 'opportunitization'. Both concepts incorporation of the insight garnered through consideration of the guiding rationale of the state and non-state actors. It is shown that a combination of these concepts results in an expanded security continuum (non-politicized – politicized – securitzed/ opportunitized – violated) that is directly relevant to the analysis of water conflict issues between Palestine and Israel. Warner identifies the prime concerns, goals and power of actors in different security sectors to develop the concept of 'security sector goals'.

Two case studies from 2002 are considered: the water infrastructure damages in the West Bank and the Wazzani River dispute between Lebanon and Israel. Dynamics revealed by the application of the theory include a split on positions between actors normally considered aligned on one side of a conflict (for example between sub-national level Palestinian water professionals and their national level representatives); the ability of governments to obscure or enhance water conflict issues to suit other unrelated political interests; the varying position that a conflictual issue can take along the security continuum in relation to time and circumstance and, perhaps most notably, the effect of power asymmetries between competing actors active in issues that have become violated.

Keywords: security, conflict, water, violization, opportunitization, Palestine, Israel, Jordan River

21.1 Introduction

The end of the Cold War signaled the beginning of a new way of thinking about state security. This cognitive evolution has matured, has been tested and is now deeply ingrained in the public psyche. It is widely recognized that a weak economy is as dangerous as a military adversary for the stability of a state. Few would question that the protection of identity and the environmental services of water are also important aspects of life that are 'worth fighting for'. In addition, most citizens understand that their state's perceptions and concerns about its security in these sectors is governed in part by its relationships with other states crucial to its foreign policy. These concepts have been clarified and theorized by security studies theory, chiefly by 'the Copenhagen School' of Buzan, Wæver, de Wilde (1998) and others (Neumann 1998; Warner 2000).

The theory helps to explain why the Jordan River basin may be one of the least secure areas in the world and yet is very highly 'securitized'. Insecurity comes about due to the conflict over land between Palestine, Israel and Lebanon. Just as water is an integral part of the land, however, water-related issues form an integral part of the conflict. On the ground in the region an observer can simultaneously witness excessive amounts of rhetoric, wanton destruction of infrastructure, skewed analysis and yet cooperation between the actors in the water sector (Selby 2003; Jagerskög 2003; Allan 2001). A better understanding of these apparent paradoxes requires a deeper look into international relations theory, hydrology, social science, political ecology and, of course, political science. "If we are to increase the solution-space in water management, we'll have to recognize that there is no single actor, no one best way, no single knowledge base that can do the trick" (Warner 2000: 2). The theory of security studies presented in this chapter will help with the trick.

21.2 Security Studies Theory

Forced by global historic events to depart from the traditional 'narrow' military understanding of security, Barry Buzan's theoretical conception of different security 'sectors' effectively captures the wider view of security studies. Each of Buzan's five security sectors – political, military, economic, societal and environmental – can be analyzed at any or all of four levels: international, regional, national and sub-national. The concept of 'security complexes' assists further with the analysis. Defined as "a set of states whose major security perceptions and concerns are so interlinked that their national security problems cannot reasonably be analyzed or resolved apart from one another" (Buzan/Wæver/de Wilde 1998: 12), the concept contributes to explanations of actions and dynamics that occur between interacting states.

Buzan, Wæver and de Wilde (1998) furthermore note that power asymmetries define the parameters of the complex, and they are in constant flux. Changes thus developed can impact on the complex in four manners: *maintenance of the status quo* (the change does not undermine the structure of the complex), *internal transformation* (the change affects relations and asymmetries within the complex), *external transformation* (the change affects relations with states previously outside of the complex), and *overlay* (where an actor external to the complex imposes its own power asymmetries upon the indigenous security dynamic).

The theoretical framework is itself quite complex. As in molecular or anatomical studies, analysis of the dissected elements is relatively easily understood (the eye can be proven to send some form of impulse to a specific part of the brain) but the more important and most difficult task is to understand the whole (why did that impulse not elicit the person to react as expected, and what did she really see, anyway?). After all, "states approach security as aggregate security, not as five different fields" (Buzan/Wæver/de Wilde 1998: 170). Nonetheless, analysis of a single security issue between several actors in a specific sector, at a particular level, within a broader security complex, is a necessary step in the analytical process.

21.2.1 Prime Concerns and Rationales of Security Sectors

At this microscopic, dissected level, specific actors' actions and reactions could be expected to vary according to each actor's constitution (the structure and members forming the actor) and motivation (the force driving the decisions and actions of the actor). A particular actor's *constitution* can be quite diverse, with representation from some combination of the government, civil society or the private sector. Analysis of a heterogenic state behaving as a collective actor is always a complex task (Benvenisti 2002: ch. 3). The American actor in the economic security sector at the international level, for example, would be composed of the U.S. government representatives at the World Trade Organization, domestic production unions, special-interest groups, etc. Given the myriad of possible combinations, generalizations about the make-up and structure of each actor are ineffective. The analysis is best-advanced on a case-by-case basis.

The *motivations* of each actor, on the other hand, are more generally predictable. Within the 'liberal realism' perspective of Buzan, rational actors – if they don't always make rational decisions – at least follow certain rationales to achieve their objectives (and to

Figure 21.1: Buzan's Security Diagram as Enhanced by Warner. **Source:** Warner (2000). Reproduced with permission of the copyright holder.

Security Sector → *Level*	Physical	Political	Economic	Socio-cultural	Environmental
International system					
Macro-region					
Unit (state)					
Sub-system					
Prime Concern	integrity	stability, legitimacy	wealth	identity	health
Rationale	goal	legitimacy, power-base	cost-benefit ratio	social values, habit, instinct	adaptation

ensure their own survival). Warner (2003) incorporates this concept into security studies theory, identifying the *guiding rationale* of individuals and institutions involved in each sector. According to Kant, these fall into the category of either 'goal rationality' (concerned with material values) or 'value rationality' (concerned with processes). Warner further identifies that each sector has a *prime concern* - that is the state of being which, until achieved, means serious security and survival concerns for actors within that sector.

These enhancements to the theory overlayed onto the amended Buzan security diagram (adapted to change the 'military' domain to 'physical' in order to accommodate water and raw material acquisition, and augmented to include each sector's *prime concern*) presents us with an augmented tool of analysis (figure 21.1).

The rationale categorization used in figure 21.1 seems accurate and useful in at least so far as each domain's guiding rationale closely mirrors its prime concern. Recalling that these dynamics occur within an established security complex, the previously-discussed complexity of the model is evident and unavoidable. This complexity is compounded further when one considers the very different *capacities* of each actor to achieve their prime concern, or the power asymmetries and relativities that exist between the actors. The discussion could be taken further yet to examine the *methods* available or used by the actors in each domain. We shall now concentrate on the motivations of the various actors.

Strong actors could be expected to attempt to reach (and to probably achieve) their prime concerns, through various methods. An example of this type of competition is that of a successful businessman franchising out his business while smaller independent businesses close in his wake. Moderately strong actors would be consistently aware of their position, ever on the lookout to improve it. An example in politics is where a political party ruling with a fragile coalition faces an upcoming election. Weak actors, on the other hand, may hold their prime concern only as a goal perhaps never to be attained, and they are forced to deal with the much dirtier daily struggle for their own *survival*. One thinks of those attempting to manage natural resources in the scorched earth circumstances of the West Bank.

21.2.2 Base Values and Aspirations: First, Second and Third Order Goals

Depending on the power asymmetries of the various actors, there can be substantial gaps between the strong actors (seeking to go much further than their 'prime concerns') and the weak actors (desperate to achieve their 'prime concerns'). In theorizing this phenomenon, Warner conceives of the notion of *first- and second-order goals.* With the addition of the higher-yet third-order level, these motivations may come to be known as 'security sector goals', whose characteristics are defined in figure 21.2.

First order goals are essentially the 'prime concerns' themselves and are characterized by the notions of "base values" or "bottom-lines" "which if allowed to fall below may trigger defense-mechanisms" (Warner 2000: 4). The actors who have not been able to achieve this first order goal are forced to deal regularly with real threats to their security. The overriding characteristic governing behavior is *protection*, or the continued attempt to ensure survival. Actors who *have* achieved the first order goal, particularly those who have struggled laboriously for it, would tend to take a conservative approach to maintaining their achievement.

Figure 21.2: Basic Security Sector Goals. **Source**: Warner (2003). Reproduced with permission of the copyright holder.

Security Sector → *GOALS*	**Military**	**Political**	**Economic**	**Societal**	**Environmental**
First-order goal* (*protection*)	physical integrity	political legitimacy	self-sufficiency	identity	integrity
Second-order goal* (*accumulation*)	*lebensraum* (room to grow)	power, influence	wealth, development	fulfillment of potential	sustainability
Third-order goal (*supremacy*)	meta-control	hegemony, domination, independence from international community	super-stability, independence of global treaties	spread of culture, conversion	deep ecology

Second order goals can be considered more beneficial, higher risk achievements. Because a certain amount of risk would normally be required to achieve this higher order, the goals can be considered "rational maximums", or "risk-ceilings" as Warner (2000: 4) puts it. The conditions necessary to achieve this order would be normally available only after a period of careful and calculated maintenance of an actor's position or else following "emblematic events" as identified by political ecology theory (Allan 2001). The dominant characteristic governing behavior at this level is *accumulation*, or the acquisition of resources, allies, tactics, etc. enabling an improvement of or consolidation in position.

Third order goals may be considered "irrational maximums", where an actor attempts to gain distinction. This can be considered beyond risky to cocky, beyond influence to worship. Examples include state empires such as colonial Britain or else megalomaniac media conglomerates set on global dominance and perpetual growth, calling themselves 'empires' in the process. The overriding characteristic governing behavior at this level is *supremacy*, where the goal of preservation of an actor's position is seen to justify the means used against and suffering endured by competing actors.

21.2.3 Threat – Defense and Opportunity – Offense

Warner goes on to state the very important point that "if the baseline value [first-order goal] is violated, a security logic may be invoked" by the actor who is being violated (Warner 2000: 3). That is, the actor is essentially obliged (by virtue of the reaction to the violation by the different constituents that form the actor) to react in some way to the violation, possibly through physical action. This is the *challenge-resistance* (Aradau 2001a) or *threat-defense* (Warner 2000) mechanism identified by the Copenhagen School.

Neumann, a major Copenhagen School exponent, elaborates on this idea arguing that the crucial addition of the "use of force" is a *violation* of politics, leaving little use or room for talk (Neumann 1998). The issue therefore becomes "violized" and a "violation logic" rather than a "security logic" will be invoked for decision-making. Decisions made under a "violation logic" would not be expected to be particularly rational, except perhaps under the wisest of leaders or the most resilient and tested of structures.

Taking this argument further, one would expect that if an actor's position (or goals achieved) are threatened (or perceived to be threatened, but not quite violated), a 'security logic' may be invoked by the actor under threat. This actor may react to counter the threat (or perceived threat) by mobilizing the support and resources required to act. The issue at hand becomes 'securitized' and the dynamic allowing this process of mobilization is known as the speech-act of 'securitization'. An incomplete but accurate idea of securitization can be identified by considering that it "functions as a technique of government which retrieves the ordering force of the fear of violent death by a mythical replay of the variations of the Hobbesian state of nature. It manufactures a sudden rupture in the routinized, everyday life by fabricating an existential threat which provokes experiences of the real possibility of violent death" (Aradau 2001a citing Huysmans 1992). As stated above, this form of 'sabre-rattling' applies not only to war (and violence) but to the other four security sectors of politics, economy (and currency), environment (and health), society (and identity). The concept has been extensively developed by the Copenhagen School and will be referred to again.

While the term 'securitization' may not be known by most politicians, their understanding of its concepts is exemplified by their experience with its language. Indeed, its familiarity is such that some are sounding warning notes: "do we really want security to become, as Waever eloquently puts it, 'a synonym for everything that is politically good or desirable?'[then] the processes of politicization and securitization suddenly become rather complicated due to the fact that the two processes cannot be distinguished on the grounds of distinctive features" (Ostraukaite 2001).

This blurring between politicization and securitization is highlighted by examining another phenomenon: namely the similarities in the dynamics involved in defending security or capitalizing on opportunities. Referring back to figure 21.2, it can be shown that if there is an opportunity for an actor to achieve a higher order goal, an 'opportunity logic' may be invoked by the actor presented with the opportunity. An example of this is an expansionist state implementing a land grab while the otherwise-restricting international community is focused on more dramatic events elsewhere. If the opportunity is presented through negotiation or seized through various power asymmetries (coercion, deception, etc.), the issue "may be promoted with the same sense of urgency as a security issue would" (Warner, 2004: 12) and could be considered 'opportunitized' (in Warner's opinion, shared by this author – a term unfortunately as inelegant as 'securitized'). Opportunitized can thus be considered the flip-side of securitized and instead of a *threat-defense* mechanism, an *opportunity-offense* mechanism would be at work. Correspondingly, an 'opportunity logic' would be invoked for decision-making, most likely coupled with the use of a tired metaphor. Rather than the defensive security logic of 'we're under attack' or 'they walk amongst us!', offense-speak would be heard: 'let's strike while the iron is hot' and 'we may never be presented with such circumstances again, let's do it now!'

21.3 Integrating 'Violated' and 'Opportunitized'

The concepts can be applied to a very useful conceptual continuum developed by Buzan, Wæver and de Wilde (1998). The continuum applies universally and in particular to issues of conflict encountered in the politics of dynamic societies:

non-politicized → politicized → securitized

A *non-politicized* issue is defined as 'the state does not deal with [the issue] and it is not in any other way made an issue of public debate and decision' (it is a non-issue to the actors involved). *Politicized* means that 'the issue is part of public policy, requiring government decision and resource allocation'. *Securitized* is used when "the issue is an existential threat requiring emergency measures and justifying actions outside the normal bounds of political procedure" Buzan et al. (1998: 23).

Neumann, as mentioned previously, takes note of the different dynamics and reactions which occur when a conflictual issue actually goes beyond the sphere of talk and rhetoric to 'war'. At the point where violence is used, politics becomes violated and the issue itself becomes "violized" (Neumann 1998: 8). The implications are significant, particularly in the Jordan River Basin. For example, Palestinian scientists and managers attempting to manage Palestinian water resources under Israeli dominance, prior to the 2002 re-occupation of the West Bank, were desperately trying to achieve their first order goal of sovereignty over the resource, or 'integrity'. Subsequently faced with a complete military occupation of their land, the destruction of much water infrastructure and inability to leave their homes due to curfews or roadblocks, their will for cooperation that existed prior to the act of war and the corresponding trust built with their Israeli counterparts had been violated.

This builds directly on Clausewitz's famous phrase of 'war being the continuation of politics by other means'. While the distinction is valid and accepted following its real world testing, some fine-tuning of the definition is suggested. Is it only 'the use of force' that characterizes violation? Neumann gives the example of one group denying recognition of its constitutive stories: the group denied has three choices – to accept the stories told about it by the other, to abandon their own stories, or to maintain their stories and even force their stories upon the other. This last choice involves *action*. He invokes Ringmar (1996) on reasons a state may "go to war" in order to gain some particular recognition – one reason is due to "a series of occasions under which recognition was denied under humiliating conditions ... the group suffered and the failure of recognition was indeed experienced as a loss of dignity, worth and 'face'" (Neumann 1998: 6). One could imagine the humiliated group acting in various other manners were it unwise for them to 'go to war' (as is the case for the Palestinian water managers, whose political representation lacks both the political support and military might to declare war on Israel and who are thus consigned to death with their Israeli counterparts though complaints, pleading or silence). This touches upon the concept of state *identity*, which may be composed of corporate and social components that affect a state's interests in debatable but very real ways (Aalto 2000). Hourani (1991) pulls together these concepts of identity, violation and humiliation, within the previously-mentioned asymmetric power relations that shape events in Buzan's security complexes to note that the effects are not always apparent to the more powerful actor: "Defeat goes deeper into the human soul than victory. To be in someone else's power is a conscious experience which induces doubts about the ordering of the universe, while those who have power can forget it, or can assume that it is part of the natural order of things and invent or adopt ideas which justify their possession of it" (Hourani 1991: 300).

Considering these subtleties, a violation of politics could be a result of something between 'the use of force' (violent conflict) and 'talk' (politics); it is suggested that 'confrontational action' be taken as the defining limit of violization; action rather than just words. Politics and politicized issues can be violated by confrontational action. 'Action' can here include war, forced disarmament, political assassinations, occupation, destruction of infrastructure and other actions. It does not by definition necessarily include death, but it does include some form of humiliation, trauma or other outcome eliciting a reaction from the receiver of the action.

Tighter boundaries can thus be given to each of the components of the continuum, which then extended becomes:

non-politicized → politicized → securitized → violized

We see that the definition of violized ('violated' preferred) thus depends partly upon the reactions and logic of the dominant decision-makers amongst the actors on the issue. Will their reaction be mute, or violent? This is close in spirit and concept to the consideration of the rationale and first, second and third order goals of actors within the security sectors as discussed above. The corresponding concepts of 'opportunitized' and the 'opportunity-logic' also beg to be included in the continuum. Recalling that in terms of dynamics and motivations it is the flip-side of the securitization logic, opportunitized can be coupled with it on the continuum, which then becomes:

non-politicized → politicized → securitized/ opportunitized → violated

Every conflictual issue of concern, particularly in terms of any of Buzan's five security sectors at four different levels, will be located somewhere along this continuum. The exact location would be expected to change in response to changing internal and external pressures and circumstance, ultimately modifying the security complex in whose space they are taking place. Once categorized, the actors involved in the issue could be expected to deploy a corresponding logic, yielding perhaps corresponding and somewhat predictable outcomes. Figure 21.3 is an attempt to define and exemplify the terms of the expanded continuum.

21.4 Water and Security in the Jordan River Basin

The Jordan River Basin contains the Palestinian territory of the West Bank bordering Israel and Jordan which in turn have Syria and Lebanon as neighboring riparians. In this highly-charged political and military environment, stunted economies and a ravaged ecological environment, ideologies flow much more readily than water. While the root of the Palestinian-Israeli conflict is control over the land, issues surrounding water-sharing form an integral part of the conflict. The concepts and analytical frameworks identified in the preceding discussion can be deployed to analyze the dynamics involved in this conflict.

The issue of water-sharing between Palestinian and Israeli actors touches upon all of Buzan's security sectors directly, perhaps surprisingly less so in the environmental sector than the others. From a military perspective, water could be (or has been) used as a weapon (through contamination), while access to the scarce resource places it squarely in the economic sector. The relationship of water and the land to both the harmonious traditional Palestinian use of the land as well as in the founding elements of Zionist ideology sets it firmly in the political (in terms of potential political gain) and societal sectors (especially in terms of pride and identity). A level of complexity higher than most analysts would care for is thus unavoidable. To complicate the issue further, and depending on the particular issue under analysis, there are usually at least two actors from each side involved in each of the five sectors.

The power asymmetries that exist within the current security complex are extreme. Israel, the regional hegemon, enjoys superpower political support, powerful armed forces and a broad-based and dynamic

Figure 21.3: Definitions of the Adapted Security Studies Framework of 'Politicization' and 'Securitization'.

Security Continuum	*Definition*	*Example*
Non-politicized ↑ ↓	"The state does not deal with [the issue] and it is not in any other way made an issue of public debate and decision" (Buzan et al., 1998: 23). A "non-issue".	Illegal immigrants finding a 'silent' labor market (SE Asian clam-pickers in the UK 2004 (prior to the tragic drowning of 15 workers).
Politicized ↑ ↓	"The issue is part of public policy, requiring government decision and resource allocation (Buzan et al., 1998: 23)	Organized crime, traffic congestion, international relations with friendly neighbors
Securitized /	"The issue is an existential threat requiring emergency measures and justifying actions outside the normal bounds of political procedure" (Buzan et al., 1998: 23)	Carbon dioxide emissions, imperalism, 'terrrorism', weapons of mass destruction, expansionism.
Opportunitized ↑ ↓	The issue offers such an opportunity to improve a situation that it justifies risks and actions outside the normal bounds of political procedure (Warner 2000: 12)	Off-shore oil deposits leading to a unilateral expansion of a state's perimeter; foreign policy alignment with U.S. to reap political rewards (Spain, UK for war on Iraq).
Violated	The issue has escalated in intensity to the point that 'confrontational action' is employed and the normal conventions of politics are violated (adapted from Neumann 1998: 3)	Land-grabs while international attention is diverted (Israel's Separation Barrier); opposition leaders being arrested under government-declared state of emergency (Aung San Suu Kyi).

economy. The partially formed, occupied state of Palestine enjoys little effective political support, has no armed military and has an economy that is either completely contained by, or a client to, Israel's (Khan 2004). The relative influence of Jordan, Lebanon and Syria fall somewhere between these extremes. The driving rationales behind each state's actions, furthermore, are just as varied.

The great variety in the way that the actors involved can spin or conceal the nature of water conflict issues means that the issue can fall at many different points on the adapted security continuum. A few examples at this point suffice to confirm the argument.

21.5 Case Study 1: Damages to the West Bank Water Infrastructure

Repeated Israel Defense Forces (IDF) incursions into the West Bank in early 2002 culminated in the effective ongoing military occupation. The worst of the tank-and-bulldozer activity has thus far damaged an estimated US $ 73 million worth of water infrastructure and US $ 71 million of wastewater infrastructure (IMG 2004). For example, consider the water departments of the municipalities of the typical West Bank cities (Bethlehem, Nablus, Hebron or Jenin). Having had one or two of its main transmission lines cut by the IDF military activity, one quarter of its customers were without any piped water for several weeks (World Bank 2002; EWOC 2002). The head engineer of the water department or the mayor of the city would consider the issue beyond securitized - that is to say 'violated'. They would find themselves at odds with the Palestinian Authority and the Palestinian Water Authority on how to deal with the situation. These latter actors may not want to jeopardize the actual cooperation they undertake with their Israeli counterparts, and preserve the subordinate as it may be relationship that they have. The Palestinian Authority would thus attempt to keep the issue simply politicized or, preferably, non-politicized, unless there were some political gain to be gathered from it, perhaps in the arena of negotiations (in which case the issue would become quickly securitized). In contrast, the IDF, having accomplished its mission, would find the issue non-politicized, a position that the Government of Israel (GOI) may also seek, in order to avoid creating domestic dissent. Figure 21.4 attempts to represent a summary of the case.

The competing interests and power assymetries that exist within the security complex result in a situation whereby the destruction that occurred can be of no importance (a 'non-issue') to one actor (the IDF) but of the utmost importance to another (in terms of pride or financial loss, for example to the municipality).

Figure 21.4: Security Study Theory Applied to Case Study 1.

Issue: 'Destruction of municipal water infrastructure by Israeli military activity'				
Actors →	Palestinian Goals		Israeli Goals	
Security Sector	Palestinian Municipality	PWA/PA	IDF	GOI
Military	survival (<1)	n/a	victory (3)	dominance (3)
Environmental	sustainable resource (<1)	sustainable resource (<1)	n/a	n/a
Political	sovereignty (<1)	sovereignty (<1)	n/a	hegemony (3)
Economical	cost recovery (<1)	n/a	n/a	n/a
Socio-cultural	pride (<1)	pride (<1)	n/a	n/a
Postition on Security Continuum	violated	non-politicized	non-politicized	securitized

Security Sector Goals achieved: less than first (<1), first order (1), second order (2), third order (3).
PWA = Palestinian Water Authority; PA = Palestinian Authority; IDF = Israel Defense Forces; GOI = Government of Israel.

Notwithstanding the absence of other actors involved in the case study (Israeli water-professionals, Palestinian NGOs, Israeli academics), the analysis provided by figure 21.4 reveals at least two other interesting dynamics. *Firstly*, a difference in stances is revealed between different actors from the same 'side'. The Palestinian municipality may feel as much violated by the silence of the PA as from the actions of the IDF, perhaps even more so as an element of trust is also violated. Future relations between the two Palestinian actors could be expected to be volatile, irrational and compromising to any future negotiations between them. Similarly, the IDF has much less concern about the effects of its actions than does the GOI, which is directly dealing with other players within the regional security complex, as well as at the international level. The GOI is therefore forced to regulate IDF behavior and be directly involved with the establishment of the 'rules of engagement', itself a potential source of sub-conflict.

Secondly, figure 21.4 reveals significant difference in the level of the 'security sector goal' achieved or aspired to by the different actors. Both of the Palestinian actors have not achieved their first order goals (<1) while the Israeli actors have achieved the highest order goal (3) in each relevant sector. The GOI in particular, as a regional hegemon, has every interest to ensure that the IDF's actions, which are taking place within the security complex contribute only to the maintenance or improvement of the *status quo* of the complex, and to avoid any internal transformation of it. This follows Buzan, Wæver and de Wilde's description of the dynamics that exist within security complexes, as previously discussed. The resultant attitudes, decision-making logics and reactions on the Palestinian side (desperation, irrationality, resentment, submission) and on the Israeli side (dismissal of the issue, denial) are entirely predictable. It is a classic case of strongly-established hegemony, but that is another story.

21.6 Case Study 2: The Wazzani River Dispute

The short-lived but very vocal near-war between Israel and Lebanon in autumn 2002 over a water development project on the Wazzani tributary of the Hasbani River is another case in point. Having recently gained access to the land which had been occupied for over 20 years by the Government of Israel (GOI), the Governement of Lebanon (GOL) and international donors invested in a small scale drinking water delivery project on the Wazzani River. The Wazzani empties within Lebanon into the Hasbani River which crosses the border into Israel to form one of the main sources of the Jordan River. .

Prior to the resolution of the dispute, Israeli and Lebanese politicians and their media quickly had their constituents and clients in a state of confrontational fervor (IMFA 2002; Ha'artez 2002; New York Times 2002), with the Israeli people feeling their source of life was threatened and the Lebanese people fearing for their actual lives from the 'unavoidable' Israeli air strikes. In practice the volume of water in question

Figure 21.5: Security Study Theory Applied to Case Study 2.

'Water-Development Project on the Wazzani River'		
Actors → Security Sector	Government of Lebanon Goals	Government of Israel Goals
Military	physical integrity (1)	dominance (3)
Environmental	*n/a*	sustainability (<2)
Political	sovereignty (1)	hegemony (3)
Economical	development (1)	development (2)
Socio-cultural	pride (1)	pride, identity (2)
Postition on Security Continuum	from **Non-politicized → Securitized**	from **Politicized → Non-politicized**

Security Sector Goals achieved: less than first (<1), first order (1), second order (2), third order (3).

(3.5–8.5 million cubic meters per year) posed no threat to Israel nor presented a great opportunity to Lebanon, and had much more to do with the highly charged political atmosphere where any actors' unilateral actions are scrutinized by the neighbors (Luft 2002). Upon the peaceful arbitration (but not resolution) of the dispute through U.S., UN and EU intervention, the politicians and the media in Lebanon spoke of victory. Their counterparts in Israel kept silent so that the Israeli public remains largely unaware of the dispute's resolution. Figure 21.5 presents a summary of the issue.

Figure 21.5 reveals three interesting dynamics. *Firstly*, that the competing actors have the same goals in certain security sectors. For example, both actors covet the river partly in order to develop their economic situation, and both feel the denial of the right to exploit the resource in the socio-cultural terms of pride and identity. Where common goals exist, solutions to conflict can usually be found. Were this commonality somehow to spread to the other security domains and the resultant aggregate approach to security even partly the same to warring governments, political resolution of the conflict would be theoretically achievable. This would be a case exemplifying how a conflict over water resources positively affects the broader political conflict. The fact that it has not occurred says a great deal about the limited influence that the issue of water typically has compared to 'higher-politics' issues such as sovereignty, the status of Jerusalem and the return of the 1948 refugees (Jagerskög 2003; Lowi 1993).

Secondly, the figure reveals the asymmetric influence over public opinion between politicians and the mass media on one hand and that of political scientists or water professionals on the other. Israeli analysts' accurate and sober analyses of the GOI's use of the water issue to conceal other concerns (water management inefficiencies or else principles of unilateral action (Newman 2002; Zisser 2002)), for example, had much less effect on public opinion than the more sensational and more prevalent radio, television and newspaper attention paid to the subject.

Thirdly, figure 21.5 reveals how the location of the issue can vary on the 'security continuum'. The Wazzani water development issue on the Israeli side spanned the security continuum from politicized → securitized → non-politicized. On the Lebanese side it spanned from non-politicized politicized → securitized politicized. The respective footprints of the Government of Lebanon and the Government of Israel are presented graphically in figure 21.6.

Notwithstanding the absence of lesser actors involved in the case study (Israeli and Lebanese water professionals, academics, NGOs, etc.), the importance of figure 21.6 is that it shows that an issue can vary with time and circumstance. It is no coincidence that the level of public concern on both sides directly reflected the intensification of the issue as seen by the respective governments; indeed, that was their goal. The intensification was required in order for their people to allow their governments the mobilization required to act outside of the normal uneasy relationship between the countries, or else to conceal other issues. According to security studies theory, both governments have an interest to present "an argument with a particular rhetorical and semiotic structure [to] achieve sufficient effect to make an audience tolerate violations of rules that would otherwise have to be obeyed" (Buzan/Wæver/de Wilde 1998: 25). The theory of the dynamic applied to the sharing of transnational resources is best put by Benvenisti: "Often gov-

Figure 21.6: Issue: WaterDevelopment Project on Wazzani River as Seen from the Governments of Lebanon and Israel, 2002.

resolution of dispute (→ November)

	August	September	October	November
GOL	Non-politicized →	Politicized →	Securitized →	Politicized
GOI	Politicized →	Securitized →		Non-politicized

GOL = Government of Lebanon; GOI = Government of Israel

ernments find it opportune to respond to their domestic public's demand for a larger share, not by allocating less to the powerful small groups [within their own societies] but by presenting a tougher stance on the international scene, thereby mobilizing public opinion against the neighboring states" (Benvenisti 2002: 51).

An unfortunate but noteworthy aside to this case is the fate of the project following the Israeli-Hizbollah war in summer 2006. As with the previous case of extensive destruction of Palestinian water infrastructure, the Wazzani project – like water infrastructure throughout southern Lebanon - was heavily targetted by IDF forces. The partial destruction of the project includes damages to the hydraulic rams, booster station, reservoirs and associated treatment plant. The guiding rationale and intent of the Israeli side can only be guessed at at this stage, but merits further investigation.

21.7 Conclusion

While thorough analysis of water conflict issues in the Jordan River basin necessitates a full range of interdisciplinary theory, this chapter has shown that security studies theory can provide useful insights. Using Buzan's security diagram as a foundation, Neumann's concept of violization and Warner's concept of opportunitization have been integrated. The expanded 'security continuum' has been linked with the concept of 'security sector goals', and tested on two conflictual water issues in the Jordan River Basin. The application has revealed the complexity of the issues, highlighting the very real split on positions between players normally considered aligned on one side of a conflict; the limited potential of common goals shared by competing actors; the variability of a position of an issue along the 'security continuum' as a function of time and circumstance and, perhaps most notably, the effect of power asymmetries between competing actors.

This piece of analysis, however, falls short of revealing the whole story. The limits of these analytical tools are evident in that they do little to explain the rationale of different actors or the prediction of their behavior. Nor do they consider the methods available to or used by different actors to achieve their goals. Security studies theory does quite naturally lead, however, to other theoretical frameworks that can make analysis complete, and these should be pursued. One thinks immediately of the lead-in to cultural theory, international relations and actor-network theory for further insights into the dynamics of the players involved. Risk theory is a more scientific approach to the concept of security study goals; political ecology can bring the abstract security world back to the natural one. Mass communications theories will shed light on the most efficient use of 'speech-acts', while within security studies itself, there is a lot to be gained by the application of the concepts of de-violization and de-opportunitization. These topics remain to be explored with vigor while the conflicts on the ground continue.

References

Aalto, P., 2000: "The Saviour and Other Europes – Identity, Interests and Geopolitical Images of Europe in Estonia", Paper given at the ISA 2000 conference, Los Angeles, 14–18 March, 2000; see at: <http:www.isanet.org/archive/aalto.doc>.

Allan, J.A., 2001: *The Middle East Water Question – Hydropolitics and the Global Economy* (London: I.B. Taurus).

Aradau, C., 2001a: "Beyond Good and Evil: Ethics and Securitization/Desecuritization Techniques", in: *Rubikon E-Journal*, December 2001; at: <http://venus.ci.uw. edu. pl/~rubikon/forum/claudia2.htm02/02/2004.

Aradau, C., 2001b: "Migration: The Spiral of (In)Security", in: *Rubikon E-Journal*, March 2001; at: <http://venus.ci.uw.edu.pl/~rubikon/forum/claudia1.htm02/02/ 2004>.

Benvenisti, E., 2002: *Sharing Transboundary Resources – International Law and Optimal Resource Use* (Cambridge, UK: , Cambridge University Press).

Buzan, B.; Waever, O.; de Wilde, J. 1998: *Security – A New Framework for Analysis* (London: Lynne Rienner).

EWOC, 2002: *Water and Wastewater Situation in the West Bank Governorates During and Following the IDF Reoccupation March, April 2002 – Draft Interim Report* (Jerusalem: Emergency Water Operations Center (UNDP, USAID, Oxfam), June).

Ha'aretz, 2002: "Sharon Warns Against Diversion of Water Sources in Lebanon", in: Ha'aretz Newspapter, 11 September.

Hourani, A., 1991: *A History of the Arab Peoples* (New York: Warner Books).

IMFA, 2002: "Cabinet Communique – 13 October, 2002" (Jerusalem: Israeli Ministry of Foreign Affairs Cabinet Secretariat communique, 13 October).

IMG, 2004: *IMG Damage Assessment and Reconstruction Management in the West Bank and Gaza Strip Database*. International Management Group, European Commission Representative Office in the West Bank and Gaza Strip, at: <http://www.ecwbg.info/first.asp>.

Jäkerskog, A., 2003: *Why States Cooperate Over Shared Water: The Water Negotiations in the Jordan River Basin* (Linkoping: , Linkoping University).

Khan, Mushtaq (2004) "Evaluating the emerging Palestinian state: 'Good governance' versus 'transformation potential'", in: Khan, M.,: *State Formation in Palestine: Viability and governance during a social transformation*. (London: RoutledgeCurzon).

Lowi, M., 1993: *Water and Power – The Politics of a Scarce Resource in the Jordan River Basin*, (Cambridge, MA: Cambridge University Press).

Luft, G., 2002: "The Wazzani River Dipute: More Tension Along the Israel-Lebanon Border", in: *Peace Watch*, No. 397, 20 September, at: <http://www.washingtoninstitute.org/watch/peacewatch/peacewatch2002/397.htm>.

Mason, S.; Bichsel, C.: Hagmann, T., 2003: "Trickling-Down or Spilling-Over?" Exploring the links between international and sub-national water conflicts in the Eastern Nile and Syr Daria Basins", Paper presented at the ECPR Joint Sessions of Workshops Edinburgh, Workshop 9: "Geography, Conflict and Cooperation", 28 March–2 April.

Medzini, A., 2001: *The River Jordan: Frontiers and Water* (London: School of Oriental and African Studies).

Neumann, Iver B., 1998: "Identity and the Outbreak of War: or Why the Copenhagen School of Security Studies Should Include the Idea of 'Violisation' in its Framework of Analysis", in: *International Journal of Peace Studies*, 3, 1 (January): 1–10.

Newman, D., 2002: "The Wazzani and Our Water Problem", in: *The Jerusalem Post*, 18 September.

New York Times, 2002: "In Israel and Lebanon, Talk of War Over Water", in: *New York Times*, 10 October.

Ostrauskaite, R., 2001: "Environmental Security as an Ambiguous Symbol: Can We Securitize the Environment", in: *Rubikon E-Journal*, December; at: <http://venus.ci.uw.edu.pl/~rubikon/forum/rasa2.htm 02/02/2004>.

Ringmar, Erik, 1996: *Interest and Action: A Cultural Explanation of Sweden's Involvement in the Thirty Years' War* (Cambridge: Cambridge University Press).

Selby, J., 2003: *Water, Power and Politics in the Middle East – The Other Israeli-Palestinian Conflict*, (London: I.B. Taurus),

Sherman, M., 1999: *The Politics of Water in the Middle East – An Israeli Perspective on the Hydro-Political Aspects of the Conflict* (London: Macmillan).

Warner, J., 2003: *Images of Water Security: a More Integrated Perspective* (Middlesex University, Flood Hazard Research Centre).

Warner, J., 2000: "Plugging the GAP – Working with Buzan: the Ilisu Dam as a Security Issue", Paper presented at McGill University, Montreal, Canada, April.

World Bank, 2003: 27 *Months of Intifada, Closures and Palestinian Economic Crisis* (Washington, D.C.: World Bank, May).

Zisser, E., 2002: "Israel and Lebanon: The Battle for the Wazzani", in: Heller, M. (Ed.): *Tel Aviv Notes – An Update on Political and Strategic Developments in the Middle East*, No. 50 (Tel Aviv University, Moshe Dayan Center for Middle Easter and African Studies, Jafee Center for Strategic Studies, October); at: <www.tau.ac.il./jcss/>.

22 U.S. Sponsored Conflict Resolution Through Cooperation in the Water Sector

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Abstract

This chapter examines U.S.-sponsored water dispute prevention and resolution programs on water issues between Palestinians and Israelis. The intent of these efforts has been to facilitate the development of water infrastructure, including water and wastewater systems in the Palestinian Authority and Israel. The report is based on reviews of project statements and ex-post interviews with program participants. The chapter describes some of the goals of program organizers and discusses whether those goals were and continue to be met. The chapter focuses on programs' effect on conflict prevention and resolution as well as the results on the water and wastewater industry. Program participants were interviewed to establish their goals for each program in which they were involved, both prior to its commencement and how or why these goals may have adjusted as a result of their experience. These results are used to form recommendations for trilateral efforts between the U.S., the Palestinian Authority and Israel.

Keywords: Conflict resolution, technical programs, Texas, water cooperation

22.1 Introduction

Of all of the issues between Palestinians and Israelis, access to fresh water for drinking and agriculture is one of the most visible to the people involved. Water is one element necessary to survive, and concerns are often voiced about 'water security' or the fair allocation of scarce water resources in that arid region. However, water is also one issue in negotiations that has the potential for a solution amenable to all involved. It also provides opportunities for citizens on both sides of the conflict to work together to make their fellow citizen's lives noticeably better through

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technical activities. The former Water Minister of Jordan pointed out that,

> ...water is needed to keep the talks alive and to have them bear fruit. Alternatively, water is capable of inflicting damage and destruction when floods are not controlled. In other words, by its very nature and occurrence water can promote fruitful cooperation, or may trigger and accelerate destructive conflicts (Munther 1992).

A senior official at the U.S. Department of State also stressed that water cooperation projects should be supported since this is one of the few areas where Palestinians and Israelis can still work together. He stated that water cooperation discussions could also bridge into other negotiations in other industries.

Politicians and policy experts are often perceived as the sole parties involved in solving political disputes. However, scientists, by the nature of their occupation, can advance international conflict resolution. Because science is an international field – scientists need the support and critique of scientists from the international scientific community in order to gain credibility in their fields – it is natural for scientists to play a role in resolving international disputes. Alexander Keynan points out that, "the permanent intellectual communication framework used by scientists for mutual cooperation within science can also be useful for contact and cooperation between scientists on other matters across lines of conflict" (de Cerreno/Keynan 1998). In addition, scientists share a culture which can be utilized in promoting understanding between citizens of conflicting nations. They share a common language and a belief in a universal and objective reality of physical, geological, chemical or biological systems.

Water is a very visible issue to those who use it every day. In Gaza, for example, where the water table has sunk and the water is increasingly saline, many people have preventable illnesses that are related to poor water quality (interview with a Palestinian geographer in 2004). These health issues, which are tied to the political conflict, can be approached in a multitude of ways. For example, at The University of Texas at Austin a number of programs have sought to bring people together by addressing water as an issue of importance to all involved parties, no matter what side of the border they live on. People who have worked with so-called back-channel programs often believe that by bringing people together in any capacity, building blocks for peaceful, stable societies can be created, using micro-diplomacy to promote peace.

This chapter takes past academic, technical and political programs into account, focusing on academic and technical programs, especially at The University of Texas at Austin. The design, implementation and evaluation of such programs involve sensitive structural issues. This study focuses on vetting some of the past initiatives based on over fifty interviews. It is possible to identify successful aspects of programs that will be useful for future water infrastructure and conflict resolution modules.

22.2 Method Based on Interviews

Research is extremely sparse on the efficacy of using technical programs for conflict resolution. With the exception of a few publications, the subject is rarely addressed in academic publications. Therefore, much of this research is based on conversations with people who have organized and participated in technical programs in the past. This study is weighted toward an analysis of technical programs that have been held at The University of Texas at Austin, since we did have access to participants in these programs. Interviews were also conducted with program organizers at the U.S. Department of State, the U.S. Bureau of Reclamation, the Environmental Protection Agency, and various non-governmental agencies in Washington, DC and in the Middle East. Names of people who were interviewed have not been included without their explicit permission. The few academic works that do exist were used.

22.3 Results and Discussion

22.3.1 Types of Cooperation Programs

There are several types of joint Palestinian-Israeli water programs – political, academic, and technical – that address conflict resolution in the Middle East. Each type has its own characteristics and sets of expectations.

The most visible and the least frequent kinds of programs are *political*. Ministers or other political figures attend these political programs. Activities focus on finding a political solution to water problems between Israelis and Palestinians. Participants usually deal directly with the issues that need to be resolved. Participants might partake in a role-playing exercise in which they are asked to play the role of the opposing side when discussing a contentious issue and then discuss the current situation, trying to arrive at a mutually agreeable solution. Exercises like this are meant to open participants' minds to the point of view of the other side. These programs usually attempt to move negotiations forward through direct changes to Israeli and Palestinian governmental policies. Political programs have both strong support and opposition.

Political programs have the advantage of dealing with the water situation in the manner it must eventually be addressed – through political discussion. Political programs have the advantage of providing an example of how negotiations *could be* conducted by the official negotiators. However, negotiators attending privately funded programs are generally unable to perform official negotiations because governments prefer that negotiations be conducted in more formal settings.

The risk of dissonance between what could occur and what can be accomplished can lead to disappointment, because participants might wish to negotiate concrete policy solutions. For example, Yoav Kislev, a professor at the Hebrew University, felt that one Texas program in which he was involved did not advance the solution to the problem because the program failed to come to an agreement on concrete policies for either side. One intangible benefit of political programs, regardless of the policy outcome, is that they may allow participants to develop relationships among people from all sides of the conflict. Although this may seem like a small thing, it is of vital importance when the parties sit down to negotiations. If negotiators already know one another and recognize their partners' desire to see an end to the conflict, it may be easier for negotiators on both sides to come to agreements that are beneficial for all parties concerned either at the time or in future negotiations. Prior to the Oslo accords, an informal Palestinian-Israeli academic community was established which facilitated later negotiations (Shoham 1998: 211). Efforts in micro-level diplomacy, such as having non-politicians partake in conflict resolution exercises, can help in establishing mutual respect.

Academic programs are attended by academics or researchers. In general, the aim of these programs is to produce joint research done by both Palestinians and Israelis. Papers produced by such programs are meant to be used by negotiators in discussions about the water situation. With research done by both Palestinians and Israelis, the hope is that negotiators will have a firm starting point from which to broker a deal, rather than having to argue about scientific aspects of the situation. Academic programs are somewhat easier to organize because persons involved in teaching and research tend to pride themselves on not being involved in politics. For example, some of the academics involved in one University of Texas program stated that politics does not affect them and that what they study is too important to be tied up with the conflict between Israel and the Palestinian Authority.[2]

In general, academics who are involved in these types of programs are open to discuss a variety of solutions to the water situation, because they openly recognize the technical restrictions placed on both parties by the struggle over water rights, wastewater treatment, and pollution. Many academic programs produce a concrete product, usually an evaluation of the water situation on recommendations for managing water resources. Such a research product may be useful to political actors when attempting to negotiate water issues. By providing an analysis agreed upon by professionals from opposing sides, academic papers may assist negotiators in arriving at a feasible solution. Forming relationships between researchers on all sides of the conflict, academic programs may also lead to future cooperation between universities or other institutions. For example, one Israeli professor has organized events in which his Palestinian counterparts come to his university for symposia. On the other hand, academics rarely wield any political power or direct influence in their countries. In Israel, for instance, as in many other countries, there is a clear divide between academia and government. In the Palestinian Authority academics can sometimes participate in an advisory or official role in government.

The third type of program can be referred to as a *technical program*. These programs are attended by professionals who work in the field of water and wastewater. Participants can include engineers, plant managers, program managers, or anyone else who works directly in water and wastewater provision. Technical programs may be billed as training programs, the aim of which is to enhance the technical capabilities of water professionals. The technical programs can include elements that address cooperation between or among multiple parties. An additional aim of these programs is, of course, to build relationships between people who must cooperate on a day-to-day basis or to allow parties to work together who are separated by political boundaries. Outcomes of these

2 Levy, N. (2004) Interview, *Israeli Ministry of the Environment* and Yaqubi, A. (2004). Interview, *Palestinian Water Authority.*

programs are usually less tangible, since they are capacity-building programs. As with any program, the ultimate goal is cooperation between Israelis and Palestinians. However, even if this goal is not achieved, technical training programs contribute to the capabilities of water professionals in both countries. Technical programs, particularly those involving younger participants, are unlikely to yield concrete results in the immediate future. Instead, they are an investment in the future of both countries and in the future of the peace process. As a water specialist at the U.S. State Department (2004) commented, "you can't teach ministers", meaning that once people are high up in government, their attitudes and biases may be set. By working with people who do not yet have political power, future political players may become more open to cooperation and reconciliation with the political opposition. Technical programs also have the advantage of being non-political, allowing participants to assume an objective, somewhat removed position from the political situation and focus on water provision rather than on the politics of water provision.

22.3.2 Middle East Regional Cooperation (MERC)

Robert B. Abel (1997) constructed an analysis of the Middle East Regional Cooperation (MERC) Marine Program, a program designed to "solve the water program by an altogether different means". Abel and other creators of the MERC program found that few politicians dealt with water issues in the Middle East before the mid-1990s and understood the importance of working toward a solution regarding this precious natural resource.

The MERC program was different from other technological programs that broached conflict resolution issues, in that it was directly instituted and funded by the U.S. Congress, as opposed to non-governmental or international service organizations. The MERC program also differed from previous programs because of its innovative methods of integrating technological cooperation project initiatives and conflict resolution topics in the water sector. Due to the lack of precedence, Abel (1997) and his associates were able to construct a program individualized to their goals and make adjustments as needed. One of their goals was to involve both professionals willing to participate in conflict resolution exercises and younger scientists and academics in the project, so as to invest in the future of water cooperation in the Middle East. This approach has also been adopted by The University of Texas at Austin in its planning for a technical program in January 2005.

The United States contingent's role in the MERC program was instrumental in its construction and initial implementation. However, the program was designed to have the U.S.'s role diminish over time, so as to allow the local professionals a certain level of autonomy and build independence into the program. In congruence with the commitment to have the U.S. disengage as the program flourished, the creators were hesitant to allow other states to become involved, even though there was a high degree of interest from other governments in the region to be involved (Abel 1997).

After the initial success of the MERC program, the designers of the program offered several future aims to take into consideration. They argued that outside groups that were not participants in the original program should be involved, so as to spread the idea of integrating innovative industry findings with political cooperation in a volatile region. This cooperation can only be maintained by scientists working with counterparts on the other side, visiting their peers across borders and creating bilateral plans to stabilize the water sector in the Middle East. If these industry findings could be translated into economic and cultural gains to be offered to government officials, the program's effectiveness could rise (Abel 1997).

22.3.3 Participant Profiles

One critique of bilateral cooperation programs is that such programs tend to invite people already receptive to cooperating with the other side on water issues. Inviting those open to dialogue may facilitate a pleasant and productive program. However, some participants argue that the people who are already open to cooperation are not those who need to be involved. In order to change people's attitudes toward cooperation, they argue, it is necessary to involve people who are not already open to such experiences.

One past participant, Nitsan Levy, lives in one of Israel's West Bank settlements and deals with environmental issues in the West Bank. He has advanced the argument that settlers should always be a part of bilateral programs because they are the Israelis who deal with Palestinians on a day-to-day basis. Palestinians, however, generally feel that their interpretation of international law dictates settlers would not be allowed to live in the West Bank. In other words, Palestinians may see no reason for talking or cooperating with people who are attempting to appropriate Palestinian land. One Palestinian academic felt that the presence of settlers in a bilateral program will cause so much tension that nothing could be accomplished. Currently, most program designers tend to avoid inviting settlers to attend U.S.-sponsored programs due to the political implications of their presence.

A Palestinian water professional, who has been involved in many bilateral programs, including the 2002 program at The University of Texas at Austin, points out that participants must be mature enough to adapt to new situations and to communicate with others in the program even though they are new acquaintances. He also points out that programs should involve women as much as possible, because they do not get many opportunities in the Palestinian water sector. The inclusion of women would reflect U.S. commitment to gender equality, and may be justified because women are relatively rare in the water sector, and therefore may be overlooked by the Palestinian bureaucracy.

In the interest of long-term results, it is useful to involve younger, less experienced water sector participants. Ahmad Yaqubi (2004) commented that less-qualified Palestinians should be involved in bilateral programs because they do not understand anything about Israelis and are still afraid of them. When they start to realize that Israelis are human, they are better able to work with them. Yoav Kislev (2004) and Shimshon Belkin (2004) also agree that it is vital to provide opportunities for younger professionals to cooperate with the other side.

22.3.4 Location

Holding programs outside of the region is ideal in the current political climate since it has proven difficult to gather groups of Palestinians and Israelis in either nation due to travel restrictions, as well as geographic proximity to the current political crisis. Having programs in a neutral location, such as a foreign research institution like The University of Texas at Austin, allows participants to distance themselves somewhat from the realities of the political situation at home. It also limits advice from friends, family and coworkers, who may not support cooperation between Palestinians and Israelis. Being in an unfamiliar place allows participants to bond over the exploration of Austin and the differences between Texas and their homes. Texas is also an ideal location for water issues in the Middle East, because the two areas have a similar climate and therefore similar water issues. Finally, the university's proximity to the U.S. border with Mexico allows participants to witness the trans-boundary water issues between those two countries. Many academics who participated in University of Texas programs found the comparison to be apt, including one participant who is writing his doctoral thesis on the U.S./Mexico water conflict and its applications in the Israeli/Palestinian situation.

22.4 Conclusions and Recommendations

Although the participants in cooperation initiatives generally dub the programs successful and positive experiences, their lives after the programs do not usually change drastically. Part of the reason for this conclusion is that when programs are evaluated, the time between the program and the evaluation is usually quite short. Participants return to the same homes and jobs as before their program, and it is difficult for them to implement immediate changes in their professional lives. It is one goal of programs, such as those organized by The University of Texas at Austin, that participants can use the connections they have made and to foster professional relationships over political lines in their current and future service.

Some participants do use what they have observed in their programs. For example, one Palestinian professor mentioned that he regularly uses the example of the U.S./Mexico water conflict in teaching his classes at Al-Azhar University in Gaza to discuss bi-national cooperation in the water sector in a politically-separated region. He is also in regular contact with a professor at Ben Gurion University in Israel; they have collaborated on project proposals since the Texas program at which they met. In fact, this Israeli professor has held four workshops and symposia to which his Palestinian colleagues were invited. All of the Palestinians he invited were eager and able to attend his events. Professors from An-Najah University in Nablus and The Hebrew University of Jerusalem have also maintained contact and regularly submit proposals for joint research projects. Cooperation and friendship between these two men illustrates one tangible outcome of academic programs.

Many of the participants have suggested that any opportunity to get to know individuals from the other side will plant the seeds for eventual cooperation, even if there may be few concrete changes in their professional lives. By understanding that the other side "doesn't have horns"[3], participants will be more willing to consider cooperation with members of the other nation, even if they are not acquainted with the individual. This issue was identified and addressed within the MERC program by encouraging industry professionals, academics and scientists to remain in contact with their counterparts across borders and visit their peers' place of work, which would add to the professional relationship and prove to other peers in the region the benefits of cooperation (Abel 1997).

Based on this discussion, there are several ideas that should improve third-party water sector programs related to Palestinians and Israelis. These ideas relate to the program location, participant selection, duration, activities and follow up.

Location. In order to take advantage of the willingness of scientists and academics to talk, it seems best to locate cooperative programs in a country other than Israel and the West Bank and Gaza. Although it would be ideal to address water problems in the area where they occur, having a program on location may add to tension and prevent participants from forming fruitful relationships. Texas has been a useful venue because of the correlation between the United States/Mexico water issues and the situation between Israel and the West Bank and Gaza, in addition to similar issues Texas and Israel/Palestine face in an arid climate. Cyprus or Turkey have been convenient locations. Egypt and Jordan have similar arid climates.

Participants. Programs involving senior academics and scientists have proven successful in the past. Many past participants and contacts in U.S. government agencies have suggested that now may be the time to invest in a future generation. Therefore, future programs should focus on graduate students or young professionals who are likely to be future leaders in the water sector, in conjunction with professionals who have more experience to act as mentors and/or facilitators. In addition, the United States should consider expanding program participants to include Israeli settlers and other participants whose presence may have political implications, but who might have their views of the water situation altered dramatically through contact with the other side. Although this will be a sensitive suggestion to implement, programs not limited to people already willing to cooperate may benefit the region.

Duration of Program. Programs that allow repeated contact may increase the likelihood of personal change, as opposed to the current practice of one-time attempts at intensive relationship building and conflict resolution. Ideally, once a group of academics, scientists or technicians is selected, they should be able to meet at least twice for at least a week at a time. This would allow them to build long-term relationships and maintain cooperation over a longer period of time; participants should be encouraged to bridge gaps over borders by visiting peers in their place of work. Such visits could prove the effectiveness of cooperation created by the programs and spread the efforts of bi-national collaboration to other professionals in the visited organization. If budget limits preclude such repeated interaction, short informal efforts by participants may be useful.

Programs organized for fresh teams of participants should be as long in duration as possible to allow the ice to break and an atmosphere of cooperation and friendship to develop. A longer program will also allow more time for social and educational activities in which participants may form sincere relationships. The longest possible duration is probably one month, since participants have professional and personal obligations at home. An official at the U.S. State Department, believes that the most important way to resolve environmental conflicts is to create communities of people who are willing to interact, such as those who work in the same field. Longer and repeated programs may help accomplish this goal.

Activities. Friendships are rarely formed in a heavily supervised formal setting. Therefore, it is important to have both organized social activities and free time for participants to get to know one another independently. Meals taken together can provide a forum for independent and personal conversations. Planned activities, such as concerts, field trips, and museums, will give participants a starting point for conversations. Free time is important, so people can choose to communicate instead of being forced to converse. However, free time will be more fruitful later in the program, after the ice has been broken and people are more familiar with one another.

Follow-Up. Since one of the goals of multilateral programs is to help participants form lasting professional and personal relationships, it is fitting that program organizers devote some time after the program to maintain contact among participants. Contact can occur through a monthly newsletter for all the participants about new developments in water technology, conferences that might be of interest, and personal milestones for former participants – much like an

3 Kislev, Y. (2004). Interview, *Department of Agricultural Economics and Management Faculty of Agriculture Hebrew University.*

alumni newsletter from a college. It may also be useful to establish an internet group, where participants can chat and post messages about their lives and their work. The external organization's involvement should be somewhat limited and diminish over time, contingent upon the success of bi-national cooperation between Palestinians and Israelis. Joint research and projects should also be encouraged to foster continued discussion. One advantage of tangible results would be that the sponsors would be pleased by concrete outcomes.

Any program that builds bridges between members of conflicting nations can be valuable, although that value might not be immediately apparent. Even organizations that are not involved in bilateral activities, such as USAID, regard bridge-building programs as useful and necessary for cooperation on vital activities, such as the provision of water and wastewater. In this era of constant low-level conflict between Palestinians and Israelis, water sector discussions have continued to represent a means to advance cooperation between Israelis and Palestinians on water issues and the political arena.

References

Abel, R., 1997: *The Influence of Technical Cooperation on Reducing Tensions in the Middle East* (Lanham, Maryland: University Press of America): 20–97.

De Cerreno, A.; Keynan, A. (Eds.), 1998: *Scientific Cooperation, State Conflict: The Roles of Scientists in Mitigating International Discord* (New York: New York Academy of Sciences), Vol. 866.

Shoham, Dany, 1998: "Palestinian-Israeli Academic Encounters," in: de Cerrena, A. L.C.; Keynan, A, (Eds.): *Scientific Cooperation, State Conflict* (New York: New York Academy of Sciences), Vol. 866.

23 Water Allocation for Nature and the 'End of Conflict' Era

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Abstract

Human activities and development pressures increasingly threaten open spaces (or 'the countryside'), natural ecosystems and other natural resources in Israel. Among them, water sources are continuously degrading. Water is mainly managed for human use, and consequently, the ability of natural ecosystems to maintain themselves and to provide humans with ecosystem services decreases.

Despite the present status of the Israeli-Palestinian peace process, planners should address long-term water-related issues and consider the possible situation at the 'end of conflict' era. The authors examined aspects regarding water resources in the peace agreements, in proposed regional cooperation development projects, and as reflected by social and economic trends and scenarios. Their findings indicate that in peaceful times the pressures on the natural environment and water resources are likely to increase. Proposed development and improper management by all sides involved may lead to further degradation of water resources (particularly critical to the mountain aquifer), and to a situation of 'prolonged thirst' of terrestrial ecosystems. A first attempt to address nature's right for water through legislation was recently made in Israel, along with discussions on desalination and on increased usage of treated effluents in agriculture. Nevertheless, these changes in water management may be inadequate to guarantee ecosystems with sufficient and sustainable water supply.

Keywords: biodiversity, ecosystem services, peace agreement, regional cooperation development project, water allocation for nature

23.1 Introduction

23.1.1 General Background

The state of Israel has been going through major economic, social and environmental changes ever since its establishment. Israel has largely adopted western standards – regarding science and technology as well as standards of living and consumption, and standards for one's personal aims in life. These standards have been imported along with their associated processes and problems, posing a burden on the natural environment and thereby increasing the local environmental crisis. The environmental pressures are accelerated by the fast rate of population growth (including immigration) and a very high population density.

Israel has been blessed with a rich and unique variety of habitats and ecosystems. Apart from the intrinsic value of its rich biodiversity, it also supplies humans with invaluable *ecosystem services*, which include water accumulation, absorption, and filtration (see discussion and examples in Achiron-Frumkin/ Frumkin 2002). Today in Israel, human activities and growing development pressures increasingly threaten 'open spaces' (or 'the countryside'). The result of this state-of-affairs is that many of Israel's agricultural and natural ecosystems, many habitats with their associated biodiversity, are threatened (Shalmon 1999;

Frumkin 2003a; Frumkin/Shmida/Sapir/Fragman-Sapir/Levin 2004).

Among its other natural resources, Israel's water sources are continuously degrading for two reasons. The first is quantitative – the increase in water consumption leads to over-pumping, resulting in a lowered water table of above- and below-surface water sources. The second is qualitative – water quality is worsening due to salination (which is partly caused by over-pumping) and due to constant input of various contaminants. The loss of open space that functions as aquifer filtration area aggravates the situation. In particular, accelerated building on the coastal plain aquifer's filtration areas decreases the available filtration surface area and increases the leakage of contaminants into it (Han 2002; Israel Hydrological Service 2000; Katz/Burmil/Carmon/Shamir 2001; Achiron-Frumkin/Frumkin/Rudich/Maloul/Levin/Papai 2003).

Desalination is frequently suggested as the only viable remedy to the entire region's water problems, but apparently, this is not the case. Desalination is planned to be an additional supply, a partial substitute to natural sources and cannot wholly substitute for them. It would not solve problems of desalination and contamination of the natural water sources. Alongside desalination, another suggested practice that can save a large amount of fresh water is the increased usage of treated effluents in agriculture. However, this practice involves problems related with salination of soils and a possible gradual degradation of both soils and aquifers, a process that is also likely to affect natural systems as well (Gvirtzman 2002; Kliot 2003).

23.1.2 Water Allocation for Nature

Regarded a scarce resource, water is mainly managed for human use, while water allocation for nature is primarily perceived as a luxury. The degradation of water sources affects natural ecosystems in their ability to maintain themselves and to provide humans with ecosystem services. Water shortage joins with habitat loss and defragmentation to make ecosystems more fragile and less resistant to changes and catastrophes. The main loss of species and habitats in Israel in the last decades has occurred in wetlands (Frumkin 2003a; Frumkin/Shmida/Sapir/Fragman-Sapir/Levin 2004; Shaham 2003).

A preliminary attempt to address 'Nature's Right for Water' was made through the patient and persistent work of the *Israel Nature and Parks Authority* (INPA) and the Ministry of the Environment, which led to legislation in the Knesset. The legislation is meant to ensure a regular water allocation for the maintenance of nature reserves, rivers and other wetlands (Shaham 2003). The INPA wishes to ensure that some 150 *million cubic meters* (MCM) of water would be available annually to nature and to conservation of open spaces, and that additional 50 MCM would be available for river restoration. With the Water Commission, the INPA intends to prepare a national yearly master plan to define nature's need for water. This is a major step forward. It is not yet clear if the desired allocation is sufficient and if it can indeed guarantee a long-term commitment.

23.1.3 What are Nature's Needs for Water?

Israel is located in a semi-arid region, where water is relatively scarce and therefore it is one of the limiting factors to biological mechanisms. In order to be able to maintain a healthy life, for existence and proper functioning, water supply should be within certain quality limits. It is generally agreed that water for aquatic organisms should be better than drinking quality standards (Shaham 2003). The current legislation is concerned with water allocation for aquatic nature reserves and wetlands, which are the main natural 'consumers' of water, and probably the most vulnerable habitats.

Nevertheless, other terrestrial ecosystems, in nearby smaller tributaries and generally, in non-wetland habitats, also require adequate water supply. Terrestrial ecosystems away from rivers throughout the country are supported by their available water supply – through direct rainfall, through underground water supply or aboveground runoff, filtration and streaming. If we take a closer look, we can further examine the need for water at a local level: plants in any ecosystem need water. The amount of plants, their composition and the presence of particular rare species may depend on very local circumstances; some animal species rely on plants for their water as well as for their food supply; many animal species need fresh drinking water, which they may find in small local sources; winter ephemeral ponds are a nearly-extinct habitat in Israel – they require a sufficient supply of fresh water for their formation and maintenance for a minimal duration that will allow their inhabitants to reproduce.

23.1.4 Aims of this Work

The Israeli-Palestinian peace process is currently on hold. Nevertheless, while it was still going many understandings and programs were made by official and private bodies for a time to come, a peaceful 'end of conflict' era in this region. Some of this planning can affect water allocation to nature. Whenever the peace process will resume, it is very likely that much of this dormant planning will again be relevant.

Planners as well as nature conservationists should be aware of these plans, prepare for times when they will be promoted and consider them on a regional basis. In this work the authors try to draw a possible scenario for the status of water resources in the 'end of conflict' era and its possible ecological implications. Forecasting and drawing scenarios are many-a-time quite a risky business. Our aim here is to draw attention to possibilities and to actions or precautions that may need to be adopted.

23.2 Methods

The authors used three sources of information about possible events in the future 'end of conflict' era: (a) the peace treaties and agreements; (b) proposed development projects for regional cooperation; and (c) multi-disciplinary group discussions and interviews with professionals. The peace agreements, development projects and general trends will mainly be discussed with reference to their impact on the environment within Israel.

23.2.1 Peace Treaties and Agreements

Israel signed peace agreements with Egypt (1979) and Jordan (1994) and an interim agreement with the Palestinians (1995). The authors examined the environmental aspects and clauses in these agreements (Israel Ministry of Foreign Affairs 2004a, 2004b, 2004c), and their relevance to various development programs. The authors try to point at lacunae and possible environmental conflicts deriving from the agreements – mainly between development and conservation.

23.2.2 Proposed Development Projects

Data on 280 proposed or on-going projects of regional cooperation and programs were received from the former Israeli Ministry for Regional Cooperation. Forty-seven projects directly involved water issues – agreements, planning, supply, desalination, treatment of effluents and reclamation of contaminated areas. Of these, we referred to development programs that are relevant to the Israeli environment, ending up with 26 projects (6 cooperation projects, 15 non-cooperation projects that may affect Israeli water supply, 5 general protocols and programs). The authors also checked for other possible indirect effects of major projects on water availability to the natural environment.

23.2.3 Discussions and Interviews

Between 2000–2002, as a part of a multi-disciplinary work group (Achiron-Frumkin/Frumkin 2002), the authors participated in an active discussion group on different aspects and scenarios for a peaceful era. They had personal interviews with various environmentalists – both governmental and NGOs – and heard their perspective and scenario for environmental, social and economical prospects on a time of peace.

23.3 Results and Discussion

23.3.1 Peace Treaties and Agreements

The peace treaties with Egypt (1979) and Jordan (1994), and the interim agreement with the Palestinians (1995) reflect the prevailing environmental attitude at the time they were prepared. Water issues that are mentioned include water usage, allocation and resource maintenance. A major lacuna is the absolute absence of any water allocation for nature where water allocations are discussed. The agreements do not pay attention and do not include sufficient guidelines to nature's needs for maintaining ecosystem functions, particularly in terms of water and land allocation. No attention is paid to the necessity to devise water quality standards and to solve possible conflicts between different water usages.

The peace treaty between Israel and Egypt does not directly refer to any environmental issues, including water. Though no major water sources are shared between Israel and Egypt, agreed development projects may have local impacts (see below).

The peace treaty between Israel and Jordan includes article 6, which is dedicated to water. It designates "rightful allocations of both of them [Israel and Jordan] in Jordan River and Yarmouk River waters and Araba/Arava ground water" Article 6 addresses the need to define water quantities and quality regarding usage, and the need to develop present and new water sources. It refers to required measures and monitoring in order to protect water resources from contamination. It includes provisions for water allocation and distribution between the two sides, of the Jordan River and its tributaries and in the Arava valley, which do not consider ecosystem needs. The flow of fresh water in the lower Jordan River is considered 'waste'. Hence, it was agreed that the lower Jordan would change from a river of high-quality water flow into a canal used for the disposal of treated sewage and brackish water to the Dead Sea.

Apart from considering directly this scarce resource, other articles that discuss transportation, energy and development may involve indirect effects to natural ecosystems (see discussion below). Water quality standards have not been defined. The environmental article (article 18) and its associated annex IV are quite detailed and cover a wide array of topics, including suggested cooperation between both parties according to sustainable development principles. They emphasize the need to protect biodiversity by various means, though the maintenance of water sources and their quality is mentioned solely with respect to human usage.

The Israeli-Palestinian Interim Agreement has no environmental clauses. References to environmental issues appear in annex III and annex VI. Annex III, clause 12B, deals with cooperation and understandings, and outlines the general attitude:

> Both sides will strive to utilize and exploit the natural resources, pursuant to their own environmental and developmental policies, in a manner which shall prevent damage to the environment, and shall take all necessary measures to ensure that activities in their respective areas do not cause damage to the environment of the other side.

Most measures are intended to mitigate different kinds of pollution. Other agreed principles are: developing measures to fight desertification, the need to conduct an *Environmental Impact Statement* (EIS) for major development programs, and the protection of forests, nature reserves and natural assets. Clause 40 outlines principles concerning water and sewage, and acknowledges the Palestinian need for additional water supply.

23.3.2 Proposed Development Projects

Generally, the proposed development projects are based on understandings that were outlined in the peace agreements. With one exception, none of the 26 projects related to water deals with nature's rights and needs for water, though several projects may help to reduce water pollution. Here we shall give but a few examples. Several water-supply projects in Jordan draw water from the Jordan River and its tributaries. A proposed desalination project will use brackish water on the Jordanian side of the Dead Sea. The Jordanian Water Conduit will allocate additional tens of MCM/year to Israeli and Jordanian salt plants. Quite a few Palestinian wastewater conduction systems and treatment facilities are planned. Treating pollution of the Jordan River includes several wastewater treatment facilities on the Jordanian and Israeli sides. Another plan to restore the lower Jordan River also designates an area for a bi-national nature reserve on both sides of the river. The Red Sea-Dead Sea Canal is the only project that mentions water allocation to the Dead Sea.

Of the other cooperation projects we examined – those not directly related to water – some may affect the natural environment either by protecting areas (several proposed transboundary nature reserves and a biosphere reserve) or by using land and emitting pollutants (e.g. several industrial areas, energy, transportation and tourism), as will be discussed below.

23.3.3 Socio-economic and Environmental Scenarios

People rightly expect that the 'end of the conflict' will bring about economic prosperity and improve the standard of living (particularly of the Palestinians). There will be great need for building and reconstruction on both the Palestinian and the Israeli sides, in particular an urgent need to answer the Palestinian lack of infrastructures.

The experience so far has shown that in quite a few environmental cases that required urgent cooperation, political considerations made such cooperation impossible even before the current surge of violence (e.g. Israeli-Palestinian problems to resolve issues of wastewater management, see Frumkin/Achiron-Frumkin 2003; Kliot 2003). When the 'end of conflict' will finally be with us, it is likely that initially it would not be a 'warm peace' but rather avoidance of violence that would allow each side to slowly recover. In such circumstances, cooperation and joint management of a crucial resource is made more complicated.

23.3.4 Possible Ecological Implications

Human activity can affect the availability of water to ecosystems directly, through above- and underground water resources, by pumping and by direct discharge of pollutants. It can also affect it indirectly, through development and through the way humans act in open spaces. In what ways can development affect water supply to nature? It can:

- Change the amount of water that is being accumulated locally – through a change or damage to a drainage basin's original waterways, or through a decrease in the area of open space available to this basin (e.g. by construction of roads or buildings);
- Change the quality of available water – through local contamination of soil or runoff that can lead to local or regional contamination of water sources, both above and below ground. This can be due to oils, pesticides or other toxic substances.

Once a drainage basin is changed, its ability to supply water to living organisms also changes. It may well be that overall, the same amount of water may still be available to an area, but it will be distributed in a different manner locally, creating local environmental changes. Such changes may render a mountainside, a mountain spring, a winter ephemeral pond or the residence site of a rare plant with less water than before or nearly waterless, if not enough water is accumulated to sustain them. This is also true where local pumping lowers the aquifer water level, thus drying local springs. The desert environment is particularly sensitive to changes in the water regime, and the opening of new roads and railways may change water runoff routes and drastically affect local habitats. These changes at the local level seem minor and negligible, but they do accumulate and can be particularly felt in dry years. The good news is that today we know ways to develop while conserving water sources, via adoption of careful, water-sensitive and sustainable-oriented planning (e.g. see Katz/Burmil/Carmon/Shamir 2001). It needs more awareness, it needs courage to explore new methods and a willingness to use them. To better understand some environmental implications of the agreements and development projects a closer look at some examples of the current environmental situation is needed:

The annual water flow input to the *Dead Sea* today is ca 1,000 MCM of water less than it was at the beginning of the 20th century. This gradual decline has led over the years to a decrease of over 26 meters in the Dead Sea level, and has severe implications for both man and the natural environment. It involves changes in the aboveground and underground flowing regimes of the Dead Sea coastal oases ecosystem and salination of springs. These changes lead to a rapid change of this unique ecosystem, while threatening its endemic biodiversity. The solution to the situation is far from clear. In addition, the decline of the water table has induced the formation of hundreds of large sinkholes, mainly along the western coast, making any human activity in the area a perilous task (Frumkin 2003b; Bromberg 2004; Eidelman/Cohen/Bein/Kaplan 2006).

Some of the development projects designated along its coast will probably somewhat worsen the water balance of the Dead Sea. Additional water uptake and further use of floodwater up the Jordan River will probably also be bad for the Dead Sea. Plans for tourism and other enterprises along its coast may become obsolete due to the risks involved. The plans for a biosphere reserve there may conflict with other projects designated for the same area. The Red Sea-Dead Sea Canal is the only project that mentions water allocation to the Dead Sea, but it may involve major changes to regional ecology, whose character is not clear.

The water of the upper *Jordan River* basin is being continuously used by all adjacent countries: Lebanon, Syria, Jordan and Israel, as well as by the Palestinians. Some of its tributaries currently conduct treated effluents. Israel and Jordan exhaustively divided the Jordan River water resources, including excess unutilized floodwater that can be pumped for storage off the course of the river. The treaty between them allocated no water for nature and its application has probably already contributed to the deterioration of the lower part into a canal conducting effluents (Kliot 2003). The stated need for "ecological rehabilitation of the Jordan River" is not backed by any of the water clauses of the treaty.

The proposed project entitled 'treating pollution of the Jordan River' includes several wastewater treatment facilities in the Jordanian and Israeli sides. It has no defined bi-national framework to coordinate the management of the drainage basin and the river itself, and does not allocate any water to the river itself, a supply that could help clean the riverbed and restore its ecosystem. This project probably adopts the approach that if pollutants are removed – the river ecosystem will eventually restore itself. It is not clear how this project corresponds with another plan to restore the lower Jordan River, which also designates an area for a bi-national nature reserve on both sides of the river, where currently effluents have been allowed. Further south, excess pumping of groundwater in the Arava valley has already caused deterioration of some oases and drying of several unique salt marshes (e.g. Yotvata and Evrona). There as well, the parties agreed on quotas for pumped water to be divided between them, with no restrictions deriving from ecological needs.

Agricultural development (e.g. combating desertification) should be carefully examined to verify that irreversible damage is not caused to the area's biodiversity, and to long-term quality of soil and water. *Development of transportation* along and across the Rift Valley would probably lead to further conflicts with environmental well being, including water balance for local ecosystems.

A major problem with the proposed or on-going regional cooperation projects and programs is that many of them are located on a limited geographical area. On one hand, this saves open space. On the other hand, little attention was paid to their cumulative effect on the region, on its open spaces and its natural habitats. Many of the projects reflect a conservative, non-sustainable approach. The only plans that may consider ecosystem needs and may eventually include water allocation for nature – those for nature reserves – seem to partly conflict with other development plans designated for the same areas.

The mountain aquifer is currently polluted by both Israelis and Palestinians. Effluents, including also industrial effluents, are running down westwards into Israel's coastal rivers, jeopardizing efforts to restore them. Among the proposed projects were some Palestinian wastewater treatment facilities which could have reduced pollution (including transboundary pollution) and groundwater contamination. Several projects and solutions that were suggested to handle the Palestinian effluents were not promoted due to the political situation, and part of the foreign funding to Palestinian infrastructure project may be lost by now (Kliot 2003).

Generally, both the peace treaty with Jordan and the interim-agreement with the Palestinians contain clauses that show positive environmental intentions. For example, annex VI of the Israeli-Palestinian interim-agreement declares that

> In implementing the various economic cooperation programs, the two sides will ensure that aspects of environmental protection including air, water, marine and land resources, and prevention of environmental risks, hazards and nuisances will be taken into consideration.

The mutual desire to cooperate in protection of biodiversity and nature reserves is shown in the following statement: "economic cooperation will take into consideration environmental protection aspects."

It is reasonably feared that the important guidelines and principles that do appear in the agreements with Jordan and with the Palestinians may not be fulfilled. This may be due to lack of awareness among decision-makers, lack of criteria for sustainability or lack of administrative and fiscal tools to apply them (see Frumkin/Achiron-Frumkin 2003). It is not clear, how well Israel and Jordan can implement their good will, as many of the topics have not yet been implemented within each country. Most current development in Israel is not sustainable, and we do not expect that the Palestinian side, which faces highly critical issues, will place nature's right for water first on its priority list. Important statements and declarations are not enough to guarantee their appropriate application, to guarantee that environmental interests will be considered alongside economic (or other) interests, particularly as examination of alternative plans was not required.

A higher level of economic activity usually leads to higher consumption and contamination levels, and to increased demands for water, energy, open space (for both development and recreation purposes) and other natural resources. Development of the kind that will cover open space with asphalt, stone and concrete may affect water drainage basins and decrease water penetration into aquifers. This problem may be particularly felt in the mountain and coastal aquifers. Yet, official guidelines for development at the 'end of conflict' era may not necessarily incorporate high environmental standards, particularly if development is done under time pressure, with a limited budget and with many other issues to be dealt with.

23.4 Conclusions

23.4.1 Would Israel's Biodiversity be Better off in Peaceful Times?

The case of water allocation to nature is a clear example of the conflict between the needs of this generation and the needs of future generations, the needs of those who have more and those who have less, and between human needs and the needs of other co-patriot organisms. The sustainable development approach – as manifested in Agenda 21 and the biodiversity convention which Israel has signed – tries to address these conflicts and resolve them. Most of the future problems are already here with us. The fragile current acknowledgment of nature's right for water – if adequate at all – may not hold if water shortages worsen. It may be implied within Israel, but will probably not be considered in the surrounding areas. The trends of change in water management (including desalination and effluent irrigation) may not be adequate to guarantee sufficient and sustainable water supply for natural ecosystems.

Our findings suggest that in terms of water allocation for nature, the scenarios for the 'end of conflict' are not likely to produce a more comforting picture than our present situation. Rather, they actually indicate that the immense pressures on the natural environment and water resources are likely to increase. Unless a dramatic change in the way we manage our water resources will take place, we are likely to encounter further damage to water resources. This will be added to the already deteriorating quality of the mountain aquifer, and to the continued denial of the ecosystem's justified needs for water by all sides involved. In times of water shortage, water allocation to nature and its relation to the vitality and stability of natural ecosystems may come last on the priority list. One should also bear in mind that water stress or shortage would be only one of several environmental stresses that are quite certainly likely to increase. Such are the decrease in open spaces (available physical space and habitat) and connectivity within and between natural populations, increased human activity in residing area, increased levels of air pollution, etc., whose effects on ecosystems may not be incremental but rather synergistic.

Such circumstances necessitate careful planning and management of natural resources, with a long-term view and policy which will incorporate water professionals and ecologists in a wider regional planning and management framework, applying the 'precautionary principle'. Nature's right for water should be incorporated, as another aspect that needs addressing, into master plans and cooperation projects. New ways to include this aspect in cooperation work between environmental officials, educators and NGO work should be devised and can already be put to action now. Unfortunately, in the process of planning and decision-making, political and security considerations often rule out professional considerations, sometimes yielding a devastating outcome. As shared resources, there should be some form of shared responsibility for the deterioration of the Dead Sea and the mountain aquifer. It is vital that the shareholders involved would join forces and efforts to avoid any further deterioration and cooperate in order to solve the described problems, including water allocation to the ambient ecosystems.

References

Achiron-Frumkin, T.; Frumkin, R. (Eds.), 2002: *Biodiversity and Sustainable Development* [in Hebrew]. Strategy for sustainable development in Israel – Working group summary (Jerusalem: Ministry of the Environment).

Achiron-Frumkin, T.; Frumkin, R.; Rudich, R.; Maloul, A.; Levin, N.; Papai, N., 2003: *Conservation of the sands of the coastal plain* [in Hebrew]. A policy paper (Jerusalem: Ministry of the Environment, SPNI, NRPA, JNF, HS, JIIS).

Bromberg, G., 2004: "Water and Peace", in: *World Watch*, 17: 24–30.

Eidelman, A.; Cohen, G.; Bein, A.; Kaplan, M. (Eds.), 2006: *The Dead Sea basin: Assessment of current situation and prospects for the future under continued Dead Sea water-level decline*. Policy document submitted to the government of Israel [in Hebrew, English summary]. (Jerusalem: Ministry of National Infrastructures, Ministry of the Environment, Jerusalem Institute for Israel Studies).

Frumkin, R., 2003a: "Extinction of Animals [in Israel]", in: Frumkin, R.; Khenin, D.; Eidelman, A. (Eds.): *Vital Signs* 2002 - *Worldwatch-Israel* [in Hebrew] (Tel Aviv: Babel Press): 188–190.

Frumkin, R., 2003b: "The Dead Sea is lower than ever before", in: Frumkin, R.; Khenin, D.; Eidelman, A. (Eds.): *Vital Signs* 2002 - *Worldwatch-Israel* [in Hebrew] (Tel Aviv: Babel Press): 174–176.

Frumkin, R.; Achiron-Frumkin, T., 2003: *Environmental aspects of agreements and development plans for regional cooperation: current status and future recommendations* [in Hebrew] (Jerusalem: The National Council for Environmental Quality, JIIS).

Frumkin, R.; Shmida, A.; Sapir, Y.; Fragman-Sapir, O.; Levin, N., 2004: "Extinction of Plants in Israel", in: Frumkin, R.; Khenin, D.; Eidelman, A. (Eds.): *Vital Signs* 2003 - *Worldwatch-Israel* [in Hebrew] (Tel Aviv: Babel Press): 41–43.

Gvirtzman, H., 2002: *Israel Water Resources* [in Hebrew] (Jerusalem: Yad Ben-Zvi Press).

Han, I., 2002: *Planning Gas Stations and Commercial Centers in Rural Areas and Open Spaces* [in Hebrew]. Position paper (Jerusalem: JIIS).

Israel Hydrological Service, 2000: *The development of usage and the status of water resources in Israel up to autumn* 1999 [in Hebrew] (Jerusalem: Ministry of National Infrastructure, Water Commission, May).

Israel Ministry of Foreign Affairs, 2004a: "Peace Treaty between Israel and Egypt. March 26, 1979"; at: < http: // www.mfa.gov.il/MFA/Peace+Process/Guide+to+the+Peace+Process/Israel-Egypt+Peace+Treaty.htm>.

Israel Ministry of Foreign Affairs, 2004b: "Treaty of Peace between the State of Israel and the Hashemite Kingdom of Jordan. October 26, 1994"; at: <http://www. mfa. gov.il/MFA/Peace+Process/Guide+to+the+Peace+Process/Israel-Jordan+Peace+Treaty.htm>.

Israel Ministry of Foreign Affairs, 2004c: "Israeli-Palestinian Interim Agreement on the West Bank and the Gaza Strip. September 28, 1995", at: <http://www.mfa.gov.il/MFA/Peace+Process/Guide+to+the+Peace+Process/the+israeli-palestinian+interim+agreement.htm>.

Katz, Sh.; Burmil, Sh.; Carmon, N.; Shamir, U., 2001: *Water-sensitive Urban Planning: Infiltrating rainwater into groundwater by designing urban lots* [in Hebrew] (Haifa: The Center for Urban and Regional Studies, Technion).

Kliot, N., 2003: *Transboundry Pollution: Israel, Arab Countries and the Palestinian Authority* [in Hebrew] (Jerusalem: The National Council for Environmental Quality, JIIS).

Shaham, G., 2003: *Nature's Right for Water: water requirements for aquatic ecosystems and wetlands* [in Hebrew] (Jerusalem: Ministry of the Environment and INPA).

Shalmon, B., 1999: *A Report on the Status of Wildlife in Israel* [in Hebrew] (Jerusalem: INPA, SPNI, and Ministry of the Environment).

24 Allocating Gaps of Shared Water Resources (Scarcity Index): Case Study on Palestine-Israel

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Abstract

The chapter proposes a cooperative support model for Palestine and Israel, using both technical and managerial tools that could eventually improve the water supply situation in the whole Middle East area. The model suggests improvements in the patterns of information exchange to include information collection, sharing information on catchments, desalination, reuse techniques, etc., institutional capacity building such as a qualified labor force, organization and management. Cooperation can be applied in many areas of water management: a) management of water resources (management of underground and ground water), b) management of the water supply network (operation, monitoring, maintenance), and c) wastewater management (water reuse).

To assist the management of shared water resources a mathematical model (*scarcity index*) has been developed to evaluate water resources gaps on the national and international level. The need is measured by the value of the scarcity index, which considers most of the elements that affect structural demands and ecosystem conditions of the water bodies.

Keywords: Modeling, Sharing, Scarcity Index, Water Resources

24.1 Introduction

Sharing transboundary water resources and the process of portioning them are challenges for downstream countries around the world. Development and pollution are both increasing, while the supply of water is not. At present, there are increasing demands for the limited water supplies by people, agriculture and industry. In addition, humankind is dependent on its environmental partners. Before we all dry out or get flooded out, or in the worst case killed, in struggles over water, all interested parties, whether private, governmental or non-governmental, are advised to work together to manage our water better under UN leadership.

Water scarcity is often the result of a misunderstanding among the parties sharing transboundary resources. Or it could be a failure to integrate policies and practices related to the management of water resources. Good water governance exists where government bodies responsible for water establish an effective policy and legal framework to allocate and manage water in ways responsive to national, social and economic needs, and to the long-term sustainability of the resource base. There will be no transition to sustainable development without a transition to water sustainability (*Swedish Environmental Institute* (SEI) 2002), which requires a systemic perspective that links water resources to requirements for irrigation, industry, human needs and ecosystems. In recent years, the issue of the long-range adequacy of fresh water resources has moved to center stage in international discussions of sustainable development. The call for the adoption of sustainable water strategies has become urgent as conflicts over the allocation of increasingly scarce water resources loom (GWP 2000).

24.2 Water Equality Accounting System

The *Water Equality Accounting System* (WEAS) was created to monitor the inlet and outlet of available water in national and international basins. The model is based on the *Water Accounting For Integrated Water Resources* (WAFIWR) approach developed by David Mulder at the *International Water Management Institute* (IWMI) in 2001 (IWMI 2001). Both models have in common the balancing of water resources supply and use by humans and the environment. The WAFIWR model builds on factual data, while the WEAS is based on the availability, reliability and probability of sharing the data on the one hand and also recognizing the equal rights of neighbors over transboundary water resources on the other. WEAS uses a water balance approach to quantify the amount of water entering an area through precipitation, rivers, groundwater flows in addition to water re-use, other water resources obtained through transport or import, and desalination and the amount leaving an area through evaporation, plant transpiration, rivers and groundwater flows or other water losses as illustrated in figure 24.1.

The amount of unused water flowing out of the system is classified according to whether or not it is committed for downstream use. Non-committed outflows are further subdivided into water that is currently utilisable and water that is not utilisable without additional infrastructure. The inlet and outlet parameters have to be defined and exchanged, and the following questions should be answered and analyzed for each riparian state: (i) how water is being used, (ii) where can water be saved and, (iii) how efficiently are the utilities are managing water resources.

In developing countries, strategies and planning should focus on reducing the flow of irrigation and drainage water into the sea (IWMI 2001). One of the biggest needs in developing countries is irrigation and use of water for food production. Planning of upstream and downstream irrigation systems for equal and reasonable use should be ensured, water conservation at penetration areas improved, and well drilling controlled. Other alternatives can also be applied to conserve water. For instance, social and religious aspects in Saudi Arabia during the Hajj season can provide an opportunity to save water by reducing the water flow in the mosques and by recycling treated wastewater to the flushing system for almost three million Hajjis during their visit to the Mecca and Medina mosques (Asheesh 2001).

24.3 Water Balancing

Balance in general can be defined as the relation between the system's input volume and the system's output volume in all use directions. Balancing investigates the relation between the above mentioned parameters as illustrated in figure 24.1, during a certain time period under different conditions. The result of the balancing for a certain future time depends on reliability and availability of exchanged data, and when estimating missing data the probability theory should be applied. Water resources balancing parameters calculated for a state or riparian states can be divided into four major groups: a) system input volume, b) system output used volume, c) system output losses, and d) system output to the environment. The grouping can help in determining the amount of annual water resources needed or available on the national or international scale.

24.3.1 System Input Volume

The *system input volume* group represents the annual input of water into the system on the national or international scale including the following inputs classified by the origin of the water resource: a) water reused by natural or artificial means, b) surface water, lakes, rivers, c) underground water, d) desalinated water, and e) other resources, such as importing or transporting water or other options and alternatives for covering water gaps.

24.3.2 System Output Used Volume

System output used volume balance parameters that must describe where the water has been used. Generally, the *System Output Used Volume* may comprise four key water categories: a) domestic use (domestic, urban and rural, including settlements and camps in some cases) , b) industrial use, c) irrigation in all forms (for crops and the methods of irrigation), and d) green services for the public green areas.

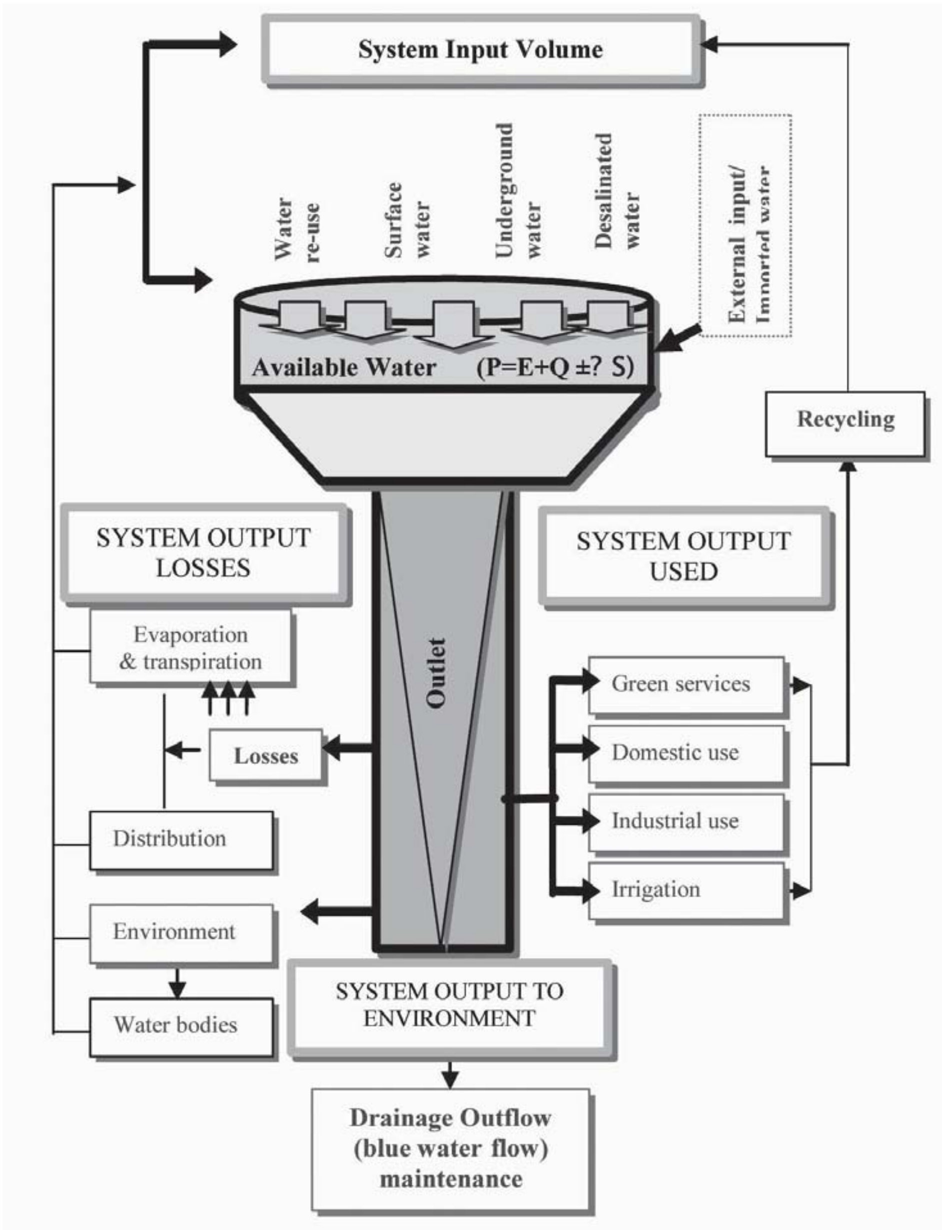
24.3.3 System Output Losses

System output losses show where there are opportunities to save water through monitoring and control.

24.3.3.1 Losses During Distribution

The determination of where the losses in the distribution system occur is an important aspect of water resources management. It is a significant factor in deci-

Figure 24.1: Water Equality Accounting System (WEAS) Structure Suggested by the Author.



sion making related to portioning of shared water resources. In the case study, the amount of loss in the West Bank and Gaza Strip is estimated at 25–60 per cent in some places (PECDAR 2000), while the leakage in Jordan is 60 percent (Alicante 2003). The water accounting system is one of the tools that can be applied to determine two parameters, the condition index for the network and unaccounted for water. These two parameters are important elements for completing the calculations of the *Water Accounting System* (Asheesh 1998).

24.3.3.2 Natural Losses (Evaporation and Transpiration)

The evaporation process can have four different forms: a) evaporation from surface water, b) evaporation from snow, c) evaporation from soil surface, and d) evaporation from plants (transpiration). In general, it can be calculated as the difference between precipitation and runoff. According to Algahriani (2002), the ratio of evaporation in arid and semiarid climates during irrigation and other agricultural activities can exceed 0.25 per cent of the irrigation water. Changes in temperature should be considered in this case.

According to FAO (2002), plant roots suck or extract water from the soil to be able to live and grow. The main part of this water does not remain in the plant but escapes to the atmosphere as vapour through the plant's leaves and stem. This process is called transpiration, which happens mainly during the daytime. Evapo-transpiration is a process of total evaporation from the soil surface. Water from an open water surface that escapes as vapor to the atmosphere during the day is called evaporation. This volume is usually expressed in mm/day, mm/month or mm/season. The losses of water through transpiration can be controlled and prevented by humans by choosing appropriate crops.

24.3.4 System Output to the Environment

System output to the environment is a flow requirement defined as the minimum amount of water in stream flow required at a point on a river or diversion to meet water quality demands for fish, wildlife, navigation, recreation, downstream use or other requirements.

24.3.5 Water Scarcity and the Balance of Water Resources

There have been numerous attempts to develop indices related to scarcity. According to Turton (1999), 'water scarcity' means water poverty. Priscoli (2000) defines with English dictionaries 'security' as freedom from danger, from fear or anxiety, from want or deprivation. Indeed, this is what the history of humanity's management of water is all about: trying to be sure we have good water, in the right quantity, and at the proper time and place. Water crises are thus not driven only by absolute scarcity, but also by disruptions in distribution of water, knowledge and resources. Increasing our flexibility and capacity to respond to exigencies of nature and reduce our vulnerability to events such as droughts and floods will increase our security. That is: we are reducing uncertainty and building predictability and safety into what was often experienced as a harsh environment. As regards water, security can be seen as freedom from fear, anxiety and deprivation regarding water supply.

Water scarcity is usually evaluated with the help of a water scarcity index. Probably the most famous water scarcity index is the one developed by Malin Falkenmark (1989). Basically, she carried out a survey of a number of countries and calculated the water amount used per person in each economy. Falkenmark then determined the state of economic development of those countries. Based on that she calculated the index (table 24.1) using the concept of the "water barrier" beyond which no industrialized country would be able to sustain itself.

Table 24.1: Water Barrier Demarcations. **Source:** Falkenmark and Widstrand (1992).

Index (m^3 per capita)	Category/Condition
>1,700	No stress
1,000-1,700	Stress
500-1,000	Scarcity
<500	Absolute scarcity

Ohlsson (1999) did some more sophisticated work on indices. By using the Human Development Index he worked out a fairly complex index which takes social aspects into consideration. According to Gleick (1993a), scarcity is the relationship between human needs and the reserve of water resources. Gleick claims that water availability should be 100 liters per person per day. Others define water scarcity as a situation where we cannot satisfy the minimum water requirements for drinking and planting for food. Different organizations' definitions of human needs also vary. For example, WHO defines the minimum daily water requirement as 150 liters per person (Asheesh/Al-Otaibi/Katko 2002). Gleick's interpretation of water scarcity is shown in table 24.2.

Table 24.2: Water Scarcity Index According to Gleick (1995) as Modified by the Author.

Index (m^3 per capita)	Category/Condition
>1,667	Abundance
<1,667	Stress
<1,000	Scarcity

In Finland 'water scarcity' has been defined by Kantola, Auvinen, Härkönen, Lahti, Pohjalainen, and Sipola (1999) as follows: "When the amount of fresh water is less than one thousand cubic meters per capita, we can say that there is scarcity of water" (table 24.3).

This author suggests the following definition for water scarcity:

Table 24.3: Some Examples of the Amount of Available Fresh Water per Capita in some Countries around the World. **Source:** Kantola/Auvinen/ Härkönen/Lahti/Pohjalainen/ Sipola (1999).

Country	**Amount of fresh water m^3/cap.x10^3**
Canada	94.4
USA	8.9
China	2.2
India	1.9
Finland	21.3
England	1.2
Kenya	0.7
Israel	0.3
Egypt	0.04

> Water scarcity is a shortage in freshwater availability from renewable resources to meet the essential demand in various water consumption sectors. Essential demand includes domestic demand and agricultural demand needed to ensure food security for the nation, while industrial demand can be met, to a great extent, by recycled water.

Based on the above interpretations of scarcity and the relationship between the availability of water and human consumption needs, scarcity can also be understood as an increase in the use and need of water related to available water resources in a country or region.

The scarcity between the riparians can be most conveniently expressed as the relation between available water and the need of a human being (100 l/c/d) according to Gleick (1993b), or 100–150 l/c/d in arid and semiarid regions according to Falkenmark (the so-called barrier, i.e. use of available water resources fulfilling principles of equitable and reasonable use).

Another form of the scarcity index presented by Falkenmark and Gleick is the benchmark indicator; the 1,000-cubic-meter benchmark has been accepted as a general indicator of water scarcity by the World Bank (2002) and other analysts. Gleick (1993b), of the Pacific Institute, called it the "approximate minimum necessary for an adequate quality of life in a moderately developed country." In the Middle East, Israel, a relatively prosperous country, is commonly cited as surviving on much less than 461 cubic meters of fresh water per person (although Israel also depends on some non-renewable groundwater). But even countries with high water availability may experience problems because of regional disparities or very high water demand (Gleick 1992). Acknowledging such discrepancies, however, hydrologists and water use experts find that 1,000 cubic meters serves as a useful benchmark for water scarcity around the world. Falkenmark's higher benchmark of about 1,700 cubic meters per capita per year is a 'warning light' to nations whose populations continue to grow. In time, in the absence of conditions that lead to population stabilization, most water-stressed nations will fall into the scarcity category (Falkenmark/Widstrand 1992).

Throughout this chapter the author refers to water scarcity if the scarcity index defined by equation 24.1 is negative. This index is expressed by a balancing equation as follows:

Equation 24.1: Scarcity Index Based on Water Balancing

$$W_{sci} = (W_{av} / W_{tad}) - 1 \quad \textbf{(1)}$$

Where :

W_{sci} Water scarcity index

W_{av}: Available water resources in shared basin (in the state)

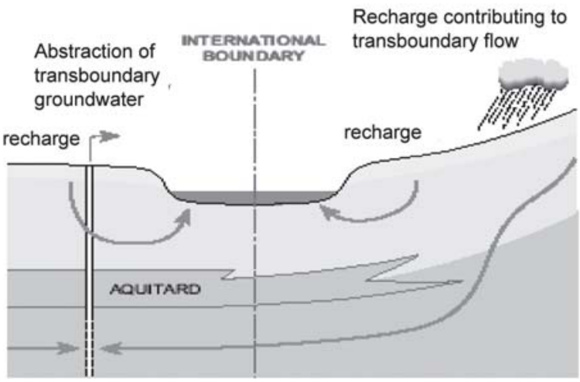
W_{tad}: Total annual demands for all riparians/states

The scarcity index is an indicator that shows developments in the water situation of a riparian country. It points to the size of the gaps that should be covered or amounts to be returned into the system in order to secure the balance between available water and water demand.

Balancing of the system is accomplished by covering the gaps or preventing the depletion of water resources and monitoring the relationship between the inputs and outputs of the system. In the case of depleted national or international river basin aquifers, covering of gaps or controlling and stopping the flow of the shared transboundary aquifer can be an alternative to balancing the situation inside and outside the system on the national and the international level. As an example, figure 24.2 shows an international aquifer that can be protected for balancing purposes from both sides of the border. The process is assumed to be supported by riparian cooperation and the establishment of an international commission by the riparians.

In order to reduce water scarcity and support sharing of international water resources, water balancing needs to be done by applying mathematical calculations to assist the evaluation of the availability of water resources and projecting the demand for long-term and short-term development, as well as for system planning and plans implementation to meet future demand.

Figure 24.2: The Boundary of an International Aquifer River Basin. **Source:** ISARM (2001), as Modified by the Author (2002).



The calculations and evaluations will enable clearly depicting the ongoing situation in every sector inside the riparian states. The point of evaluation is to find the weak or strong sectors and to try to cover the gaps between the parameters inside the sector and inside the states. Recovering can be solved in expectable ways by satisfying all the parties involved in sharing.

The developed equation is based on understanding the probability and availability of data, analysis of collected data and assumption of the risk for long-term and short-term development. Balancing of inputs and outputs can be done through monitoring total available water resources and total use of water resources, monitoring where the water is going, how the water is used, and how we can save water. These elements should be calculated in relation to changes in time (Δt).

24.4 Water Demand and the Scarcity Index

The scarcity index developed in this study reflects the relationship between the water system inputs and outputs from the system based on population growth in a given time. The scarcity index is expressed as a shortage or gaps (expressed as percentages), as the relationship between the parameters of available water and demands as illustrated in equation 24.2. The main element of the equation is population growth, which determines all water sector demand parameters. Population growth will increase the demand for green areas, irrigation, water distribution and development of industry of a certain type (water-intensive or just the opposite, as in the case of Nokia, there is no special need for water, but this depends on the country and its industrial base).

Equation 24.2: Scarcity Index

$$Wsci = \left(\frac{\alpha}{\left(\left[\frac{100}{100-p} \right] \beta \exp^{\lambda \Delta t} (\varepsilon + \gamma + \delta) \left(\frac{100}{100-\kappa} \right) + h + b \right)} \right) - 1 \quad (2)$$

Where:

W_{sci} Scarcity index

α: Input into system (A or B riparian)

ε: Annual domestic demand (m^3/c/y)

γ: Demand for green areas (m^3/c/y), it depends on population growth

δ: Demand for irrigation (m^3/c/y)

λ: = Ln (1+r), population growth rate

Δt: Length of time for which the estimation is made, the period can be calculated as the difference between the present and the future (t-k);

β: Population

t: Present time

h: Yearly evapotranspiration of water, depends on climate of country

b: Water needed to maintain the environment, depends on the length and depth of the water body

k: Estimated losses

p: Industrial demand as a percentage, depends on country structure, its value can be determined as 15 – 25 percent of the domestic demand

24.5 Water Balance and Scarcity Index Calculation in the Case of Palestine and Israel

Solving the exponential equation (table 24.4) for calculation of water scarcity can be carried out using software to assist the evaluation of the water resources situation in the area. The idea is to construct a node system inside the state or between riparians who share the river basin. Software can be used as a toolbox for the model suggested. By using this toolbox, the input and output of water at every node can be evaluated. After calculating the water inputs and outputs into and out of the node, the toolbox will allow transferring or locking the water from or to the node. In this way, the system can be controlled and every riparian will have the possibility to receive his portion of the shared water for at least the short term. The software can be written by Visual Basic, and the graphical part can be connected to a scanned form of a map digital system. In the example below, the calculation was performed using Excel spreadsheets; most of the parameters of table 24.5 were estimated, while some of them were collected from the field.

Table 24.4: The Palestinian Water Scarcity Index..

Palestine	**Parameter**	**Water Demand mm^3/y**
Input into water system	α	600*
Industrial demand	ρ	17
Population	β	2,600
Growth rate	λ	0.033
Time	Dt	20
Domestic demand	ε	54.75
Green area/c/y	γ	20
Irrigation demand	δ	35.58
Population at t	κ	20
Evapotranspiration	h	451,462
Maintenance water	b	140,000
Water scarcity index	**Wsci**	**-0.37**

*Based on assumptions regarding the outcome of imminent bilateral negotiations in the region

24.6 Conclusions and Recommendations

Freshwater conflicts are common in arid and semiarid regions, and they tend to remain particularly acute when international relations are otherwise tense. These two elements co-exist in the case of the West Bank-Gaza Strip and the Jordan River Basin.

Among the riparian countries, the situation is particularly difficult bilaterally between Israel, Palestine, Jordan, and Syria. Israel and Jordan, both suffering from extreme water scarcity, have so far not fully agreed on the sharing of the waters of the Jordan and Yarmuk Rivers, although major efforts for cooperation have been made recently. Syria has a contentious dispute/agreement with Israel regarding the future national control of the Golan Heights area. The Palestinians are not powerful enough to participate in any discussions involving the important headwaters of the Jordan River. Syria and Jordan have had some disagreements over the project to build a dam on the Yarmuk River, which Israel opposes anyway. Finally, the Palestinian state question is also closely linked to water issues, since the West Bank area aquifers constitute a major source of water for Israel.

Table 24.5: The Israeli Water Scarcity Index.

Israel	**Parameter**	**Water Demand mm^3/y**
Input into to system	α	900*
Industrial demand	ρ	21
Population	β	6,000
Growth rate	λ	0.024
Time	Dt	20
Domestic demand	ε	54.75
Green area/c/y	γ	20
Irrigation demand	δ	38.325
Population at t	κ	20
Evapotranspiration	h	941,999
Maintenance water	b	180,000
Water scarcity index	**Wsci**	**-0.53**

*Water available to Israel reduced by the Palestinian portion of the Aquifer in the West Bank

In Israel and Palestine, the conflict over shared water is the result of distrust, sovereignty, ownership of the water resources in theory, and use of force in reality. On the other hand, international water rights and water sharing principles are ignored. It is a fact that the area will suffer from water shortages in the long term. Increasing the supply and decreasing the demand could be an alternative to covering the gaps. Water saving and water-use priorities could decrease the demand. This could be achieved by eliminating swimming pools in the settlement areas. Water demand for irrigation and other use also needs to be regulated and minimized. This can be achieved by growing the proper types of crops, or importing fruits and vegetables from neighboring countries, if possible.

Allocation of the water resources in the area is important for long-term planning and strategy building. Any allocation or any portions should be based on the principles of international law. Available tools and rules have to be applied to achieve the goal. The developed model is a tool applicable in allocation and evaluation of the water resources of the area. Yet, tools cannot be applied without faithful and real cooperation between the riparians. Exchange of information should be practiced to monitor the resources over the long term. Water authorities, consultancies, researchers and even decision makers can use this model.

Ironically, international cooperation is both necessary and difficult in the Jordan River Basin and the aquifer basin in the West Bank. The peace efforts of the 1990s could have eased the situation, but the only solution for the long run is to agree on basin-wide water allocations and management. It remains to be seen whether a general water agreement can be made before a lasting peace has been secured, or if these political questions must be resolved simultaneously.

References

[Alicante,] Anon, 2003: Personal communication: discussion with Tahal engineering for consulting /Israel, and the Palestinian vice president of environment ministry/ Gaza. Alicante, Spain, 10–14 April, 2003.

Algahriani, S. A., 2002: "Future Perspective for Irrigation in the Southern Mediterranean Region", in: *Policies and Management: Water Resources and Management*: 4, 313–320.

Asheesh, M., 1998: "The mathematical model of the scheduling the rehabilitation of the water pipe network" (Licentiate Thesis, TUT, IWEE, Finland).

Asheesh, M., 2001: "Rules and Tools for Non-Navigational Use of International Watercourses", American Water Resources Association, University of Dundee International Specialty Conference on Globalization and Water Management, The Changing Value of Water, Dundee, Scotland, August 6–8, 2001 (CD publication).

Asheesh, M., 2003: *Integrating Rules and Tools for Transboundary Water Resources Management, Case Israel and Palestine* (Tampere: Tampere University of Technology, Finland).

Asheesh, M.; Al-Otaibi, M.; Katko T. S., 2002: "Model for Evaluation of the Scarcity Index of the National and International Water Resources", Conference Paper Presented at the First Regional Conference on Perspective of Arab Water Cooperation, Challenges Constraints and Opportunities, Cairo, Egypt, 12.–14. October.

Falkenmark, M., 1989a: "The massive water scarcity threatening Africa-why isn't it being addressed", in: *Ambio*, 18,2: 112–118.

Falkenmark, M., 1989b: "Middle East Hydro politics: Water Scarcity and Conflicts in the Middle East", in: *Ambio*, 18,6: 350–352.

Falkenmark, M.; Widstrand, C., 1992: *Population and Water Resources, A Delicate Balance*. Population Bulletin (Washington, D.C.: Population Reference Bureau).

FAO, 2000: *New Dimensions in Water Scarcity-Water, Scarcity and Ecosystem Services in the 21th Century*, FAO Report, AGL/MISC/25/2000 (Rome: Food and Agriculture Organization of the United Nation, Land and Water Development Division).

FAO, 2002: I*rrigation Water Management: Irrigation Water Needs*, Part 1: *Principles of water needs*, and Part II: *Determination of irrigation water needs*, Training manual no. 3, available online at http://www.fao.org/docrep/S2022E/s2022e02.htm, December *2002*.

Gleick H. P. 1992: "Water and Conflict", Occasional Paper No.1 of the American Academy of Arts and Sciences, Cambridge, Massachusetts and the University of Toronto for the Project on Environmental Challenge and Acute Conflict.

Gleick, P. H. 1993a: "Water and Conflict, Fresh Water Resources and International Security", in: *International Security*, 18, 1: 79–112.

Gleick, P. H., 1993b: "Water and Energy", in: Gleick, P. H. (Eds.): *Water in Crisis. A Guide to the World's Fresh Water Resources (*New York: Oxford UP): 67–79.

Gleick, P. H., 1995: *Human Population and Water, to the Limits in the 21th Century*. Symposium on Human Population and Water (Oakland, CA.: Pacific Institute for Studies in Development, Environment and Security).

Gleick, P. H., 2000: "Water Conflict Chronology September 2000 version", at: <http://www.worldwater. org/ conflict.htm>, downloaded in April 2003.

ISARM, 2002: "The Significant and Sustainable of The International Aquifer Water Resources Management", in: *Internationally Shared Aquifer Resources Management) (2001)*; framework document IAH, UNESCO, FAO & UNECE, available online at http://www.iah.org/News/2001/016.html, (April).

IWMI, 2001: T*ools for Improved Water Management, International Water Management Institute*, available online at http://www.cgiar.org/iwmi/press/IBSRM.htm, (15.06.).

Kantola, A.; Auvinen, J.; Härkönen, R.; Lahti, V-M.; Pohjalainen, A-L.; Sipola, S., 1999: *Maailman tila ja Suomi* [in Finnish] (Helsinki: Ministry of Foreign Affairs, Department of Development Cooperation, 2000).

Ohlsson, L., 1999: *Environmental Society and Conflict, A Study of Malthusian Concerns* (Göteborg: University of Göteborg, Department of Peace and Development Research).

PECDAR, 2000: *Palestinian Water Strategic Planning Study* (Ramallah: Palestinian Economic Council for Development and Reconstruction (PECDAR)).

Priscoli, J.D., 2000: "Water Security, Interdependency, Dependence and Vulnerability", SIWI Seminar, Water Security for Multinational Water System-Opportunity for Development, Stockholm 34–61.

World Bank, 1992: *World Development Report 1992* (New York: Oxford UP).

25 Factors Relating to the Equitable Distribution of Water in Israel and Palestine

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Abstract

Access to sufficient volumes of water of appropriate quality is a vital human need, as demonstrated by proposals of the World Health Organization (and others). Indeed, the United Nations Committee on Economic, Social and Cultural Rights has recently recognized the human right to water. Many authors have documented the inequitable distribution of water resources in Israel and Palestine, and this issue is included as an element of the Permanent Status negotiations between both Parties. Surprisingly, the Road Map produced by the Quartet does not specifically mention the need for attention to water resources except in the context of multilateral efforts (addressing regional sources of water, and the Jordan River basin in particular). However, it is clear that the current inequitable division of the water resources as a whole in the region must be addressed if Palestine is to become an independent viable State in the future, which is a pre-condition at the end of the second phase of the Road Map.

In this and other facets of the negotiations between the Parties, Palestine should rely upon the principles of customary international law, if a robust and lasting agreement is to be attained. Israel's reliance to date on the single criterion relating to the prior use of water should be considered against the background of the multiple factors determining the equitable and reasonable allocation of international watercourses, as set out in customary international water law. The relevance of such international law to the permanent status negotiations is discussed, and the implications for resource allocations from shared freshwater sources are addressed. It is noted that both parties will benefit significantly from the joint management of shared watercourses in the future, and a framework for this is proposed.

Keywords: Water, Israel, Palestine, International Law, Jordan River

25.1 Introduction

On 28 September 1995, representatives of Palestine and Israel signed *The Israeli-Palestinian Interim Agreement on the West Bank and Gaza Strip*. Article XXXI of that Agreement requires Palestine and Israel (generally referred to as "the Parties", hereafter) to reach final agreement on a number of issues, through the completion of permanent status negotiations. These negotiations are intended to cover several aspects of relevance to the Parties, including water-related issues.

Topics relating to water and wastewater were addressed by Annex III of the Interim Agreement (the *Protocol Concerning Civil Affairs*), and principally in Appendix 1, Article 40 (entitled *Water and Sewage*). This included the recognition by Israel of Palestinian water rights in the West Bank; laid down agreements on the coordination of the management of water supplies and of wastewater treatment and disposal for the interim period; and specified additional water resources which should be made available to Palestine during the same period. General agreements were also included on mutual cooperation, and on the protection of water resources and infrastructure. Article XXXI of the Interim Agreement also stated the following, in Clause 6:

> Nothing in this Agreement shall prejudice or pre-empt the outcome of the negotiations on the permanent status to be conducted pursuant to the DOP [the Declaration of Principles]. Neither Party shall be deemed, by virtue of having entered into this Agreement, to have renounced or waived any of its existing rights, claims or positions.

A similar provision is repeated in Article 40 [8] of Annex III, Appendix 1, in relation specifically to water resources. Negotiations between Palestine and Israel on permanent status have not been concluded, as yet. This chapter addresses factors relating to the key element of negotiations on water between the Parties, this being the need for an equitable and reasonable distribution of the existing regional water resources, as recognized previously by Israel and as required under the principles of customary international water law.

25.2 Water Stress and the Human Right to Water

The three downstream co-riparians to the Jordan River (Israel, Palestine and Jordan) suffer from water deficiency, as determined by either the 'water stress index' or the 'water poverty index' proposed more recently (Falkenmark/Widstrand 1992; Lawrence/Meigh/Sullivan 2002). The threshold for 'absolute scarcity' in relation to water resource availability is generally considered to be 500 m^3/year on a *per capita* basis. Israel currently has a *per capita* utilization of fresh water of approximately 330 m^3/year, while the equivalent figure for Jordan is 160 m^3/year, and that for Palestine is presently about 70 m^3/year. It is clear from these figures that the *per capita* use of water in Israel is almost five-fold greater than that in Palestine, on average.

International authorities on water utilization, such as the World Health Organization and the Food and Agriculture Organization, make no distinctions between the magnitude of the demand for water by different communities within countries, noting only that the degree of attainment of adequate water supplies may differ markedly according to the level of socio-economic development and other factors (Howard/Bartram 2003; WHO 2003). The *International Covenant on Economic, Social and Cultural Rights* of 1966 (ratified by Israel in January 1992 and by the other riparian States to the Jordan River basin in 1976) has been interpreted to include the human right to water (United Nations 2002; see also Guissé 2004). These authorities suggest that all persons should have access to water, and that no distinctions should be made on the basis of color, creed or other matters. It is argued here that this should extend to Israelis and Palestinians.

The concept of equal *per capita* shares of water for Palestinians and Israelis in the region is not new, having been proposed in the early 1990s and repeated more recently. Thus, Shuval (1992, 2000) suggested that 125 cubic metres/person/year (equivalent to 342 litres/person/ day) would be an appropriate volume for "domestic, urban and industrial use" for both the populations, with supplies for agriculture being additional to this currently, but deriving mainly from recycled wastewaters in the future. In addition, strong arguments have been made that there is no basis for discrimination between the Israeli and Palestinian populations in this respect, and that many stakeholders on both sides have accepted this principle (Shuval 2000). Consistent with this analysis, it is argued here that the permanent status negotiations should seek to allocate water on an equal *per capita* basis in Israel and Palestine as a *prima facie* reflection of their equitable entitlements.

25.3 Distribution of Water Resources in Israel and Palestine

The total water resource available to Palestine and Israel in combination has risen over time in recent decades. Thus, for example, the total combined water resource (for an average year) has increased by about 450 MCM/year since the mid-1980s, to some 2,450 MCM/year currently. This reflects an increased use of the available regional water resources, plus the introduction of rising levels of desalination and water reuse, especially by Israel. Recently, Israel has also considered the importation of small volumes of water in bulk, from Turkey (Peterson 2000; Shamir 2004).

Table 25.1: Water Consumption (MCM/year) for Various Uses in Palestine and Israel, for the mid-1980s and 1998. **Source**: Data for the mid-1980s are from the United Nations (1992), while the data for 1998 are from the Palestinian Water Authority and the Statistical Abstract of Israel. It is noted that 1998 is utilized to typify more recent years, as the droughts of 1999–2002 influenced allocations during that period, and full data for 2003 are not yet available. MCM: million cubic meters.

Type of Use	Palestine		Israel		Total	
	Mid-1980s	1998	Mid-1980s	1998	Mid-1980s	1998
Domestic	47	87	325	671	372	758
Industrial	5	5	125	129	130	134
Agricultural	175	165	1,320	1,364	1,495	1,529
TOTALS	**227**	**257**	**1,770**	**2,164**	**1,997**	**2,421**

Despite this significant increase in the total combined water resources over time, the volume of water allocated to Palestine has hardly altered since the mid-1980s (see table 25.1). Within Palestine, the population has more than doubled in this period. The total volumetric allocation of water to domestic use in Palestine has risen through these years, almost maintaining the *per capita* allocation for this category of use. Allocations to industrial use in Palestine have remained effectively unchanged, while those to the agricultural sector have fallen. By contrast, an increase in the total allocation of water for domestic use in Israel has occurred between the mid-1980s and the present, with *per capita* water use for domestic purposes also rising in this sector in Israel, during that period (table 25.2)

Table 25.2: Water Allocations on a per capita Basis (m^3/person/year). **Source:** Calculations by the authors.

Parameter/ Type of Use	Palestine		Israel	
	Mid-1980s	1998	Mid-1980s	1998
Population (millions)	1.47	3.0	4.3	6.0
Domestic	32	29	76	112
Industrial	3.4	1.7	29	21
Agricultural	119	55	307	227
Total Allocations	**156**	**86**	**412**	**360**

One of the reasons for the ongoing paucity of water in Palestine relates to the difficulty in accessing the additional water volumes allocated to Palestine in the Interim Agreement of September 1995. To date, only about 40 MCM/year of a total of 70–80 MCM/year as cited by the Interim Agreement has been made available. A number of reasons exist for this, including the effective veto held by Israel through the Joint Water Committee, relating to the construction of wells and other water infrastructure in the West Bank.

Referring specifically to shared surface water resources, the Johnston Plan of 30 September 1955 sought to generate a preferred allocation pattern for the waters of the Jordan River basin. The Plan was predicated on the water demand in the agricultural sector only (as irrigable land areas were the sole determinant of water demand, as calculated by Johnston). This methodology does not match the present-day approach to allocating shared watercourses, and the allocations proposed in the Johnston Plan are therefore of only limited utility to either Palestine or Israel in the bilateral negotiations on permanent status.

Despite the fact that the Johnston Plan was never officially recognized by the co-riparians to the Jordan River basin, some authors have claimed that its proposed allocations of the water resources within the basin have been respected by the co-riparians since the mid-1950s. However, this is not the case. Both Syria and Israel presently abstract considerably more than their share of the Jordan River waters compared to the Johnston Plan allocations, while Lebanon, Jordan and Palestine receive much less than the shares allocated to them in the Johnston Plan.

It is clear from these data that the existing regional water resources are not shared equitably between the Parties. Israel has dominated the development of the regional water resource, essentially from the time of the partition in 1948.

25.4 Water, the Road Map and Israeli Intentions

The Road Map was released by the Quartet (the European Union, Russia, the USA and the United Nations) in May 2003. The Road Map sought to reinvigorate the peace process between the Parties, laying out a new framework for addressing permanent status and for achieving a two-State solution by mid-2006. Most curiously, the Road Map includes very little by way of direct reference to water-related issues, although it mentions the need to revive the multilateral track on water in the region, during the second phase (supposedly year two of the three-year process). This has clear implications for the allocation of the Jordan River water, and it is anticipated that further discussions may be held on this topic in the near future.

This sparse attention by the Road Map to water-related issues should not be taken to imply that the Parties can ignore the allocation of water during the permanent status negotiations. Thus, the requirement at the end of phase two of the Road Map process to create a viable and independent Palestinian State with provisional borders has clear implications for the need for negotiations on the allocation of the regional water resources prior to that time. This is because a future Palestinian State obviously cannot be viable without a reliable and secure source of water, of appropriate volume.

A recent statement by Shamir (2004) provides a preview of Israel's intentions relating to this matter. In testimony to the Committee on International Relations of the United States House of Representatives, Shamir stated that "the only viable long-term solution for the West Bank" involves major desalination on the Mediterranean coast (proposed at Hadera), funded by the donor community or by the Palestinians. This assessment and conclusion, which has not been accepted by the Palestinian Authority, is flawed in a number of respects:

- it fails to address the high costs of pumping desalinated water from the Mediterranean Sea to the West Bank;
- it fails to acknowledge the fact that desalinated water produced within Israel at the Mediterranean coast would far better be utilized by the near-coastal Israeli population;
- it ignores the need for a reallocation of the existing regional water resources, to attain an equitable and reasonable allocation between two independent sovereign states existing peacefully side-by-side; and
- it fails to recognize Israel's responsibilities in relation to customary international water law (see below), or to other elements of international law.

25.5 Relevant Principles of Customary International Water Law

International water law has been developed over the whole of the last century, but it has been codified only relatively recently. This process is ongoing, and continues to refine the principles relating to the allocation of shared water resources. As the process of codification continues, customary international law on water is strengthened.

Israel is bound by the principles of customary international law, whether or not it has signed or ratified international agreements to this effect. This includes customary international law on water. Three instruments, all of which constitute evidence of customary international law, are of particular note in the latter respect:

- *The Helsinki Rules on the Uses of the Waters of International Rivers,* adopted by the International Law Association in 1966;
- *The Seoul Rules on International Groundwaters,* adopted by the International Law Association in 1986; and
- The *Convention on the Law of the Non-Navigational Uses of International Watercourses,* adopted by the United Nations General Assembly and opened for signature in 1997.

While all of these instruments have evidentiary value as to the applicable rules of customary international law, the last is the most recent and authoritative, being the product of preparatory work and negotiations within the United Nations system.

Customary international law on water contains a number of key principles. The most important of these relate to the equitable and reasonable allocation of shared watercourses; the avoidance of significant harm; and the need for prior notification of any development plans which could affect shared watercourses.

The most fundamental standard of international law for allocating shared freshwater resources among two or more States is that of *equitable and reasonable allocation*. The International Court of Justice recognized this in its 1997 judgment in the Gabcikovo-Nagymaros Project relating to the Danube River, when it referred to a State's "basic right to an equitable and reasonable sharing of the resources of an international watercourse." In stating this rule, the Court was no doubt mindful of the 1997 UN *Convention on the Law of the Non-Navigational Uses of International Watercourses*, to which it referred several times in its judgment and which embodies the rule of equitable and reasonable utilization. This rule is also a cornerstone of the Helsinki Rules and the Seoul Rules, referred to above.

It is notable that Israel has previously approved the standard of the equitable allocation of regional water resources. Thus, for example, the Declaration of Principles includes a demand for the equitable utilization of water (see Annex III, paragraph 1), and this agreement remains binding upon the Parties. Israel has also approved this general principle in other documents, including the tripartite Oslo Declaration on water resources, and *The Bahrain Environmental Code of Conduct for the Middle East*. As early as 1981 in an official response to the United Nations, the Israeli Government stated the following with respect to regional water resources: "Under international law this principle of equitable distribution among riparians is a well-established right" (United Nations 1981).

The avoidance of significant harm is the second most important standard arising from international law relating to shared watercourses. The 1997 UN Convention reflects that obligation (see Article 7 of the Convention) as one of the general principles in the field. It also figures in the Helsinki Rules of 1966 (in Articles V and X, being termed "substantial injury" or "substantial damage" therein). The *Bellagio Draft Treaty on Transboundary Groundwater* of 1988 referred to the need to "avoid appreciable harm" to the groundwater of other States. Several other international legal instruments also contain such a provision. Article 40 [3] [b] of Appendix 1, Annex III to the Interim Agreement notes the requirement for the Parties to take "all necessary measures to prevent any harm to water resources, including those utilized by the other side." This is important in the context of the watercourses shared between Palestine and Israel, as reflected by past accusations of each Party against the other (in relation to potential pollution of the aquifers, in particular).

The obligation of prior notification is the third principle of importance arising from customary international water law. This requirement was included in both the 1997 UN Convention (Part III, Articles 11–19) and the Helsinki Rules (Article XXIX), although in somewhat different forms. Article XXIX [4] of the Helsinki Rules is particularly interesting, as it states that a failure to provide prior notification will affect the weight accorded to any change in the regime of a drainage basin, when equitable and reasonable shares are determined at a later time.

25.6 Reallocation and the Importance of the Transition Period

The three pillars of customary international water law as discussed above are certainly of relevance to Israel and Palestine, especially as the bulk of the water resources in the region as a whole are international watercourses, shared by two or more parties. It is argued here that the existing water resources available to Israel and Palestine should be reallocated, to comply with the principles of customary international law.

However, it is most important to note that any such reallocation of the regional water resources would not have immediate effect, as the existing infrastructure would not allow Palestine to abstract greatly increased volumes of water, and would need to be developed over time following the agreement. This implies that a transition period would exist following any agreement to reallocate water based on the principle of equitable and reasonable use. The most important aspect of the transition period is that Israel would have sufficient time to further develop its own water resources following the conclusion of a permanent status agreement with Palestine. As a result of this, the volumes of water available to Israel would not necessarily be reduced by any such agreement. This is of great importance to both Parties, and should provide a key to their determination to reach an equitable and reasonable allocation of the existing water resources within the region.

25.7 Future Management of the Shared Water Resources

Once the equitable and reasonable allocation of the available water resources has been agreed by Israel and Palestine, the Parties will need to consider the future management of the shared water resources. Many authors have documented the historic mismanagement of the available water resources in Israel and Palestine. Examples of such mismanagement follow:

- Abstraction rates have commonly exceeded recharge volumes in the shared aquifers, especially during periods of drought. The Gaza sub-aquifer (which constitutes a geographical part of the much larger Coastal Aquifer) has been particularly heavily affected, with annual abstraction rates presently averaging about 140 MCM/year, as against recharge rates of about 60 MCM/year. However, almost all the shared watercourses have been subject to over-abstraction in recent years.

- At least in part as a result of such over-abstraction, water quality has deteriorated in all the shared aquifers over the last decade, with salinity intrusion being common, and contamination from terrestrial sources also occurring (especially in Gaza).
- The drought years of 1999–2002 were accompanied by a very considerable reduction in the levels of the aquifers and of Lake Tiberias (Kinneret), this being evidence of the poor management of the resources in relation to ensuring that abstraction rates match the previous rates of recharge.
- The Dead Sea has decreased markedly in both level and size during the last two decades in particular, principally due to the abstraction of high flows by Israel from Lake Tiberias, to feed the National Water Carrier.

It is emphasized that the aquifers in particular are vital resources for both Israel and Palestine in the future. Their shared nature implies that both Parties have a responsibility for their protection (and hence, for the avoidance of significant harm to the other Party, as noted previously).

The historic mismanagement of the shared water resources cannot continue, if they are to be of acceptable quality and are therefore to be of utility to the Parties in the future. For this reason and to ensure that any agreement on allocations is respected, it is clear that the shared resources should be subject to some form of joint management regime in the future. In any such joint management scheme, the monitoring of water supplies is of very considerable importance, as each Party has a duty of care to supply consumers (and probably also each other, in the future) with water of the appropriate quantity and quality. The current level of monitoring effort in both Palestine and Israel is insufficient to guarantee the safety of consumers.

Both Parties will also wish to have access to data on the water quantities utilized in the future, as part of their efforts to manage the resources efficiently and to ensure that the other side is adhering to its rightful allocations from the shared watercourses. This implies the need to install a comprehensive monitoring network within the region, extending and reinforcing the monitoring systems used presently by either Party. The installation of telemetry links at key nodes in such a network would ensure that both Parties receive real-time data on abstraction rates at critical locations, and this would serve to defuse future disputes between the Parties. Any such monitoring system should also extend to water quality parameters, as both Parties have an interest in ensuring that the water provided to end-users is of appropriate quality, and that 'significant harm' is avoided.

It is noted that none of these requirements is unique to the region, and that the installation of a comprehensive monitoring network to provide the basis for coherent water resource management is a facet of all such systems in developed nations. With respect to the aquifers, it is critically important that the Parties introduce a system of management that matches abstraction rates in any one year to the previous year's recharge rates. This will allow the sustainable use of the available water resources, and should eliminate the historic mismanagement of those resources.

25.8 Conclusions

The difficulty in ensuring a fair availability of water to the Parties has been cited as a major impediment to any future peace agreement between Israel and Palestine. However, this need not be the case. While Israel has resisted the demand for the equitable allocation of the existing regional water resources, this is a requirement of customary international water law, which applies to Israel as to other states.

In reality, the equitable allocation of the regional water resources would not disadvantage Israel, as new sources of water (many of which are already under development) could be utilized to supplant any volumes allocated to Palestine under a permanent status agreement. If this were to occur, both Parties would attain water security, and this should clearly be the primary objective for each side.

An enhanced management regime will be needed in the future, both to improve the protection of the shared watercourses and to ensure that the Parties abide by the allocations to be determined through the permanent status negotiations. Such improvements are in any event required, to eliminate the historic mismanagement of the critical resources.

References

Falkenmark, M.; Widstrand, C., 1992: *Population and water resources: A delicate balance*. Population Bulletin 47 (3). (Washington, D.C.: Population Reference Bureau).

Guissé, E-H., 2004: *Final Report of the Special Rapporteur.* Commission on Human Rights, Sub-Commission on the Promotion and Protection of Human Rights, Fifty-sixth session; Doc. E/CN.4/Sub.2/2004/20 (New York: United Nations).

Howard, G.; Bartram, J., 2003: *Domestic Water Quantity, Service, Level and Health*. WHO/SDE/WSH/03/02 (Geneva: World Health Organization).

Lawrence, P.; Meigh, J.; Sullivan, C., 2002: *The Water Poverty Index: An International Comparison.* Economics Research Papers 2002/19 (Keele: Keele University).

Peterson, S., 2000: "Turkey's plan for Mideast peace", in: Christian Science Monitor, 18 April.

Shamir, U., 2004: "Testimony", in: U.S. Congress, House, Committee on International Relations, Hearings on "Water Scarcity in the Middle East: Regional Cooperation as a Mechanism towards Peace" (Washington, D.C.: GPO, 5 May).

Shuval, H., 1992: "Approaches to resolving the water conflicts between Israel and her neighbors – a Regional Water for Peace Plan", in: *Water International*, 17,2: 133–143.

Shuval, H., 2000: "A proposal for an equitable resolution to the conflicts between the Israelis and the Palestinians over the shared water resources of the Mountain Aquifer", in: *Arab Studies Quarterly*, 22,2: 33–62.

United Nations, General Assembly, 1981: A/36/260/Add. 1, 25 September 1981: Thirty sixth session, Agenda item 69 (k); response by Israel of 25 March 1981; paragraph 41.

United Nations, 1992: *Water Resources of the Occupied Palestinian Territory* (New York: United Nations).

United Nations, 2002: General Comment No 15 of the Committee on Economic, Social and Cultural Rights entitled: *The right to water (arts.* 11 *and* 12 *of the International Covenant on Economic, Social and Cultural Rights)*. UN Document E/C.12/2002/11 (New York: United Nations, 26 November).

WHO, 2003: *The Right to Water* (Geneva: World Health Organization).

26 Groundwater Management in a Cross Boundary Case: Application to Israel and the Palestinian Authority

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Abstract

To achieve temporal economic efficiency for groundwater in a geographic region such as the West Bank, we propose a management system that is a combination of a nonprofit regional utility with a representative governing body. Water prices would be determined by the utility to balance supply and demand and meet specific groundwater use limits. Revenue from water pricing would provide funds for investments to expand supply through water recycling and new technologies such as desalination. The desired levels of investment and security would be determined by a representative body of water users who would express willingness to pay for these public goods. Simulation modeling indicates that water prices could fall over time as investment and groundwater storage increase. While a water market could improve spatial allocation, it would not necessarily address sustainability or provide for investment.

Keywords: aquifer, management, pricing, sustainability, utility, water.

26.1 Introduction

The Mountain Aquifer which straddles Israeli and Palestinian lands can be viewed as a commons that provides benefits to users over time and over the geographic area of the West Bank. Pumping beyond the safe yield – the current situation – can destroy the aquifer for all users. For such groundwater externalities, some (Gisser/Sanchez 1980; Hampton 1990) have suggested privatization: determination of property rights followed by market solutions. Here, we argue for explicit management of the aquifer as a common property, based on a hydro-economic model, and recommend groundwater pricing as essential for appropriate management.

A common property resource has physical characteristics such that sustained use requires group, rather than individual, decisions about management. For example, for groundwater under scarcity conditions, if each user determined withdrawals according to individual maximum gain, then there would be destruction of the resource. In contrast, decision-making in a commons would determine as a group how much each user could withdraw to maintain the resource. Ostrom (1990) discusses successful examples of management in a commons. Local water management districts in the U.S provide examples of groundwater management (Kenney 1997): local water districts manage water supplies for irrigation and domestic uses and fund local improvement projects through fees and taxes.

Price incentives can be an important tool for common property management. For water (as for other resource situations), economists recommend price incentives to promote efficient use (Rogers 1993). Pricing groundwater in water-short areas could improve its allocation toward higher value uses, i.e. with an adequate price, groundwater would not be applied to low value field crops such as grains or cotton. Price can be determined through a water market, but it can also be determined administratively, as in the case of water utility pricing. Although groundwater pricing has recently been advocated, political pressure has prevented its adoption except in rare cases.

26.2 Background: West Bank and Mountain Aquifer

Cooperation is essential to improve the well-being of both Israelis and Palestinians utilizing water resources in the West Bank (US NAS/Royal Scientific Society of Jordan/Israel Academy of Sciences and Humanities/Palestine Academy for Science and Technology 1999). Cooperative agreements about water already exist: e.g. the Annex to the Israel-Jordan Peace Treaty for water-related matters and the U.S.-Israel-Palestinian Trilateral agreement to promote cooperative efforts to increase the availability and more efficient use of water resources. But these agreements need to be implemented in the form of explicit management plans.

The Mountain Aquifer lies for the most part under the West Bank. It is the source of about 30 per cent of the fresh water supply in Israel and is the most important source of fresh water for Palestinians in the West Bank (Isaac 1998). The aquifer is recharged from rain; annual rainfall averages 600 mm per ha. The aquifer can be divided into three major units: the Western basin with a 350 mcm safe yield, the Northeastern basin with a safe yield of 140 mcm, and the Eastern basin with an annual 125 mcm safe yield. Evidence of overexploitation is the decline in the water table of 0.3–0.4 meters per year.

Water use by Israelis and Palestinians exhibits great disparity. The total annual average recharge is 615 mcm per year; from this, Israel uses about 490 mcm while Palestinians use about 125 mcm per year (Isaac 1998). Per capita use is 300 cm per year in Israel versus 70 cm in the West Bank. Further evidence of disparity is the types of crops grown by each side (Elmusa 1996). Palestinians irrigate vegetables and fruits, whereas Israelis irrigate mainly field crops such as wheat and cotton; field crops have much lower value. The Palestinian irrigated area per person is about one-fourth that of Israel.

Any cooperative approach would require that this disparity be addressed. One aspect would be a guarantee for increased household water availability for Palestinians, for example guarantee a level for household water use of 100 cm annually. Note that any level less than 500 cm per person is considered beyond the "water barrier" (Clarke 1993: 67).

Water pollution is a major concern with respect to contamination of the aquifer. Pollution sources include chemical and industrial sources as well as raw sewage; many Palestinian villages lack basic treatment facilities. Improved treatment would both protect groundwater and provide an additional source of water. Currently, wastewater volume is about 45 mcm per year.

In the peace accords, Palestinians and Israelis have agreed to manage common water resources jointly (Elmusa 1996). The form that joint management would take is then the issue (Eckstein/Zackai/Nachtom 1994; Haddad/Feitelson 1994; Committee on Sustainable Water Supplies for the Middle East 1999). The work of Haddad and Feitelson emphasizes administrative needs for joint management, including monitoring, planning, enforcement, and other management activities. In their concept of joint management, independent governance bodies for Palestinians and Israelis would form a combined board and carry out needed activities through a secretariat. However, their work does not address economic organization and institutions.

26.3 Alternative Institutions for Water Pricing

The water market approach for Middle East problems is of continuing interest (Fisher 1995; Becker/Zeitouni/Schecter 1996). Previous studies have investigated the implications of potential water market trading and valuation. Spatial optimization for the West Bank shows that an additional 100 mcm should be diverted to the Palestinians; modeling implies an equilibrium water price of about 40 cents/cm with a shadow price of about 80 cents/cm (Zeitouni/Becker/Schechter 1994). Similarly, Fisher (1995) found that: "the value of the water in dispute among the parties is not great. Using a liberal estimate, it is currently a maximum of $ 110 million per year and will rise to a maximum of less than $ 500 million per year by 2020. Such values are small compared with the economies involved ... compared with the cost of military equipment" (Fisher 1995: 386).

A water market could improve water allocation, but it would not provide for large scale investment needs of wastewater treatment and new technologies. Water quality and security are public goods that are not valued by a market.

West Bank water management could follow the pattern of a water utility. A water utility sets prices for water. A utility maintains a production and distribution system for a local service area, makes plans for future conditions, and finances investment through user revenues. A water utility does not own the water it manages. There is a contractual arrangement with citizens for whom water is managed.

Some have proposed that because of the political situation in the West Bank and the lack of trust among parties, water management should be carried out by a private utility. While there is much experience with successful privatization of water utilities, for example in France, there is no guarantee that a profit-oriented private utility would carry out needed large scale investments for water supply and improvements in pollution prevention.

This paper makes the argument that a nonprofit public utility is an appropriate type of organization to achieve temporal efficiency in water management. The basis is the comparison of decision-making by a nonprofit utility with the conditions required to solve the inter-temporal planner problem for groundwater.

26.4 The Inter-Temporal Planner Problem

The planner problem – described by a hydro-economic model – concerns inter-temporal economic efficiency: the planner seeks optimal water withdrawal rates and investment rates such that no reallocation of withdrawal and investment would yield a higher level of welfare in every time period. In the language of optimal control theory, the control variables are groundwater withdrawal rates and investment in water supply technologies (recycling and new). The objective function is the total social value (discounted over time) resulting from withdrawal and investment decisions. State variables are water utilization, net consumption, a measure of water security, and water quality.

Constraints for the dynamic system are:

1. groundwater stock is determined by rain and withdrawals;
2. total demand for households and for production requirements is equal to total supply (withdrawal, surface water, recycled supply, and supply from new technologies);
3. net consumption is production minus costs of investment and variable cost of supply;
4. variable cost is specified in terms of withdrawal cost, recycling cost, new technology cost, and surface cost;
5. there is a minimum guarantee for per capita water use;
6. the storage level should not fall below the 'safe' level.

Dynamic optimization provides a guideline for price-setting rules. The economic price of water is associated with achieving demand-supply balance. The shadow price of groundwater withdrawal is determined by value of future groundwater uses. Pricing rules are as follows:

1. Groundwater price should be the shadow price plus variable cost of withdrawal.
2. For each non-groundwater source, price should equal marginal cost (short term variable cost plus annual investment cost). Thus, optimal allocation across supply sources should result in equality of marginal costs.
3. The same price should be placed on surface, ground, recycled, and new technology sources.

26.5 Decentralized Organization for Inter-Temporal Economic Efficiency

An organizational structure satisfying the inter-temporal optimization problem has consumers and producers operating in spot market and a public utility making inter-temporal decisions. (The organizational structure is called decentralized because information about households and producers is private.)

Water use decisions by households and producers would be made myopically in each time period given appropriate water prices. Producers (agricultural and industrial) would choose water use each time period according to value of output relative to water prices. Households would determine water demand given the water price. Households would also pay fees to the utility for its maintenance of water security and water quality. Fees and prices could vary for different types of households. Because security and water quality are public goods, the sum of personalized prices would reflect the social value for each public good. Social values could be determined from expressions of household willingness to pay.

The public utility would make supply and investment decisions inter-temporally subject to hydrologic and rainfall conditions to meet demand each period. Each period, the utility would receive revenue not only for water supply but also for maintaining water security and water quality. The utility would set water prices to satisfy zero economic profit, subject to review by a regulatory body. Surface uses, groundwater withdrawal, recycling, and new sources would all have the same price. The public utility would also have to satisfy the household water guarantee.

The proof of the efficiency of this decentralized economic organization follows the paradigm of the 'first theorem of welfare economics'. Comparing first order conditions necessary for optimality in both the planner and decentralized problems, the efficiency conditions for inter-temporal efficiency will be satisfied by the decentralized problem. Feasibility of net consumption is implied by the zero profit condition. Thus, it is possible to find a feasible, efficient solution for groundwater management through the decentralized organization with a public utility, provided consumers and producers have the right prices.

26.6 Social Organization for Common Property Management

The needs of common property management of groundwater problems require more than an economic approach. First, because water security and water quality are public goods, their social values (or tradeoffs between private and public goods) must be determined. While measurement of willingness to pay can help to determine social values, social decisions (implying value tradeoffs) should also be made in a public arena. There is also a need to determine the appropriate discount rate, a matter of inter-generational equity. Issues of fairness also require social resolution. Thus, there is a role for social organization beyond the economic organization described above.

Perceived justice and equity are considered among the most important criteria for success of a group process (Mikula 1980). Two characterizations are: rule fairness (or procedural justice) and outcome fairness (or distributive justice; Zajac 1995). Since any procedure originally perceived as fair can lead to an outcome distribution that seems unfair, social organization should include procedures to adjust for any perceived fairness problems. For example, water rate-setting should be subject to review by water user representatives.

According to mediation theory, the perception of a common ground in framing a group process can be important for its success. A common ground exists whenever the participants in a decision-making process experience shared commitment to cope with problems or issues (Gray 1989), such as sustainable water management. If group members place a value on a successful group outcome, they may be willing to relax pure self interest, and hence a group outcome is possible in spite of individual differences. Social psychologists have shown that when participants with different values can openly discuss their diverse viewpoints in the decision process, they can become more committed to any decision eventually reached (Moscovici 1994).

26.7 Conclusions

The final status talks between the Israelis and Palestinians must settle questions of equitable allocation of water rights for resources common to both sides and joint management of these resources (Elmusa 1996). Important questions to be resolved are, what does joint management mean and how close will the level of cooperation be? The hydro-geologic system for the Mountain Aquifer cannot be divided, and water contamination from any source would affect water supply for both Israelis and Palestinians. Thus, essential for groundwater sustainability is that eventually there be true cooperation between Israelis and Palestinians in the management of the Mountain Aquifer.

This chapter addresses what form economic organization should take, given the joint will to cooperate. The economic organization of a nonprofit water utility making investment and withdrawal decisions and applying appropriate pricing rules, together with domestic users and producers operating in a 'spot' market, satisfies conditions for inter-temporal efficiency. To the economic organization social structures must be added to determine social values and adjudicate issues of fairness. water markets and private utilities could not provide these requisite social management elements.

References

Becker N.; Zeitouni, N.; Schecter, M., 1996: "Reallocating Water Resources in the Middle East Through Market Mechanisms", in: *International Journal of Water Resources Development*, 12: 17–32.

Clarke, Robin, 1993: *Water, The International Crisis* (London: Earthscan).

Committee on Sustainable Water Supplies for the Middle East, 1999: *Water for the Future, The West Bank and Gaza Strip, Israel and Jordan* (Washington, D.C.: National Academy Press).

Eckstein, Z.; Zackai, D.; Nachtom, Y., 1993: T*he Division of Water Sources Between Israel, the West Bank and Gaza: An Economic Analysis*. Manuscript (Tel-Aviv: The Armand Hammer Institute for Peace).

Elmusa, S. S., 1995: "Dividing Common Water Resources According to International Water Law: The Case of the Palestinian-Israeli Waters", in: *Natural Resource Journal*, 35: 223–241.

Elmusa, Sharif S., 1996: "Negotiating Water: Israel and the Palestinians"; Columbia International Affairs Online, at: <www.ciaonet.org/wps/els01>.

Fisher, F.M., 1995: "The Economics of Water Dispute Resolution, Project Evaluation and Management: An Application to the Middle East", in: *International Journal of Water Resources*, 11,4: 377–391.

Gisser, M.; Sanchez, D., 1980: "Competition versus Optimal Control in Groundwater Pumping", in: W*ater Resources Research*, 16: 638–642.

Gray, B., 1989: *Collaborating: Finding Common Ground* (San Francisco, CA: Jossey-Bass Publishers).

Haddad, Marwan; Feitelson, Eran, 1994: *Joint Management of Shared Aquifers: The First Workshop* (Jerusalem: The Harry S. Truman Research Institute for the Advancement of Peace).

Hampton, Nathan Eric, 1990: "Costs of California's Correlative Rights Doctrine as a Solution to Groundwater Overdraft", in: *Contemporary Economic Polic*, 8,4: 106–17.

Isaac, J., 1998: "A Palestinian Perspective on the Water Crises", in: *Palestine-Israel Journal of Politics, Economics and Culture*, 5,1: 54–58.

Kenney, Douglas S., 1997: *Resource Management of the Watershed Level: An Assessment of the Changing Federal Role in the Emerging Era of Community-Based Watershed Management* (Boulder, CO: University of Colorado School of Law).

Mikula, Gerold, 1980: *Justice and Social Interaction. Experimental and Theoretical Contributions from Psychological Research* (New York, NY: Springer-Verlag).

Moscovici, Serge; Doise, Willem, 1994: *Conflict and Consensus. A General Theory of Collective Decisions* (Thousand Oaks, CA: Sage Publications).

Ostrom, E., 1990: *Governing the Commons: the Evolution of Institutions for Collective Action* (New York: Cambridge University Press).

Rogers, Peter, 1993: *America's Water. Federal Roles and Responsibilities* (Cambridge, MA: MIT Press).

U.S. National Academy of Sciences, Royal Scientific Society of Jordan, Israel Academy of Sciences and Humanities, Palestine Academy for Science and Technology, 1999: *Water for the Future: The West Bank and Gaza Strip, Israel, and Jordan* (Washington DC: National Academy Press).

Zajac, D., 1995: *Political Economy of Fairness* (Cambridge, MA: MIT Press).

Zeitouni, N.; Becker, N.; Schechter, M., 1994: "Models of Water Market Mechanisms and an Illustrative Appli-cation to the Middle East", in: *Resources and Energy Economics*, 16: 303–320.

27 Feasibility Study for Cooperation in Wastewater Treatment Plants and Landfills for Israelis and Palestinians in the West Bank

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Abstract

This study examines the feasibility of cooperation and of joint *wastewater-treatment plants* (WWTP) and *municipal solid waste* (MSW) landfills to be shared by Israeli settlements with the Palestinian population in the West Bank. Five feasibility factors were weighed: geographical and environmental considerations, technical aspects, institutional factors, financial options and political constraints.

The geographical and environmental considerations involve the spatial arrangement of the Israeli settlements and the Palestinian population in the West Bank as well as attendant environmental issues. The technical aspects are related to the differences in environmental and technical capacities and an evaluation of if, and how, these technical differences can be bridged. The institutional factors were examined in the light of the existing institutional framework and how it might function in the agreements between the parties. The financial issues were explored in the context of the present situation regarding the financing of such projects by both parties and how these arrangements can be applied in a cooperative manner. The political constraints, which are viewed by the parties as the most challenging, were examined in light of the parties' political views as they relate to environmental cooperation. Five case studies between Israelis and Palestinians are described.

The chapter, which explores cooperation for the prevention of pollution of the shared mountain aquifer, has reached the conclusion that cooperation exists between Israeli settlers and Palestinians even though some political and institutional factors do not support cooperation. This cooperation stems from geographical, environmental and technical constraints, and overcomes financial constraints. Local initiatives are the main facilitator to cooperate rather than organized, national initiatives. They are not a result of the urgent need to prevent potential and actual pollution to the shared aquifer. This cooperation can be extended as political constraints change in the future.

Keywords: Israeli settlements, joint infrastructure, landfills, Palestinians, West Bank, WWTP.

27.1 Introduction

Cooperation between Palestinian and Israeli settlements in the West Bank regarding wastewater treatment and solid waste disposal facilities has not yet been the subject of an in-depth study. This is apparently due to the notion that cooperation between the parties is not feasible because of political factors. However, the danger to the joint mountain aquifer is very real (Gvirtzman 2002; Tagar/Keinan/Bromberg 2004), and requires extensive attention, especially regarding the promotion of an environmental infrastructure in order to protect the aquifer from pollution.

The mountain aquifer contributes about 600 mcm (million cubic meters) of water per year to the local water supply (Gvirtzman 2002), which is essential to the populations of Israel and the Palestinian Authority (PA). The aquifer lies along the main ridge of mountains of the West Bank and is vulnerable to pollution of many kinds due to its pervious nature and the density of human activities along the top of the aquifer recharge area. This prevents recharge and creates pollution from sewage, industrial wastewater and solid waste leach ate (Gvirtzman 2002). Most of the mountain aquifer recharge area is located in the West Bank, where multiple types of jurisdiction apply, requiring various types of regulation, which will prevent pollution of the aquifer.

27.2 Methods

Feasibility of cooperation was examined in the context of five feasibility factors:

1. *Geographical* and *environmental factors* such as geography, population data and density, spatial arrangement and heterogeneity of Palestinian and Israeli populations', watersheds, aquifer sensitivities, nature, environmental problems caused by Palestinians and Israelis in their territories as well as the extent and severity of pollution.
2. *Technical factors* related to cooperation, mainly whether technical gaps and standards exist, if they present a significant obstacle to cooperation and how technical gaps and differences in standards can be bridged in future cooperation.
3. *Institutional factors* related to the agreements between both parties, such as which institutions have been established? Do they facilitate cooperation? Have they promoted cooperation in the last few years of functioning and can their structure and mode of operation encourage cooperation between Palestinians and Israeli settlements?
4. *Financial factors* such as the financial arrangements each party has made to fund environmental infrastructures, the financial arrangements in existing cooperation in the West Bank and other arrangements that can be applied for any future cooperation in any cooperation mode.
5. *Political factors* related to forces that have influenced existing and past cooperation, as well as the magnitude of this factor in a future cooperation. It also deals with the parties views and will for cooperation and what are their political attitudes towards pollution prevention in the West Bank.

Each factor was examined in the context of the situation in the West Bank and in light of whether this situation enables and/or favors future and existing cooperation, and the driving forces that facilitate this cooperation. In addition, the conclusions relate to the question of whether cooperation between Palestinians and Israeli settlements can benefit the state of the environment and prevent pollution in a more efficient and effective manner.

Data were collected from governmental agencies in Israel, scientific literature, two Israeli Environmental Protection Associations (Judea and Samaria) that operate in the West Bank and deal with the environmental issues of 23 Israeli settlements and municipalities. In addition, interviews were conducted with Palestinians and Israelis practitioners involved in environmental institutions and environmental management in the West Bank.

27.3 Results and Discussion

27.3.1 Types of Cooperative Programs

There are four potential types of environmental cooperation in the West Bank between Palestinians and Israeli settlements, arranged below in descending order of the level of cooperation:

1. *Joint infrastructure*: Palestinians and Israeli settlements use a joint infrastructure that is equally owned by the two parties or built by a private company with the two parties' consent, with environmental services provided equally to the parties: This kind of cooperation does not exist between Palestinians and Israelis in the West Bank. Nor does it exist between Palestinians and Israelis that live outside of the West Bank.

2. *Joint use of one of the parties' infrastructure*; both parties use the infrastructure belonging to one of the parties. The side receiving services from the other party's infrastructure pays for the services rendered in accordance with an agreement between the parties or without such agreement. This mode of cooperation exists, but is uncommon between Palestinians and Israelis in the West Bank.
3. *Sharing operation activities/costs*: Both parties use the infrastructure belonging to one of the parties. The party that receives services from the other party's infrastructure pays for the services by providing the operating side with work force and/or machinery and/or materials. This mode of cooperation can be found in some instances in the West Bank where Palestinians use Israeli infrastructure without any agreement signed between the parties.
4. *No cooperation* – separate infrastructures.

27.3.2 Geographical and Environmental Factors

The total area of the West Bank covers approximately 5,600 square kilometers (2,160 square miles) excluding the Jerusalem annexation. About 2.1 Million Palestinians live in this area (UNDP 2004); 40 per cent in 8 cities and 60 per cent in approximately 500 villages. The Israeli population consists of 240,000 Israelis living in 120 community settlements and cities (data from Israel Ministry of the Interior). Hence, the population density of Palestinians and Israelis in the West Bank is about 418 people per square kilometer, much higher than that of Israel and the Arab states. None of the population is concentrated in a particular area of the West Bank and the spatial heterogeneity is very high. Figure 27.1 shows the spatial arrangement of Palestinians and Israelis in the West Bank.

Watersheds and the water divide are shown in figure 27.2. No part of the population dwells exclusively on any of the watersheds and/or on either side of the water divide. Both populations contribute to the pollution of dry streams on both sides of water divide. About 75 per cent of Israeli sewage is treated in accordance with Israeli standards and only one Palestinian city, the city of Al-Bireh, treats its sewage according to these standards. The city of Bethlehem disposes of its western watershed sewage by allowing it to flow into the Western Jerusalem WWTP. The rest of the Palestinian sewage is poorly treated (Tagar/Keinan/Bromberg 2004).

Figure 27.3 shows the spatial arrangement of the MSW dumpsite of industrial waste, construction and demolition waste in the West Bank (Environmental Protection Association Judea 2004; Environmental Protection Association Samaria and Jordan Valley 2004). Some of these dump sites contain hazardous waste, and are created due to poor waste disposal management and treatment in the Palestinian sector. Most of the Israeli waste is disposed of in well-organized and properly managed landfills that accept Palestinian MSW from the vicinity. Figure 27.3 also shows aquifer sensitivity to pollution. Most dumpsites are located on the most sensitive parts of the West Bank and pose a serious pollutant threat to the mountain aquifer.

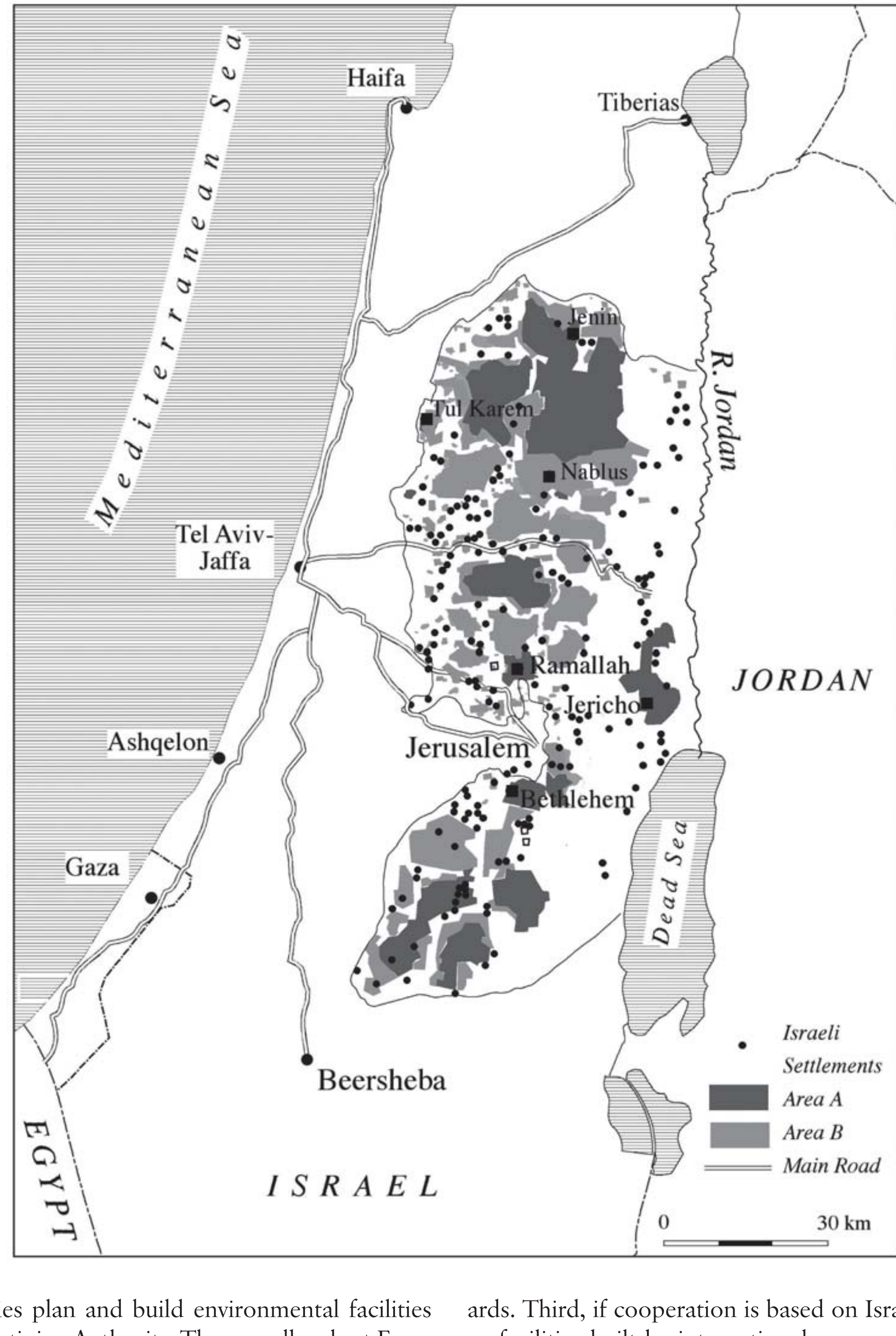
In these geographic conditions, where both populations live in close proximity to one another, and where there are serious threats of pollution, there is an advantage, from a planning aspect, to the establishment of joint infrastructure for wastewater collection and treatment as well as for waste disposal sites. Moreover, in conditions of high population density, it is important to preserve as many open spaces as possible and utilize land resources as efficiently as possible. Land is needed for infrastructure as well as for pipelines and buffer zones. Joint infrastructure can save a large amount of valuable and scarce land for other uses, such as nature and the conservation of open spaces.

27.3.3 Technical Factors

Israel ranked 22 in the Human Development Index (HDI) of the United Nation Development Program (UNDP 2003). The Palestinian Authority is not listed in the Human Development Report, but it may be assumed that the Palestinian Authority would be ranked in the area of the average Arab state, at around HDI 110. Other analyses, such as the Technology Achievement Index (UNDP 2001), show that the technological gap between Israel and the Palestinian Authority is significant.

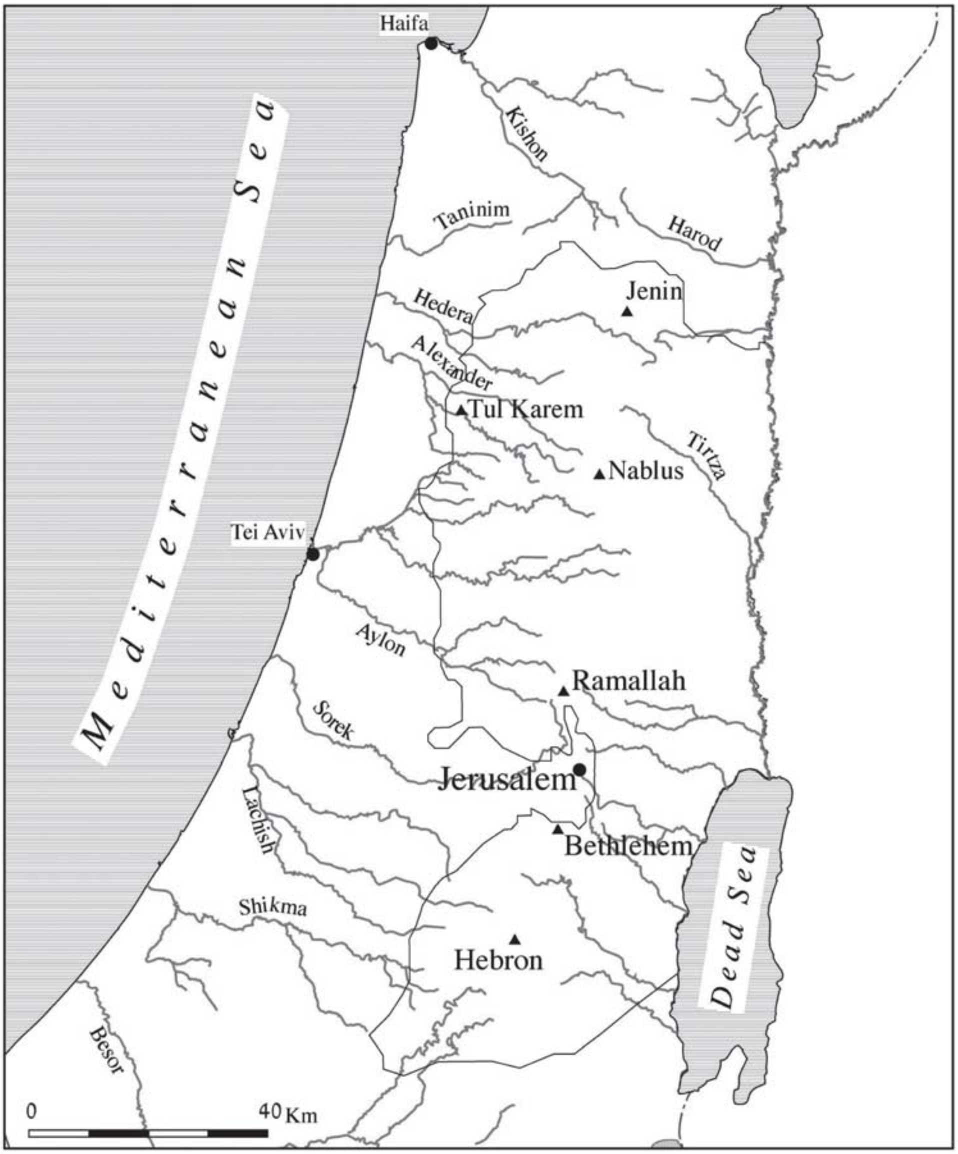
The question is whether technological gaps present an obstacle to cooperation in environmental solutions or in the planning and construction of joint environmental facilities. It can be argued that technological gaps are unlikely to create problems in cooperation. First, in the reality of environmental degradation in the West Bank, attaining high standards is less important. A WWTP that attains 30 or 40 mg/l BOD effluent is much preferable to having raw untreated sewage that can pollute the aquifer. Second, the do-

Figure 27.1: Spatial Arrangement of Palestinian and Israeli Settlements in the West Bank. Area A – Full Palestinian Military and Civil Control, Area B – Full Palestinian Civil Control and Israeli Military Control, Area C – Full Israeli Civil and Military Control (the Rest of the West Bank).



nor countries plan and build environmental facilities for the Palestinian Authority. They usually adopt European standards. In cases of disparities in standards, a compromise can be achieved so that Israel can meet its old standards (prior to standards upgrade) and donor countries can fund facilities to meet those standards. Third, if cooperation is based on Israeli facilities or facilities built by international companies, technological gaps are not likely to undermine cooperation and environmental quality.

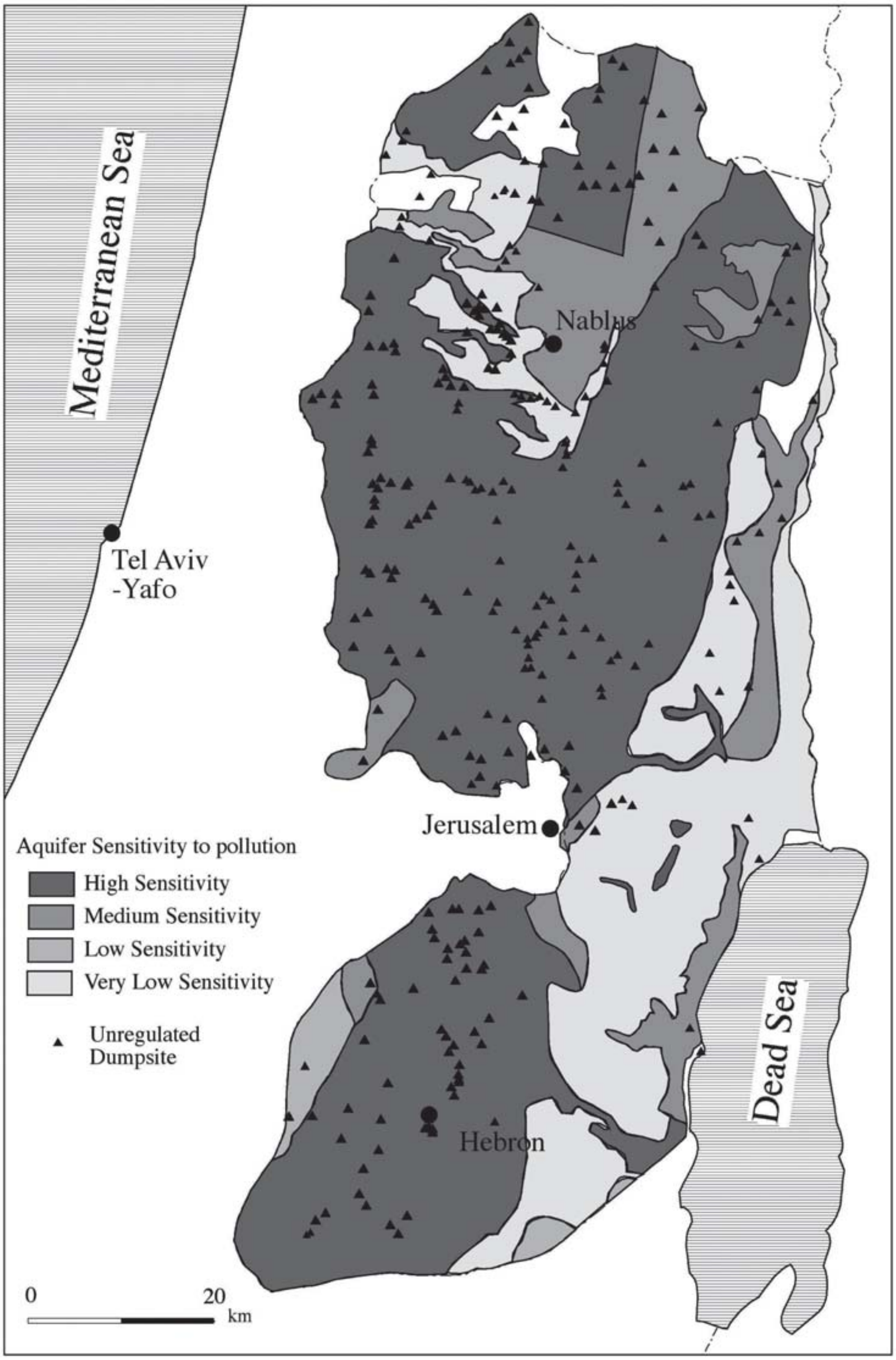
Figure 27.2: Main Streams and Watersheds in Israel and in the West Bank. **Source**: Israel Water Commission.



27.3.4 Financial Factors

Most of the Palestinian environmental infrastructure facilities are funded by the donor countries, mainly EU countries, the U.S.A. and Japan. Operation and maintenance are rarely financed by donor countries. Israeli projects are funded by Israeli local governments with assistance from the Israeli Government. In most cases of WWTP implementation, Israeli municipalities enact by-laws for the establishment of levies and fees to cover the cost of wastewater collection, conveyance and treatment. Municipalities borrow the funds needed for WWTP implementation from the government and pay it back by collecting the fees and levies from the citizens. Landfills are also funded by municipalities, either by municipal corporations or private entrepreneurs who build the landfill for business purposes. There is no Israeli policy for the funding of joint infrastructures, but municipalities are free to provide services to the Palestinians. In the past, prior to the Interim Agreement when the Civil Administration was in charge of the Palestinians' civil activities and services, there was a tendency to pay Israeli facilities for the services they provided to Palestinians. Similarly, there is no Palestinian policy to

Figure 27.3: Unregulated Waste Dumpsites in the West Bank and Mountain Aquifer Recharge Area Sensitivity to Pollution. **Source:** Environmental Protection Associations Judea and Samaria.



finance joint projects, and hence the donor countries prefer to fund unilateral projects.

Joint projects entail considerably lower costs than unilateral ones because of the economy of scale and greater efficiency in planning, without considering political and fiscal constraints. For example, conveyance lines would be shorter in a joint WWTP and collect from more customers, and the cost per cubic meter of treated wastewater would be lower than that of two plants operating at a lower capacity. The example of Salfit-Ariel WWTP below presents a case study.

27.3.5 Institutional Factors

The Israeli-Palestinian Interim Agreement on the West Bank and the Gaza Strip, signed in Washington, D.C. on 28 September 1995 (Israel Ministry of Foreign Affairs 2004) determines the institutional framework for environmental management between Israel and the Palestinian Authority without distinguishing between Israeli settlements within the Green Line and Israeli settlements on the West Bank. In Article 12 of Annex 3 of the agreement, the two sides state their commitment to mutually safeguard the quality of the environment in the West Bank. Most of the article is declarative and the only institutional element in the agreement is the decision to establish an *Environmental Experts Committee* (EEC) in subsection 22 of Article 12. However, no institution was established to implement the obligations that the two parties took upon themselves regarding the coordination, cooperation and auditing of the operational steps in the agreement. Concurrently, the EEC, being a committee of experts rather than a management institution did not meet frequently (two times a year on average) and has not convened since the last quarter of 2000, when the hostilities between the parties began.

The water and sewage section in Article 40 of Annex 3 of the agreement is much more elaborate and detailed in comparison to Article 12. It stipulates responsibilities, quantities, timetables for implementation and cooperation in the supply of water as well as protection from pollution. In subsections 11–15, the two parties define the goals, functions and structure of the *Joint Water Committee* (JWC). According to these definitions, the JWC is supposed to deal with:

1. Coordinated management of water resources and of water and sewage systems;
2. Protection of water resources and water and sewage systems;
3. Exchange of information relating to water and sewage laws and regulations;
4. Overseeing the operation of the joint supervision and enforcement mechanism;
5. Resolution of water and sewage related disputes;
6. Cooperation in the field of water and sewage, as detailed in this Article;
7. Arrangements for water supply from one side to the other;
8. Monitoring systems;
9. Other issues of mutual interest in the sphere of water and sewage.

In addition, the two parties established a Supervision and Enforcement Mechanism. The role of the *Joint Supervision and Enforcement Teams* (JSET), established under the agreement is to supervise and enforce the implementation of the agreement.

A special subsection of Article 40 is dedicated to the cooperation between the two parties. Inter alia "Cooperation in the promotion and development of other agreed water related and sewage-related joint projects, in existing or future multi-lateral forums"" (subsection 20d). The agreement does not specify the type of joint projects and where they should be implemented. One can construe this subsection as being applicable to joint projects involving Israeli settlements in the West Bank and Palestinian municipalities. Indeed, in some cases, the Israeli side of the JWC demanded that some of the projects, in which there were salient advantages in cooperation, would be implemented jointly. According to the Palestinians, this demand has delayed the implementation of some projects. However, this study found that no unilateral Palestinian projects were implemented up to November 2004, including projects that Israel did not demand to implement jointly.

The JWC has convened regularly since it was founded. Moreover, there is an understanding between the two parties to the JWC that the JWC should carry on its work notwithstanding the hostile events that began in September 2000 and that the water issue should be above the political constraints dictated by the hostile events. However, despite the management role specified for the JWC in Article 40, the JWC has not dealt with water and sewage issues in that sense. The role of the JWC has been confined to coordination and exchange of knowledge and data. The JWC has not managed to initiate and/or implement joint projects. The reason seems to be the considerable sensitivity the two parties ascribe to water issues and the inevitable linkage of water issues to higher politics.

27.3.6 Political Factors

Political constraints are the main obstacle to the implementation of joint infrastructures. Even before the ongoing violent events in late 2000, there was little feasibility for cooperation on any official project between Palestinians and Israeli settlements on the West Bank. The Palestinian stance, clearly reflected in interviews and talks with Palestinians, is that they do not recognize Israeli settlements as legitimate. Therefore, cooperation on any issue with settlements is not possible, since cooperation implies recognition. Many of the interviewees expressed emotional attitudes and some of them pointed out that cooperation with settlements could be life threatening for them. Fighting and opposing Israeli settlements is official Palestinian Authority policy. Under this policy, cooperation with the settlements is prohibited. The Palestinians' approach has been adopted by the donor countries, which promote environmental solutions for environmental hazards in the Palestinian sector in the West Bank. Most of the Palestinian interviewees agreed that cooperation could promote environmental solutions and prevent pollution of the joint aquifer, but also expressed their opinion that cooperation between Palestinians and Israeli settlements was out of the question.

The Israeli standpoint, which is well rooted in the Israeli policy and shared by all principal Israeli players in the environmental and water sectors, is that cooperation is essential for promoting environmental solutions in order to prevent pollution of the joint mountain aquifer. Israel has expressed this view in the JWC and demanded to implement joint infrastructure in instances where it is more effective and environmentally wise. The settlements' representatives are willing to cooperate with their Palestinian neighbors and claim that in many cases cooperation and joint infrastructure are much more efficient, particularly regarding the use of treated effluents that settlements can share with the Palestinians for agriculture irrigation. Moreover, Israel supports the implementation of joint infrastructures as soon as possible because of the urgency of discontinuing the recharging of the aquifer with wastewater.

27.3.7 Examples of Cooperation between Palestinians and Israeli Settlements

27.3.7.1 Al-Bireh WWTP: Palestinians Providing Service to Settlements

The only example so far of a WWTP planned and built by a donor country is the Al-Bireh WWTP (currently, Germany is upgrading the Ramallah WWTP and the planning of the Salfit WWTP is in the final stages). Cooperation was defined in the planning process prior to the signing of Oslo B Interim Agreement and before the agreement's new administrative division. It was pre-defined in the WWTP master plan that two Israeli settlements would use this WWTP for their sewage treatment. Implementation of the WWTP occurred after the signing of the agreements in a new administrative division and the existence of the Palestinian Authority.

Connecting the Israeli settlements of Psagot and Kochav Yaakov was part of the planning and made sense geographically. Psagot had already been connected to Al-Bireh's main sewage pipe that took all of Al-Bireh's sewage to a dry stream prior to the implementation of the WWTP. Kochav Yaakov is situated very close to the WWTP and was connected after the implementation. Technically, the Al-Bireh WWTP operates according to the pre-defined standards and produces effluents in accordance with Israeli standards. The precise amount of Israeli wastewater treated in the Al-Bireh WWTP is unknown but calculating it by population size shows that the percentage of Israeli wastewater does not exceed 5 per cent.

27.3.7.2 Tovlan Landfill: Israelis Providing Services to Palestinians

The Jordan Valley Israeli settlements use the Tovlan landfill for the disposal of their MSW. The landfill is located near Route 90, close to the Damia Bridge. In late 1999, the city of Nablus asked the Environmental Protection Association (Samaria and the Jordan Valley) to assist the city in finding a proper disposal site for its MSW. The request came as a result of the air pollution created by the burning of waste in the Nablus dumpsite near Balata, and inhabitants' protests and demand to shut down the burning site. The Nablus municipality was invited to use Tovlan Landfill, although not regulated at the time was operated properly by the Jordan Valley Regional Council. No water-pollution hazards resulted from it. The Nablus municipality paid for the service both with money and by supplying some heavy machinery for the site's operation. The site has been extensively upgraded and operation was started by a private Israeli entrepreneur as a fully regulated landfill in early 2004.

27.3.7.3 Kana Regional Wastewater Collection Project: Jointly Implemented Israeli Project

The Kana Stream regional wastewater collection project collects wastewater from 11 Israeli settlements in western Samaria between Nablus and Qalqilyah. The Kana Stream, a fresh water stream, one of the main tributaries of the Yarkon River and an area sensitive to pollution, was polluted by wastewater coming from the settlements. The pipeline along the stream and the connected pipelines from each settlement were initiated for the transport of the wastewater of all 11 settlements to a WWTP located to the west of this area, near Nir Eliyahu, west of Qalqilyah. Israel allocated funds to construct a ready-made outlet in order to connect each of 13 adjacent Palestinian villages in the watershed, none of which has a sewage collection system in the village. The Palestinians acknowledged the need for a regional project in that area. An understanding was reached between a highly placed Palestinian Authority official and the local Israeli Environmental Protection Association regarding the importance of the project. Laying the pipeline and connecting pipelines and outlets for Palestinian villages was completed in early 2004. There was no interference with the workers or machinery, which operated on the site throughout the entire construction phase thanks to the understanding that this project would be implemented to the benefit and best interests of both sides. The future treatment of the Palestinian villages' sewage, once a collection system is built, will rely on the Kana Stream joint system.

27.3.7.4 Al-Bireh-Psagot Landfill: Cooperation With Settlements

Al-Bireh disposed of its MSW in a dumpsite located on the eastern side of the town near the settlement of Psagot. The continual burning of the waste created a severe nuisance for the inhabitants of both Al-Bireh and Psagot. In September 2000 the Israeli army closed the site to Al-Bireh, which subsequently appealed to the Israeli High Court of Justice. The site was reopened as a result of court's involvement, and an agreement was reached between the settlements and Al-Bireh under the auspices of the Civil Administration, the World Bank and two donor countries, Germany and Japan. The agreement was based on a commitment by the Japanese government to provide 400,000 to temporarily upgrade the site for 3 years, contingent on German funding for a new landfill. In practice, the parties established a steering committee made up of representatives of the Israeli Ministry of the Environment, the Civil Administration, the Al-Bireh municipality, the Israeli Benjamin Regional Council and the Environmental Protection Association. The site has been operated under the supervision of the committee to the benefit of both parties at a time of war between them.

27.3.7.5 Ariel-Salfit WWTP: Politics Hindering Cooperation

Ariel, an Israeli town of 20,000 inhabitants, and Salfit, a Palestinian town of 9,000 inhabitants, need to treat their wastewater. They are both located in the same watershed, which is sensitive to organic pollution. Ariel has an existing WWTP that has exceeded its capacity and is currently malfunctioning. It is not possible to upgrade it at the existing site due to lack of available land. Germany has planned a new WWTP for Salfit and Israel has planned a joint WWTP for Ariel and Salfit.

Table 27.1: Planning Data of Joint WWTP for Ariel and Salfit by Israel Compared to Planning Data of a Unilateral WWTP for Salfit by Germany.

	WWTP capacity (inhabitants)	Effluent quality (Mg/Liter)	Cost (€)	Share of German government (€)
Joint WWTP	60,000	10 BOD, 10 TSS	7.5 Million	2.5 Million
Unilateral WWTP for Salfit	20,000	20 BOD, 30 TSS	10 Million	10 Million

Planning data show that an increased capacity joint WWTP for Ariel and Salfit would have better quality effluent and cost less than a unilateral WWTP. In spite these convincing data, the German government has begun implementing the unilateral WWTP. Israel initially insisted on implementing the joint plant but later backed down, taking into consideration the Palestinian opposition and the urgency of implementation.

27.4 Conclusions

Most of the feasibility factors support cooperation. Political constraints have been the main obstacle to cooperation as are some institutional factors that can be altered in the future. Unfortunately, even on issues in which there is willingness to cooperate on both sides to cooperate, institutional factors hamper it. Given the political constraints, a joint infrastructure, to be built and operated by one of the donor countries or by an international private entrepreneur, can promote environmental quality and the improved treatment of solid waste and wastewater for both populations in an efficient and effective manner.

All existing instances of cooperation between Palestinians and Israeli settlements are on the local level. Most are initiated by Palestinians to solve existing environmental problems and some come about by default, where the existing geographical and environmental conditions dictate cooperation. These instances of cooperation have occurred notwithstanding the political constraints and violent clashes. Governmental initiatives, if any such initiatives are launched, are doomed to failure. Therefore, local initiatives must be encouraged in order to prevent aquifer pollution.

References

Environmental Protection Association Judea, 2004: *Solid Waste* [in Hebrew], at: <http://www.enviosh.org.il> and <http//www_yehuda/index.html>. Last accessed: 1 December 2004.

Environmental Protection Association Samaria and Jordan Valley, 2004: *Solid Waste* [in Hebrew], at: <http://www.enviosh.org.il> and at: http://www_shomron/index.html>, last accessed: 1 December 2004.

Gvirtzman, H., 2002: *Israel Water Resources, chapters in hydrology and environmental sciences* [in Hebrew] (Jerusalem, Yad Ben-Zvi Press).

Israel Ministry of Foreign Affairs, 2004: *Selected Reference Documents*, at: <http://www.mfa.gov.il/mfa/peace%20process/reference%20documents>; last accessed: 28 November 2004.

Tagar, Z.; Keinan, T.; Bromberg, G., 2004: *A Seeping Time Bomb: Pollution of the Mountain Aquifer by Sewage* (Tel Aviv: Friends of the Earth Middle East).

UNDP, 2001: *Human Development Report* 2001. *Making new technologies work for human development* (New York - Oxford: Oxford University Press).

UNDP, 2003: *Human Development Report* 2003. *Millenium development goals: a compact among nations to end human poverty* (New York - Oxford: Oxford University Press).

UNDP, 2004: *Facts About the Palestinian People*. at: <http://192.115.229.1/en/02/index.htm>; last accessed: 1 December 2004.

28 Effects of the Separation Barrier on the Viability of a Future Palestinian State

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Abstract

Despite the surface tension over Palestinian terrorism and Israeli security methods, the peace process is ultimately hinged on many long-term considerations. With the recent political transformations in the region and efforts for peace between Israelis and Palestinians, water remains to be a strongly regarded priority, as well as a mutual dilemma. The importance of water access and control is at times concealed by its low-key political stature in comparison to the human security agenda of Israelis and the political rights of Palestinians. The perception that water is of lesser importance than security and justice is in itself a threat to the overall peace process, and the possibility of a future Palestinian state. The strategic control of water resources between Israel, the West Bank, and the Gaza Strip have geopolitical implications tied to nearly every aspect of the current political situation. Israeli settlements in the occupied territories, the refugee population, Palestinian living conditions, and the separation wall – along with its actual location and route – all have linkages to the access, control, and quality of water resources; this is by no means a complete list. The strategic control of water resources by either side in the West Bank and Gaza Strip will determine the future viability of any Palestinian state. Palestine's weak socio-economic maturation due in part to limited water access is a testament to its importance for success in agriculture, industry, health, and human development. The current heading towards an Israeli imposed unilateral peace will only further the control of water in the region, and calls into question the very viability of a Palestine for Palestinians.

In its current form, this chapter is explicitly in its theoretical stage. The ideas provided require the backing of primary source data the authors plan to collect in future trips to Israel. The interest is to expose it to the criticisms and suggestions of others interested in understanding the geopolitical realities of the Israeli Palestinian conflict, and, as such, being able to provide recommendations and solutions to bring about its conclusion. In the absence of the requisite data, satisfying Israeli water security demands, through an understanding of the security paradigm shift, will be demonstrated by identifying the relationship between the neorealist definition of the international system, and Israeli strategic culture. The specifics of the water crisis facing Israel will be provided, as will the links between water, the construction of the security fence, and settlement locations. Finally, the chapter will conclude on the effects of water scarcity and the viability of a future Palestinian state.

Keywords: Geopolitics, Water Resource Conflict, Israeli-Palestinian Conflict, Separation Wall, West Bank

28.1 Introduction

At the *Paris Peace Conference* of 1919, Chaim Weizmann set clear his vision of a viable Israeli state. He believed that it was crucial to control water resources to the nsure the longevity of the Jewish state, claiming it "of vital importance not only to secure all water resources already feeding the country, but also to control them at their source." Implicit in this demand were the lines defining the borders of Israel, and set to include the Litani, Upper Jordan, and Yarmuk rivers. Without these bodies of water, Israel could never be economically independent (Lonergan/Brooks 1994).

Today's geopolitical reality makes Weizmann's desires unrealistic, as it does so for the framework laid out by the Oslo accords and the Road Map. President Bush and Arial Sharon made this clear when they spoke to the press on 14 April 2004. Yet, the *status quo* is itself an unacceptable solution for both sides. The final peace will be shaped by these changed realities, and as President Bush stated, no matter how unfair or illegal under international law, it is unrealistic to expect a return to the armistice lines of 1949.

Ariel Sharon's disengagement plan is set to mould that final peace, and, although regrettable for some, it realistically takes into account regional power structures. Understandably, it will be a peace on Israeli terms. In this framework of an Israeli peace, the principles echoed by Zionists like Weizmann, while impossible to retain in their entirety, will be enshrined. Retaining Gaza, the Golan Heights, and the West Bank has become politically impossible and costly. In the case of the territories Sharon has made this especially clear. Yet it would be suicidal for the state of Israel to withdraw entirely from these swaths of land. Access to water is crucial for the sustainability and growth of the Jewish state, and the ability to exploit water resources is inextricably linked to the control of land. Thus, as Sharon pilots his disengagement proposal, there are tracts of land that Israel will never withdraw from, for the explicit purpose of retaining control over water.

28.2 Importance of Water

While many parts of the world are only beginning to feel the pressures of water scarcity, access in the Middle East has, for a while now, been a matter of conflicting perceptions, and of life or death. In the arid regions of Israel, the West Bank and the Gaza Strip, guaranteeing resource stability alone requires massive pipeline networks to deliver water for human, agricultural, and industrial consumption. Water is a crucial resource to every population for many reasons. Large quantities of drinking water are essential to maintain human life. Drinking water must be of a high quality and is therefore inherently expensive to procure when available sources are not polluted, or sufficient. Agriculture demands a substantially larger amount of water than domestic use (Lonergan/Brooks 1994). Although this water need not be as clean as drinking water, the staggering amounts required can severely deplete existing resources, from constant over-use. In the 21st century industry will require relatively large quantities of water, mainly for manufacturing. Simply, water can be sub-categorized into these three uses: human, agricultural, and industrial. Without adequate access to water, population growth, and development can be severely limited. Only recently, within the past century, and drastically in the past decade, have the inclusion of water in strategic decision making could be observed (Homer-Dixon 1994; de Villiers 2002). Of even more significance, water quality and access continues to be distressed and this trend is worsening. Both scientists and political researchers agree that water has and will be a factor in present and future tensions (Homer-Dixon 1994), including conflict between Israel and the Occupied Palestinian territories (Lonergan/Brooks 1994).

28.3 Neorealism and Strategic Culture: Composites of Israeli Security Policy

Israeli security policy is achieved through the interaction of its own strategic culture with the functioning anarchic international system as defined by neorealist theory. Neorealism posits that the courses of action of states are conditioned by the structure of the international system. States are sovereign, making the system anarchic. The behavior of states, amongst each other, is framed by the relative capabilities (power) they possess in relation to each other. As there is no higher authority then the state, which would impose standards of behavior, states are exposed to a security dilemma. Relations between states in the system are characterized by suspicion and mistrust. Today's friends can easily become tomorrow's enemies. Substantial cooperation between states is therefore impossible, forcing states to adopt self help strategies to satisfy their security demands (Glenn/Howlett 2004).

Two assumptions reinforce the inability of states to cooperate. Foremost, there are no legal assurances that states will be bound by their international commitments. Agreements between states cannot be trusted as sovereign states are free to opt out of them as they see fit. In many cases, states participate in treaties or international law for convenience, or for gain to the national interest. Secondly, interdependence between trading states can introduce degrees of vulnerability. As some states are inherently more vulnerable then others, the prospects for cooperation greatly diminish (Glenn/Howlett 2004).

The self help strategy of states competing amongst each other for power to ensure their own security is ultimately self defeating as it leads to a "spiraling cycle of action and reaction". (Glenn/Howlett 2004). Security becomes unachievable as states are locked in continuous conflict. However, instead of always seeking to maximize power at the ultimate expense of others, defensive realists suggest that states seek a balance of power. In doing so, they seek the minimum level of power required to maintain their position in the system (survival) and their security (Glenn/Howlett 2004).

The behavior of states is guided by the system theory of the Neorealist school. While "immutable system forces" determine reactions to events, strategic culture influences strategic preferences within those reactions. The anarchy of the international system is "shaped by the way that states identify themselves, with realpolitik strategic cultures, a bi-product of social construction" (Poore 2004). Simply stated, strategic culture provides a range of tendencies which are activated by system pressures (Poore 2004).

Culture exists as a collective sum, and not as individualistic parts. Cultures are intrinsically different when compared between collectives, and are relatively stable through time, compared to material evolution. Strategic culture implies "a nation's traditions, values, attitudes, patterns of behavior, habits, symbols, achievements and particular ways of adapting to the environment and solving problems with respect to the threat or use of force (Poore 2004).

Israel's adherence to the Neorealist school, when formulating its strategic security policy, stems from its strategic culture. The history of the Jewish people, and the modern history of the Jewish state, have reinforced in the Israeli mindset that others are not to be trusted. Exodus, the Diaspora, European persecution, the Holocaust, the numerous wars with its neighbors, anti Israeli terrorism, and rising global Anti-Semitism have reinforced the perception that Israel has an insurmountable list of enemies at its doorstep, and thus has no choice but to seek to maintain its existence and security through self help strategies. Further, the vulnerable security position that Israel perceives itself to be in greatly reduces the possibility of inter-state cooperation.[1] Comprehensive peace in the region requires all sides to come together in agreement. However, it is unlikely that Israel will be a party to an agreement which proposes a dependency on another state. Israel will continue to guarantee its security through unilateral measures, often in violation of international law.

Comparatively, one could study Canada and see that its strategic culture has resulted in an idealistic foreign policy and outlook on international affairs. Canada counters problems in the international system by fostering international law, multilateralism, and interdependence. Canada's position, in terms of survivability and security, is relatively strong, and the country is able to attempt to influence the natural neorealist tendencies of the international system with its idealistic principles.

1 A 2003 study of Israeli public opinion on national security showed that Israeli's are wary of their position and do not believe that a treaty will solve their security problems. The study showed that 37 per cent of Israelis thought that the Arabs wanted to destroy the state of Israel and its Jewish population, 23 per cent thought that Arabs states wanted to conquer the state of Israel, while 29 per cent and 11 per cent held the less pessimistic view that the Arabs wished to regain the territories lost in 1967, or regain some of those territories. As for those who believed a treaty could translate to an end of the Arab Israeli conflict, only 35 per cent believed this to be true (Asher 2003).

28.4 New Security Paradigm

Security as a concept has been usurped by a paradigm shift from its orthodox tenets to the more encompassing definition which attaches the provision of human security to the integrity of the state. The orthodox conception presented security as the collective need to preserve the state and its economic, political, and social interests against external threats. The function of national power, or aggregate of economic, political, and social factors, defined a state's capacity to construct and amass weapons, and its ability to fight war. This military capacity was the primary guarantor of security as threats were perceived as, almost exclusively, military in nature, and thus required military responses. The benchmark by which security could be preserved was the comparative strength of another state's military power. This view was especially strong throughout the cold war as the bifurcation of states along the ideological divide allowed states to compare their group's military strength vs. that of their enemy (Poku/Graham 1998; RAND 2000).

While obvious that security cannot simply encompass comparative military might, this realization did not make any progress until the end of the Cold War. The new understanding came on the heels of a more fractious world order. The international system became a complicated place as security concerns became localized as well as internal, loosing its narrow focus of conventional and nuclear weapons comparisons. The security, or survival and prosperity, of the state now has to take into account the interrelationship of demographic pressures with the surrounding, often regional, environment, as well as the effects of internal or external pressures, such as media, or ideological. Inherent in the new security paradigm is the need for human security. In attempting to provide security to each individual of the state, as equally as possible, is the admission that failing to do so could threaten the integrity of the state: through strife, protest, violence, civil war, ultimately leading to anarchy and a failed state. Additionally, the failure to provide human security weakens the elements of national power, leading to a position of comparative weakness vs. other states. Thus, security concerns such as mass trans-border or internal migration, refugee flows, unsustainable urbanization, systemic crime, quality of life, epidemics, food supply, threats to language, ethnicity, or religion, resource depletion, and the interaction between population pressures and resource degradation, among others, must now be taken into consideration (Poku/Graham 1998; RAND 2000; Homer-Dixon 1993).

Israel will have to deal with many of these pressures. This is especially true in terms of water resource depletion, and degradation, as a factor of increasing consumption. Israel will meet its security requirements through unilateral measures, influenced by its strategic culture. While the long term outlook could lead to regional cooperation, Israel will not motion to create any dependencies on its Arab neighbors. Thus, what remains is to analyze the supply of water for the region, the resulting implications and realities with which Israel will have to come to terms, and the method by which it is already guaranteeing its water security.

28.5 Water Resources and Demands

The bodies of fresh water which supply Israel, the Palestinians, and their neighbors face overuse. Many supplies are being depleted beyond their rate of replenishment, leading to the salination of fresh water deposits, which threatens absolute depletion. The regional water system is complex and overlaps political boundaries. The principal surface water system is the Jordan River Basin, with the Sea of Galilee at the centre. The upper Jordan is fed by the Hasbani River which originates in Lebanon, the Banias River and Hermon springs from the Golan Heights, and the Dan River located in Israel and the Golan Heights. South of the Sea of Galilee, the lower Jordan is fed by the Yarmuk River, and goes on to replenish the Dead Sea. The replenishment of the Sea of Galilee and Jordan River are affected by riparian water diversion projects meant to satisfy national water needs. Additionally, the Mountain and Coastal Aquifers augment the Israeli water supply. The Mountain Aquifer is divided into the Western, North Eastern, and Eastern Aquifers, which are almost exclusively within the West Bank. The Coastal/Gaza Aquifer runs from the Northern Gaza Strip to Tel-Aviv.

The precariousness of Israel's water supply is clear. Israel faces supply induced scarcity, from overpumping to meet demand, resulting in salt-water intrusion. Demand induced scarcity is occurring because Israel's population and economic activity is growing (Homer-Dixon/Blitt 1998). Stefan Deconinck (2002), from the Centre for Sustainable Development in Ghent (Belgium) highlighted Israel's supply induced scarcity. He criticizes Israeli Water Commissioner Shimon Tal's long term water policy document.

Foremost among Israeli mistakes is that long-term water planning assumes that rates of replenishment are consistently average. As a result, Israel pumps water at a consistent rate over that forecasted period of time. That rate of pumping often occurs at or above the actual rate of replenishment. Consistent years of under average water replenishment, without above average years to make up for the deficit, results in supply induced scarcity of aquifers, rivers, and the Sea of Galilee, and the increased salinity of those bodies. Case in point, during 16 years of pumping in the Coastal Aquifer, 11 years were at a deficit. That resource is now increasingly saline (Deconinck 2004).

Demand induced scarcity is further complicating Israel's capability to effectively deal with the water question. The growing population, currently 6.1 million, will surpass previous growth estimates of 6.5 million in 2020. That population is also increasing its per capita consumption of water. To preserve its current agricultural output until 2020, 530MCM of fresh water, and 620MCM of treated water will be required, while industry will require 30MCM of fresh and 25MCM of treated water. By 2020, Palestinians in the West Bank will require 70MCM from the Israeli water network, in addition to their own. Israel is also obliged to provide Jordan with 55MCM of fresh water annually as part of the peace treaty that both countries signed. Israel has an estimated supply of about 1950MCM of fresh water, while current demand is around 2100–2200MCM. While this gap may be manageable through the use of secondary water sources, a growing population and per capita use will make this exceedingly hard (Deconinck 2004; Homer-Dixon 1993).

Essentially, estimates of renewable and generated water resources are spotty at best, while future predictions, as shown in the above tables, are too perfect and do not take into account treaty obligations or provisions for the Palestinians in the occupied territories. However, the numbers are indicative of certain trends which Israel cannot escape. First is that demand on natural renewable sources cannot be increased. Surpassing the rate of natural replenishment will only add to the long-term water problems facing the country. Additionally, supply to the lower Jordan could be affected if the Syrians decide to extract more from the Yarmuk for irrigation. Secondly, while Israel can continue to increase its water supply through use of brackish and treated water, such water has limited applicability. One such limitation is that it cannot be used as drinking water to meet growing population demands. Supplementation through desalinization is also possible, however the cost of doing this on a massive scale will be difficult for Israel, which has limited financial capacity. Ultimately, Israel is tied at the hip to its fresh water resource in the West Bank. In assuring its water security, Israel will be unwilling to withdraw from sections of the West Bank where control over water will be transferred to the Palestinian Authority. This reality cannot be circumvented and is a component of Ariel Sharon's disengagement plan.

28.6 Meeting the New Security Requirements: Control of Water through the Control of Land: Security Fence

> Israel must hold on to the West Bank to make sure that Tel-Aviv's taps don't run dry (*Rafael Eitan* cited in Lonergan/Brooks 1994).
>
> If the demand is for drinking we must say yes; we do say yes. But we are not going to stop irrigating our orchards so they can plant new ones (*Meir Ben Meir* cited in Lonergan/Brooks 1994)

In 1977, Prime Minister Menachem Begin requested the Israeli water commissioner, Menachem Cator, to provide maps of Israeli water use in the West Bank. These would include zones of withdrawal which Israel could hand over to the Palestinians, without severely affecting Israeli water supply. Cator's findings defined a 'red line' which traversed parts of the territory, as seen in area C of map 1. Area C yields thousands of cubic meters per hour of water, compared to ten's of cubic meters per hour in other areas (Gvirtzman 2004). In a water study commissioned by the Jaffee Centre for Strategic Studies at Tel Aviv University, Yehoshua Schwartz, and Aharon Zohar (1991) analyzed the water relations between Israel and the Palestinians. The study recommended that Israel withdraw to redefined lines, much like the 1977 'red line', which would allow Israel to relinquish political control of the vast majority of the West Bank, yet retain those areas key to maintaining its water supply. At the time, this position went counter to government policies regarding the status of the territories. Rafael Eitan, head of the ministry of agriculture from 1988 to 1991, stated that "to protect Israel from threats to the quantity and quality of its water, it had to retain political control of the West Bank" (Wolf, 1998, page 260–1). During the review prior to publication, in December 1991 the Israeli military censored the entire report, citing the sensitivity of its findings (Wolf 2004)

The authors of the 1991 study called their maps 'an outline for retreat' (Wolf 2004). Now, this has been rephrased as disengagement. While the semantics have changed, the intention of retaining control of West Bank water supplies remains. The decision to go ahead with disengagement simply reflects the inability of the status quo to persist. Occupation is politically and economically costly for Israelis, and excluding right wing settler and orthodox groups, the vast majority of Israeli's wish to abandon most of the occupied territories. Abandoning 'most' is the operative word, and what Israel does hold on to will partly be influenced by its need to control water. This will primarily be achieved by routing the fence as close as possible to the 'red line'. While some settlements in the West Bank will be abandoned, the larger commuter settlements, which were often sited to control water tables, will be maintained. Although it is questionable whether they will be located on the Israeli side of the fence, those that are not will be fortified and expanded, and will remain connected to Israel by protected settler roads.

Many would ask why Israel cannot accept Palestinian autonomy in the territories. Why can't Israel withdraw to the 1967 borders, and satisfy its water concerns through a binding water treaty with an autonomous Palestinian Authority? That answer has been provided by precedent. Following Israeli Defence Force withdrawal from the Gaza Strip, the Palestinian Authority allowed 500 wells to be drilled, in violation of an Israeli Palestinian agreement. Palestinians suffer from critically low per capita access to fresh water, and the necessary amounts to sustain viable economic output. Thus, any treaty with Israel would likely be circumvented to meet these demands, as they were in Gaza. The potential for this to occur will be ever greater over time as the Palestinian population in the occupied territories, principally in the West Bank, is set to increase from 3.0 million to 5.8 million (Soffer 2002) Israel has to consider that dramatic water scarcity, stemming from broken treaty obligations, combined with a growing Israeli population could lead to a "collapse of transportation and other infrastructure, resulting in the emigration of Jews and the deterioration of Israel into a third world state" (Soffer 2002).

Israel is most dependent on the western basin of the Mountain Aquifer, also known as the Yarkon-Tanninim. Israeli dependence on this source, which supplies Jerusalem, Tel-Aviv, and other major cities, should be reflected by security measures meant to retain control of water supplies. Israel has already completed a majority of the fence in this area, with the exclusion of the salient out to Ariel and Salfit, and also has many settlements in area C of high potential pumping. In a study on water extraction, Haim Gvirtzman, of the Begin-Sadat Centre for Strategic Studies, clearly outlined the specific need to prevent additional Palestinian drilling and extraction from wells around Qalqilya and Tulkarem. This appears to have happened as the route of the fence has absorbed numerous Palestinian wells into what will become Israeli territory.

28.7 Effects of the Viability of a Future Palestinian State

"The main factors fuelling water demand are population growth, industrial development and the expansion of irrigated agriculture" (UNEP 2002: 151). The occupied Palestinian territories face water shortages linked to each of these, the latter two limiting the long-term socio-economic development of the potential state. Each factor will be discussed below to provide evidence that extended periods of increasing water deficit will reduce the probability of a viable sovereign Palestinian state from emerging.

Extended periods of curfews and closures, and poor family planning education, have led to a population growth rate in the West Bank that is over twice that of the Israeli rate. In 2002, the estimated fertility rate in Israel was 1.48 percent, while the West Bank experience growth of 3.39 percent (CIA 2002). This growth is primarily in urban areas (Palestinian Central Bureau of Statistics (PCBS) 2002), and incidentally where water resources are under the worst strain. This rate of population growth is not sustainable, given current water shortages. If greater quantities of water are to be allocated to the occupied territories, Israel will be required to initiate transfers from its overstretched share, or more water will have to be extracted from overburdened resources. Both options are unlikely, especially as the latter endangers the survival of current supplies, such as the Mountain Aquifer which is being emptied faster than replenished (de Villiers 2000).

The majority of this discussion will refer to areas where the wall has been completed. Known as Stage A communities, this area extends from Salem in the Jenin Governorate in the north to the Elkana settlement south of Qalqilya. The proposed location of Israel's separation barrier will cut into much of the existing water delivery infrastructure along major urban areas where clean potable water for consumption is provided by reliable high-output pumps. A report obtained from the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) lists 37 West Bank communities, totaling one-hundred and nine thousand residents, as cut off from water wells, agricultural land, and irrigation networks as a result of the construction of Stage A of the separation barrier. The report also described Israeli modifications to the fence that could place another thirty thousand Palestinians in enclaves, restrictting their access to water as listed by the Palestinian Central Bureau of Statistics (PCBS 2003; UNISPAL 2003).

Further, Palestinians who are caught between the 1949 Green Line and the proposed path of construction of the separation barrier will be forced to relocate. This region, known as the Seam Zone, includes a large partition of the West Bank's farming regions, and water infrastructure (PCBS 2003). As mentioned, Israel will require all Palestinians within the Seam Zone to move east of the separation barrier, or apply for a permit to remain in their current location; there is no appeal process for rejected applicants (UNISPAL 2003; IDF 2003). Many Palestinians will be required to abandon their homes and agricultural land, places of employment, and establish themselves in a new location. If this situation persists, the downward spiral into water poverty faced by many Palestinians will only get worse. As water is essential for the socioeconomic development of the state, this water poverty will lead to further deterioration of state autonomy.

The Palestinian economy has a large stake in agriculture, and the loss of water for irrigation will undermine the ability for Palestinian farms to produce raw goods. Ultimately this will stunt the growth of the Palestinian agricultural sector, if not contribute to its decline. Similar trends, involving appropriated land, have caused strife for farmers and primarily agricultural communities. While the most arable Palestinian lands are located within the Seam Zone of the West Bank, the separation barrier further limits the possibility of keeping these fertile lands functioning as methods of livelihood and resource production. The access for farmers, who wish to return daily to manage their crops, has been severely limited by Israel checkpoints and access gates. As a result of water shortages that have occurred over the past decade, farmers have shifted crops from citrus, other fruits and vegetables to less water demanding crops of staple foods, and olives. Since the latter crops have a lesser market value when compared to the former, Palestinian farmers experienced substantial cuts to their incomes.

This limited access to water resources over such a long period has created a substantial divide between Israeli and Palestinian qualities of life. This has left Palestinians in a situation where they are increasingly dependent on Israeli water infrastructure. Palestinians receive water through Israeli transfers, and even though much of the infrastructure exists in the occupied territories, Israel has been responsible for its maintenance, where deemed necessary, its regulation. Regulation of Palestinian water access has been especially stringent, as Palestinian wells are limited to an almost futile depth of 140 m versus Israeli wells ranging up to 800 m (de Villiers 2000).

28.8 Recommendations

Water remains one of the contested issues which must be addressed in any final status agreement regarding a future Palestinian state. There are two significant matters that must be resolved before further actions can be taken to resolve disputes related to water. From a Palestinian perspective, the concept that each side has the equal right to access water resources must be accepted. Second, functional joint water resource management is necessary (Elmusa 1996). These first two items are idealistic in nature, and unlikely to occur based as earlier portions of this paper were quick to show. Realistically, the potential for a viable Palestinian state, in the short term and in terms of water, will require third party water supply. The mediating body charged with this will require binding power to enforce the agreements made between the Israeli and Palestinian governments.

Future construction of the separation barrier should include more effective coordination and consultation with local Palestinian water authorities. The wall is built in a 'piece by piece' fashion, mainly under the direction of lower-echelon military commanders who have a say in the path of the barrier. It makes sense that lower level Palestinian water managers be consulted to improve mutual agreement on where the path could run. However, two factors may restrain this. Time is an important factor as each day the wall remains in unfinished, Israeli's feel more insecure. Although Palestinians may wish to continuously appeal the planned route, they must realize their concerns are subservient to Israeli security concerns. Thus, Palestinian water access will be subservient Israeli concerns, such as the facility of construction, proximity to urban areas, and Israeli water security through access to settlement-built wells; to name only a few. Palestinian negotiators must realize that frustrating the Israeli military planners may lead to complete exclusion from the decision making process, leaving them in a dire situation for an indefinite period of time.

If the wells appropriated by the separation barrier limit access to Palestinians, a just method to ensure a minimum level of water access should be guaranteed. This could be considered as the 'water poverty line' below which no Palestinian dwelling should fall. Without moving into the technicalities of urban hydraulics, this quota could be established within specific zones for individual, or associated groups of wells, or third party sources. USAID has set a daily per capita minimum of 100 liters for Palestinian domestic, agricultural, and industrial use (Lein 2000). To ensure adequate supply, sources must provide a flow rate based on the necessary consumption per capita multiplied by the number of persons drawing from a particular wellhead. Realistically speaking, the idea of a 'water poverty line' would take years to build-up to as many Palestinians do not even have adequate daily access to water. However, they are not far from attaining this goal; the average Palestinian currently draws 60 liters per day (Lein 2000). If efficient practices are put into place for water collection, distribution, and use, current supplies could be used more effectively.

Drawing from the preceding argument, the success of a future Palestinian state, under any plan for autonomy, will no doubt require more equitable access to water for the Palestinians; this could eventually lead down three classifiable paths, each briefly described in order of increasing effort required. First and foremost, improving essential infrastructure would substantially lessen the amount of water wasted from the source to the tap. This solution would add no stress to the water supply as no additional water will be pumped, the present amount will simply be used more effectively. While a total upgrade of the Palestinian water network would be costly, the benefits are substantial, and provisions could likely be made for international assistance from IGOs or NGOs. Allowing the Palestinian water system to continue to dilapidate will only reaffirm the seriousness of the water crisis.

Concurrently, better collection and distribution practices must be adopted for domestic, agricultural, and industrial use. Rainwater collection, and storage, improves supply, but has little impact on the urban eco-system. Infrastructure audits, and priority/utility studies, and wastewater re-use offer other possible ways of conserving water. The second dimension involves a socio-economic paradigm shift to institute a lasting and positive effect. This may initially require mandatory water rationing and monitoring, yet, over time, Palestinians would expectantly adopt an attitude of voluntary rationing, thus saving more water in the long-term. An educational component is also key, and informing Palestinians about water scarcity, and conditioning them to promote effective use could help create a future generation of Palestinians who may require less water than their predecessors.

Agriculture plays an important role in the Palestinian economy, and the failure of a water intensive crop, because of a water shortage, would lead to socio-economic catastrophe. Palestinian farmers have already been hampered by water for irrigation, having to change types of crops in lieu of the outright loss of farmland due to aridity (Homer-Dixon/Blitt 1998). Planning ahead to rotate crops, and shifting to less water-needy crops in advance of a greater water shortage is a sound, short term, solution to water scarcity. This practice of 'importing virtual water', can minimize the drastic economic effects of crop failure, allowing Palestinian farmers to reduce their dependency on the success of a fragile crop

Another conceivable option would be to introduce an external supply to satisfy Palestinian water requirements. Numerous ideas have presented themselves over the past about how this water should be sourced and collected. In 2003, the Washington Institute for Near East Policy released a document outlining the possibility of Turkey supplying Israel with water. However, this option is expensive, costing Israelis 80 cents a cubic meter. Another option is to augment Israeli supplies through desalination for 55 cents/m^3, or wastewater processing for 35 cents/m^3 (Ariyoruk 2003). Augmenting the Israeli supply in such a way would allow for excess capacity to be provided to the Palestinians. Additionally, the Palestinians could seek direct importation from a third party source, such as Turkey. Although equally expensive, such a project could be conceivably assisted by the international community. Turkey would liters benefit from such a plan as it could also supply Lebanon, Syria, or Jordan, for considerable financial gain.

The option of including the Palestinians within the Israeli water system is highly unlikely, and comes with expected limitations and consequences. The possibility of connecting the Palestinians to the Israeli National Water Carrier have arisen in negotiations, as the pipeline infrastructure is already in close proximity to the West Bank. It would essentially take little more than a few hundred kilometers of pipeline to extend into the well infrastructure of the Palestinian territories to provide additional water to them. However, interlocking both systems would allow Israel to draw water out of Palestinian wells in the event of an Israeli shortage. This is a plausible scenario considering Israel's tendency of acting in self interest.

28.9 Conclusions

Although lacking the necessary primary source data, this paper has bridged a series of theoretical assumptions to the water security dilemma which Israel faces. In doing so, it has shown that certain courses of action to satisfy water supply, such as forming a dependency on a third party, are unlikely to satisfy Israel's overarching security concerns. This assumption is based on a neorealist understanding of the international system, and of the effects which strategic culture has on state policy. It was argued that Israel would satisfy its water security demands through the construction of the security fence, and existence of settlements, which appropriate land with high water yields. Such a unilateral move by Israel, while understandable in their case, will be detrimental to the creation of a viable Palestinian state. If such a state ever comes into being, Palestinian water requirements will have to be met through more efficient water use, and very likely the introduction of third party water supply.

References

Ayca Ariyoruk, August 14, 2003, The Washington Institute for Near East Policy. Policy Watch Issue # 782.

Asher, Arian, 2003: "Israeli Public Opinion and National Security 2003"; at: <http://www.tau.au.il/jcss/sa>.

CIA, 2002: *Israel*, at <https://www.cia.gov/cia/publications/factbook/geos/is.html>; and the *West Bank*, at <https://www.cia.gov/cia/publications/factbook/geos/we.html>.

De Villiers, Marq, 2000: *Water* (Toronto: Stoddard Publishing).

Deconinck, Stephan, 2004: *Israeli Water Policy in a Regional Context of Conflict: Prospects for Sustainable Development for Israelis and Palestinians* (Ghent: Ghent University, Centre for Sustainable Development, February); at: <http://waternet.rug.ac.be/waterpolicy.htm>.

Dinar, Shlomi, 1999: "The Israeli-Palestinian Water Conflict and its Resolution: A View Through International Relations Theory", in: CIAO, 16–20 February; at: <http://www.ciaonet.org/isa/dis01/dis01.html>.

Glenn, John; Howlett, Darryl, 2004: "Neorealism" in: Glenn, John; Howlett, Darryl; Poore, Stuart (Eds.): *Neorealism Versus Strategic Culture* (Aldershot: Ashgate).

Gvirtzman, Haim, 1998: "Maps of Israeli Interests in Judea and Samaria: Determining the Extent of the Additional Withdrawals". Begin-Sadat Centre for Strategic Studies; at: <http://www.biu.ac.il/besa/books/maps.htm>.

Homer-Dixon, Thomas, 1993: *Environmental Scarcity and Global Security* (New York: Foreign Policy Association).

Homer-Dixon, Thomas F., 1994, "Environmental Scarcities and Violent Conflict: Evidence from Cases", in: *International Security*, 19,1 (summer), 5–40.

Homer-Dixon, Thomas; Blitt, Jessica, 1998: "Introduction: A Theoretical Overview", in: Homer-Dixon, Thomas; Blitt, Jessica (Eds.): *Ecoviolence: Links Among Environment, Population, and Security* (Lanham: Rowman & Littlefield).

Lein, Yehezkel, 2000: "Thirsty for a Solution – The Water Crisis in the Occupied Territories and its Resolution in the Final-Status Agreement", Jerusalem, July; at: http://www.btselem.org/English/Publications/Summaries/200007_Thirsty_for_a_Solution.asp.

Lonergan, Stephan: Brooks, David, 1994: *Watershed: The Role of Fresh Water in the Israeli Palestinian-Conflict* (Ottawa: International Development Research Centre).

MFA [Israel], 1992: "Multilateral Issues: Water in the Middle East" (Tel Aviv: MFA, 27 January); at: <http://www.mfa.gov.il/MFA/Archive/Peace+Process/1992/MULTILATERLA+ISSUES-WATER+IN+MIDDLE+EAST+-+Ja.htm.>

MFA [Israel], 1994: "Principle Water Sources" (Twl Aviv: MFA, 1 August); at: <http://www.mfa.gov.il/MFA/Archive/Communiques/1994/PRINCIPAL+WATER+SOURCES.htm.>

Ministry of National Infrastructure [Israel], 2001: "The Water Sector: Non-conventional Water Resources and Conservation.", 24 July; at: <http://www.mni.gov.il/english/units/Water/NonconventionalWaterResoucesand Conservation.shtml. >.

Ministry of National Infrastructure [Israel], 2001a: "The Water Sector: Planned Major Projects (2000–2005)"; at: <http://www.mni.gov.il/english/units/Water/Planned-MajorProjects(2000-2005).shtml>.

Ministry of National Infrastructure [Israel], 2001b: "The Water Sector: Regional Cooperation on Water Resources"; at: <http://www.mni.gov.il/english/units/Water/RegionalCooperationWAterResources.shtml>.

Ministry of National Infrastructure [Israel], 2001c : "The Water Sector: Water Production and Consumption." 2001;<http://www.mni.gov.il/english/units/Water/WaterProductiona Consumption.shtml.>

Ministry of National Infrastructure [Israel], 2001d: "The Water Sector: Water Resources and Water Availability"; see at:< http://www.mni.gov.il/english/units/Water/WaterResourcesandWAterAvailability.shtml>.

Palestinian Central Bureau of Statistics, 2002: at <www.pcbs.gov.ps>.

Palestinian Central Bureau of Statistics, 2003: at <www.pcbs.gov.ps>.

Poku, Nana; Graham, David, 1998: "Redefining Security for a new Millennium", in: Poku, Nana; Graham, David, (Eds.): *Redefining Security: Population Movements and National Security* (Westport: Praeger).

Poore, Stuart. 2004: "Strategic Culture", in: Glenn, John; Howlett, Darryl; Poore, Stuart (Eds.): *Neorealism Versus Strategic Culture* (Aldershot: Ashgate); se at: <http://www.wws.princeton.edu/~wws401c/geography. html.>

RAND, 2000: *The Security Dynamics of Demographic Factors* (Santa Monica: RAND) accessed on 15 September 2004.

Schwartz, Yehoshua; Zohar, Aharon, 1991: *Water in the Middle East: Solutions to Water Problems in the Context of Arrangements between Israel and the Arabs* (Tel Aviv: Jaffee Center for Strategic Studies).

Soffer, Arnon, 2002: "Special Policy Forum Report: Demographics in the Israeli-Palestinian Dispute." CIAO, 22 March 2002; at: <http://www.ciaonet.org/pbei/winep/peace_2002/2002_370.html.>

UNEP, 2002: *Global Environmental Outlook*, at <http://www.unep.org/geo/geo3/english/pdf.htm>, page 151

UNISPAL, 2003: "The Impact of Israel's Separation Barrier on Affected West Bank Communities: A Follow-Up Report to the Humanitarian and Emergency Policy Group and the Local Aid Coordination Committee" in: name (Ed,): (city: Publisher, 30 November; at: <http://domino.un.org/unispal.nsf>.

Wolf, Aaron T., 1998: "Hydrostrategic Decisionmaking and the Arab-Israeli Conflict", in: Albert J., M. Bernhardsson, and R. Kenna (Eds.): *Transformations of Middle Eastern Natural Environments: Legacies and Lessons*. Bulletin 103 of the Yale School of Forestry and Environmental Studies Bulletin Series.

Wolf, Aaron T., 2004: "Trends in Transboundary Water Resources: Lessons for Cooperative Projects in the Middle East", in: ed.: title (Ottawa: IDRC); at: <http://web.idrc.ca/fr/ev-33233-201-1-DO_TOPIC.html>.

29 Water as a Human Right: Understanding of Water in the Arab Countries of the Middle East

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Abstract

The international community has affirmed the human right to water in a number of international treaties, declarations and other documents. Most notably, the UN Committee on Economic, Social and Cultural Rights adopted in November 2002 a general comment on the right to water setting out international standards and obligations relating to the right to water. Based on the UN concept of water as a human right for selected Arab countries in the Middle East (Egypt, Palestine, Jordan, Lebanon)[1] it is analyzed if and to what extent these concepts are acknowledged. The paper aims to identify the scale of knowledge of and commitment to the UN concept in the region and is meant to identify the main areas of concern in each country regarding water as a human right. The paper summarizes the main challenges facing strategic and coordinated action towards the UN concept of water as a human right, identifies what types of processes and institutions need to be developed to meet the challenges of the concept and provides best practice examples from countries that have shown innovation. Objectives and priority ideas for activities of NGOs are recommended

Keywords: Human right, Lebanon, Egypt, Palestine, Jordan, UN Committee on Economic, Social and Cultural Rights

29.1 Introduction: Water as a Human Right

For human development access to sufficient water regarding quality, quantity and economy is vital. Today more then 1.2 billion people lack access to an adequate supply of water, more then 2.4 billion people lack access to adequate sanitation. More then 2.4 million people die annually from water related diseases due to an absence of a qualitatively safe water supply; most of them are children (WHO 2003).

1 Case studies have been done by Karen Assaf, Palestine, Bayoumi Attia, Egypt, Ali Darwish, Lebanon, Batir Wardam, Jordan. The project concept and coordination was handled by Simone Klawitter on behalf on hbf.

With population growth in many parts of the world, especially in urban areas, freshwater resources are affected by increasing pollution and overuse of existing natural resources resulting in a growing scarcity in quality and quantity of water. A raising competition among the different users and uses of water is the consequence.

The human rights approach to water puts the people's need first regarding water use and promotes human-centered water resource development based on a coherent framework of binding legal norms and accountability. It aims to empower individuals to achieve their full potential of and the freedom to take up opportunities in using water.

29.1.1 The Human Rights Concept

The term 'human rights' refers to those rights that have been recognized by the global community in the *Universal Declaration of Human Rights*, adopted by the United Nations (UN) Member States in 1948, and in subsequent international legal instruments binding on states. The consensus on human rights reflects a global moral conscience (WaterAid 1999).

Although legal instruments at the international and national levels have recognized and confirmed human rights, the law is not the source of these rights. Human rights are not granted by any human authority or government, but are derived from the essential dignity and nature of humankind. The list of internationally recognized human rights covers all those rights essential for human survival, physical security and development in dignity. There is no hierarchy of rights and all rights should be regarded as being of equal priority. Denial of one right invariably impedes enjoyment of others, leading to the recognition by UN Member States that human rights are indivisible, interdependent and inter-related (UN 1993; WaterAid 1999; Häusermann 1997)

The human rights approach is especially used to challenge the economic and social injustice, particularly toward indigenous peoples, women's groups, advocates of children, and disabled people. In summary, a human rights approach to development is one which (WaterAid 2003)

- puts people first and promotes human-centered development;
- stresses liberty, equality and empowerment;
- recognizes the inherent dignity of every human being without distinction;
- recognizes and promotes equality between women and men, between minority and majority;
- promotes equal opportunities and choices for all so that everyone can develop their unique potential and have a chance to contribute to development and society;
- promotes national and international systems based on economic equity, equitable access to public resources, and social justice;
- promotes mutual respect between peoples as a basis for justice and conflict prevention and resolution.

Human right treaties (covenants, pacts or conventions) are contracts signed by states which are legally binding. They impose mutual obligations on the states. Human rights treaties have been adopted by states worldwide and represent a global consensus about how individuals should be treated in accordance with their inherent rights and dignity. Six core human rights treaties do exist, which are confirmed in international law.[2] Lobbying groups have also adopted human rights texts: The League of Arab States has adopted human rights treaties open to signature by their respective member states.

There are various mechanisms within the UN human rights system to submit complaints of human rights violations: procedures to bring complaints directly under international human rights treaties and special procedures for filing complaints guided by bodies. The Commission on Human Rights and the Economic and Social Council have established what are known as 'special procedures' of the Commission on Human Rights. These are a number of additional procedures and mechanisms, undertaken either by 'working groups' composed of experts acting in their individual capacity or by independent individuals known as Special Rapporteurs', 'Independent Experts', or 'Special Representatives'. In 1997, the UN

2 The six core human rights treaties are: *The International Covenant on Civil and Political Rights*, adopted in 1966 and which entered into force 23 March 1976; *The International Covenant on Economic, Social and Cultural Rights*, adopted in 1966, entered into force 3 January 1976; *The International Convention on the Elimination of All Forms of Racial Discrimination*, adopted in 1965, entered into force 4 January 1969; *The Convention on the Elimination of All Forms of Discrimination Against Women*, adopted in 1979, entered into force 3 September 1981; *The Convention Against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment*, adopted in 1984, entered into force 26 June 1987; *The Convention on the Rights of the Child*, adopted in 1989, entered into force 2 September 1990.

Commission on Human Rights entrusted an individual expert, Mr. El-Hadji Guissé, with the task of drafting a working paper on the human right approach to water focusing on the promotion of the realization of the right of everybody's access to drinking water supply and sanitation services (WaterAid 1999).

29.1.2 Human Rights Approach on Water-related Issues

The right to drinking water is defined as the right of every individual to have access to the amount of water required to meet his or her basic needs. This right covers access by households to drinking water supplies and waste-water treatment services managed by public or private organizations. There is a discussion ongoing if this right covers water intended for commercial, industrial or agricultural uses as well (UN 2002a, WHO 2003).

The human right on water has been explicitly recognized in several international human rights treaties[3], especially in the *International Covenant on Economic, Social and Cultural Rights*[4] and other international binding laws and regulations[5]. To monitor the implementation of that treaty an independent expert committee, *The Committee on Economic, Social and Cultural Rights* was established. This committee was responsible for elaborating the content and obligations attached to the right to water in its General Comment No 15, 'The right to water' (articles 11 and 12 of the *International Covenant on Economic, Social and Cultural Rights*). The Committee defined the right to water as follows (UN 2002b, WHO 2003):

> The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses.

Significantly, the Committee stated that:

> The right to water contains both freedoms and entitlements. The freedoms include the right to maintain access to existing water supplies necessary for the right to water, and the right to be free from interference, such as the right to be free from arbitrary disconnections or contamination of water supplies. By contrast, the entitlements include the right to a system of water supply and management that provides equality of opportunity for people to enjoy the right to water.

Doing so the Committee recognized that water itself was an independent human right. The right to drinking water means that all persons, without discrimination, must have access for their basic needs to a sufficient quantity and quality of water supplied. The basic need for water must be economically affordable especially for the poor, and not dependent on if a public or private entity supplies the water. States must take all necessary measures to enable the poorest people to enjoy the human right on water, e.g. introducing subsidized water prices.

Governmental obligations with regard to the human right on water can broadly be categorized in obligations to *respect, protect, and fulfill.*

Box 29.1: Categorization of governmental obligation with regard to the human right on water. **Source**: UN (2002b), WHO (2003).

Respect. The obligation to respect requires that States Parties refrain from interfering directly or indirectly with the enjoyment of the right to water.

Protect. The obligation to protect requires that States Parties prevent third parties such as corporations from interfering in any way with the enjoyment of the right to water.

Fulfill. The obligation to fulfill requires that States Parties adopt the necessary measures to achieve the full realization of the right to water.

The General Comment No. 15 affirms that UN (2002b), WHO (2003):

> The human right to water is indispensable for leading a life in human dignity. It is a prerequisite for the realization of other human rights.

Hence, it is recognized that this right has already been recognized in a wide range of international agreements. Regarding the normative content of the 'general comment' it is stated that the right to water comprises both:

1. 'Freedoms' - such as the right to be free from interference through, for example, arbitrary disconnections or the contamination of water supplies, and
2. 'Entitlements' - including the right to a system of water supply and management that provides equality of opportunity for people to enjoy the right to water.

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3 The human right on water is also protected in times of conflict under the Geneva Conventions.

4 This covenant was ratified by 146 countries.

5 According to the *European Council on Environmental Law*, water is above all a social good, that is, a resource that forms part of the common heritage of humanity. Water is also seen as an economic good of great value, but which cannot be treated as a mere commodity like other consumer goods. The Council stresses that access to drinking water must not be subject to market forces dominated by the profit motive.

Furthermore, it is stressed that water should be treated as a social and cultural good, and not primarily as an economic good. 'General comment' No. 15 reaffirms the margin of discretion allowed to States Parties under international human rights law, at the same time stressing that states are obliged to utilize:

> All appropriate means, including particularly the adoption of legislative measures in the implementation of their Covenant obligations.

States obligations regarding the right to water and acknowledgements of constraints due to the limits of available resources are recognized as well but it is clearly stressed, that :

> States Parties have a constant and continuing duty under the Covenant to move as expeditiously and effectively as possible towards the full realization of the right to water.

The 'general comment' calls for guidelines on the three main areas in the implementation of the right to water at the national level, but it does not identify details on how to do so. These three areas are as follows (UN 2002b):

- The formulation, implementation and monitoring of legislation, strategies and policies;
- The identification and application of suitable, sufficiently disaggregated indicators and benchmarks for monitoring States Parties compliance with their obligations and progress towards the full realization of the right to water
- The provision of access to effective judicial or other appropriate remedies at both national and international levels for any persons or groups who have been denied their right to water

Furthermore international obligations concerning the right to water are outlined. These include (UN 2002b):

'Positive' obligations of States Parties - for example, to ensure that the right is given due attention in international agreements, or the special responsibility of the economically well developed States Parties to provide aid and international assistance to poorer states parties, and 'negative' obligations, such as refraining at all times from imposing embargoes or similar measures that prevent the supply of water, as well as goods and services essential for securing the right to water. The 'general comment' also stresses the fundamental importance of ensuring access to adequate sanitation and States Parties obligation to progressively extend safe sanitation services, particularly to rural and deprived urban areas, taking into account the needs of women and children. Non-state actor's obligations are stressed as follows (WaterAid 1999, WHO 2003):

- Co-operate effectively with States Parties in relation to the implementation of the right to water;
- Incorporate human rights law and principles into both policy and action; for example, the right to water should be taken into account in any lending policies, structural adjustment programs or development projects;
- Give priority to the most vulnerable or marginalized groups of the population in the provision of aid and the distribution and management of water and water facilities

Defining water as a human right leads to a broader basis for advocacy work for the water needs of human beings. Utilizing the right to water means (WaterAid 1999, WHO 2003):

- Paving the way for translating the right to water into specific national and international legal obligations and responsibilities;
- Raising attention towards water management all over the world;
- Identification of minimum water requirements and allocations for all;
- Setting priorities for water policies centered on the water needs of human beings;
- Catalyzing international agreements on water issues and, thus contributing to resolutions of watershed disputes and conflicts between different users;
- Emphasizing the governmental obligation to ensure sufficient access to water and sanitation;
- Providing a basis for lobbying towards water needs on the basis of political commitments.

All human rights are indivisible. They are inter-related. A lack of water and sanitation clearly has an impact on the enjoyment of other human rights, such as the rights to education, health and work, which form an essential basis for poverty elimination and human development as well. Recognizing water as a human right creates the political will to solve the water crisis, lowering poverty and raising health by establishing a partnership between the human rights and the water sector community.

29.2 Methodology and Analytical Framework

The methodology for the analysis consisted of the following components:

(1) *Country case studies* following *a common reporting framework* for each of the four countries: Strategic and coordinated action for each of the four countries was framed by common analytic components. The framework presents reporting principles and specific content to guide the preparation of the country reports and hopefully represents the main aim of the projects to identify the scale of knowledge of and commitment to the UN concept in the region. Analyzing the water sector, strength and weaknesses regarding the criteria of the water as a human rights concept were identified.

Box 29.2: Common reporting framework for the country analysis.

The national water sector

National macro-economic setting, development objectives and water policies

Water resource assessment: Base and potential

Analysis of demand and supply of water

Regulatory framework of water law

Institutional settings and process

Principal stakeholders, their roles, interests and conflicts

Meeting the UN concept: The national understanding of water

Evaluation of UN criteria

Areas of concern and opportunities

List of NGOs

List of donor activities of governmental and non-governmental organizations

References and further information

(2) *A country survey* focusing on criteria of the UN concept for water as a human right: The 'general comment 15' on the right to water sets the criteria for the full enjoyment of the right to water as a guideline for the evaluation as follows:

- Availability of sufficient and continuous water supply;
- Quality of water;
- Accessibility of water and water facilities and services: Physical accessibility of water, economic accessibility, Non-discrimination against marginalized areas or groups, Information on water issues.

(3) a *synthesis report* summarizing the results of the country studies.

29.3 Analysis of the UN Criteria

The following part analyses the UN criteria given in the 'comment' and intends to identify the main shortcomings regarding the human rights concept. For detailed numbers and figures as well special issues please see the country case studies which are published at <www. boell.de.

29.3.1 Criteria of the UN Concept

29.3.1.1 Availability

Regarding the physical access the 'comment' states that "a water supply is sufficient and continuous for personal and domestic uses, such as drinking, personal sanitation, washing of clothes, food preparation, personal and household hygiene" if it follows at least the basic access defined in the WHO guidelines. (Howard 2003). It needs to be taken into account that some individuals and groups may also require additional water due to health, climate, and work conditions (UN 2002b). Regarding the WHO guidelines for each of the countries, it can be stated that there is a lack of information to fulfill the needs for an evaluation of the WHO guidelines (see table 29.1 for the WHO access indicator).

29.3.1.2 Water Quality

Water is often also scarce in quality. The water supplied must be safe regarding water quality for domestic use aspects as well. The 'committee' refers to the WHO Guidelines for drinking water quality (WHO 1997) which are meant to guide governments to develop national water quality standards to be sufficient to fulfill all human beings needs.

29.3.1.3 Accessibility

Regarding the 'comment' water and water facilities and services must be accessible to every human being. It identifies four overlapping dimensions of accessibility, defined as follows (UN 2002b):

Physical accessibility. "Water, and adequate water facilities and services, must be within safe physical reach for all sections of the population. Sufficient, safe and acceptable water must be accessible within, or in the immediate vicinity, of each household, educational institution and workplace. All water facilities and services must be of sufficient quality, culturally appropriate and sensitive to gender, life-cycle and privacy requirements. Physical security should not be threatened during access to water facilities and services." The WHO Guidelines for water availability mentioned above are serving as the guiding document in assessing those criteria as well.

Economic accessibility. "Water, and water facilities and services, must be affordable for all. The direct and indirect costs and charges associated with securing water must be affordable, and must not compromise or threaten the realization of other Covenant rights." In general, water service is affordable, when not more then 2 per cent of the average family income needs to be spent for water (AWWA 2000).

Non discrimination against marginalized areas or groups. "Water and water facilities and services must be accessible to all, including the most vulnerable or marginalized sections of the population, in law and in fact, without discrimination on any of the prohibited grounds" (UN 2002b). Governments are obliged to take steps to remove any de facto discrimination that could impede enjoyment or exercise the right to water. They have to give special attention to those individuals and groups who have traditionally faced difficulties in exercising the right to water, e.g. women, children, minority groups, indigenous peoples, refugees, asylum seekers, internally displaced persons, migrant workers, prisoners and detainees.

Information on water issues. All states are obliged to make information about water freely accessible, "including the right to seek, receive and impart information concerning water issues" (UN 2002b).

29.4 Main Concerns and Development Objectives Regarding the UN Concept

The UN concept for water as a human right was used as a tool for analysis using the criteria given within the concept. The main concerns and development objectives regarding the UN concept in general and evaluating the country studies which have been identified are discussed next.

29.4.1 Indicators and Benchmarks

Indicators can provide a broad, yet succinct, description of the condition of a water sector. They can describe and track changes in key aspects as well as in the sector configuration and conditions. The UN concept lacks a coherent system of indicators to evaluate a water sector. Often problems arise in certain areas, which are difficult to access by the suggested WHO indicators for physical water access making it difficult to identify inequalities and discrimination faced by people, which impede their development. A comprehensive indicator system and corresponding benchmarks could help to overcome these shortcomings.

29.4.2 Lacking Information

Good and accessible information is the basis for making decisions about water resources. To evaluate the water sector detailed information is needed. Information and data availability varies from country to country. Most concerns exist regarding data accuracy, reliability, consistency and deficiencies.

29.4.3 Poor Governmental Commitment to the Human Right Concept

Water governance refers to a range of political, social, economic and administrative systems that are in place to regulate the development and management of water resources and provision of water services at different levels of society. Effective water governance is a prerequisite to fulfill the human right on water. Regarding the governmental commitment to the human right concept it can be stated that there is no single legal norm in any of the countries evaluated serving as a binding instrument for the human right on water although national governments are obliged to fulfill international commitments on human rights. Governmental obligation to fulfill international law regarding water in general depends on political interests and economic viability.

29.4.4 Low Awareness of People of the Right on Water

People are in general not aware of their right to sufficient water supply in quality and quantity. People often simply do not know about this right. Education and empowerment could serve as a way out and a starting point for political engagement. Stakeholders such as NGOs play an important role in encouraging dialogue among people towards their awareness of the right to water.

29.4.5 Growing Awareness of Water Problems and Water Saving Possibilities

In all countries a growing awareness of water as a finite resource was identified, but still work needs to be done. Often water is seen as a political issue rather than a basic need for life. Several methods and tools are available to promote water awareness to create an environment to support effective water policies and an understanding of water issues, which should be applied.

29.4.6 Discrimination of Marginalized Groups

Discrimination is still in place depending on political power, especially discrimination of people living in remote areas and social groups with low economic capacity.

29.4.7 Growing Number of People Who Can't Afford Water

In each of the countries analyzed a growing number of people exist who cannot afford to have a minimum of water supplied. Often people with no or low access to water are affected, living in poor neighborhoods who must buy water from private vendors at high prices. A free provision of a certain amount of water or providing water at an affordable level to serve basic needs should be obligatory.

29.4.8 People-centered Approach

As expected for a human rights approach, the UN concept for water as a human right is characterized as a sole people-centered approach to development, not recognizing the 'water rights' of the environment in an equal manner. A people-centered approach is preferable to a top-down approach which was traditionally in place with water systems imposed on the people by governmental and professional sectors. It is more effective, efficient and less costly. But water is also needed to maintain and recreate nature and the environment. The amount of water for peoples' use needs to be balanced with the needs of the environment.

29.5 Role of NGOs in Realizing the Human Right to Water

Internationally active NGOs could contribute in several ways to the realization of the right to water. The identified possible fields of activity are as follows:

- Promoting human right concepts by raising awareness and information on aspects of the right to water and on how citizens can claim that right and assist others in fulfilling it;
- Building capacities among local groups to monitor the commitment and work of local governments and therefore contributing to ensuring that an adequate policy is in place, and that the policy is implemented;
- Supporting local service provision by raising awareness of water as a limited resource, e.g. awareness campaigns, information and training, especially in schools for instance in the management of community water supplies;
- Contributing to the development and promotion of international standards, benchmarks and indicators on the right to water;
- Documentation and highlighting of violations of the right to water;
- Advocating in international and regional fora on behalf on those who have had their right to water threatened or violated.

Especially in Palestine, but in all other countries as well, the political situation is affecting much work and engagement of NGOs in water issues. During the last decade working on water issues became a key NGO working concept in most of the countries of the Near East. Environmental NGOs are the main player; NGOs which are affiliated with political parties are recently only occasionally engaged.

The fact that several NGOs are running regional offices in different countries is seen as a great advantage in contributing to the realization of the human right concept to water. A precondition for solving the ongoing water crisis is cooperation among the affected states, primarily if they are using the same water resources. Cooperation between Israel and its Arab neighbors is seen as a precondition for each future project. The sensitivities of Arab and Israeli partners in doing so must be carefully taken into account. Depending on the project content, a suitable project partner needs to be identified. Numerous NGOs have been identified in each country by the project partners who certainly are willing to cooperate. However, sufficient financial resources need to be provided.

References

AWWA [American Water Works Association], 2000: *Principles of water rates and fees. Manual of water supply practices* (city: AWWA).

Häusermann, J., 1997: *Rights and Humanity, A Human Rights Approach to Development*. Discussion Paper commissioned by DFID in preparation of the UK Government's White Paper on International Development.

Howard, G.; Bartram J., 2003: *Domestic water quantity, service level and health* (Geneva: World Health Organization).

UN [United Nations], 1993: *Vienna Declaration and Programme of Action*, A/CONF.157/23 (Vienna: UN, 12 July).

UN [United Nations], 2002a: *Relationship between the enjoyment of economic, social and cultural rights and the promotion of the realization of the right to drinking water supply and sanitation*. Report of Mr. El Hadji Guissé, Special Rapporteur on the Right to Drinking Water Supply And Sanitation (E/CN.4/Sub.2/2002/10).

UN [United Nations], 2002b: *The right to water*. General Comment No. 15 of the Economic and Social Council, (New York: UN, ECOSOC).

WaterAid, 1999: The right to water, sanitation and hygiene and the human rights-based approach to development. Water Aid Briefing paper, prepared by Belinda U. Callaguas; see also at: <http://www.righttowater.org.uk/>.

WHO [World Health Organization], 1997: *WHO Guidelines for Drinking Water Quality* (Geneva: WHO, 154503 8,); see at: <http://www.who.int/water_sanitation_health/dwq/guidelines2/en/>.

WHO [World Health Organization], 2003: *The right to water*. Health and human rights publication series; no. 3, ISBN 92 4 159056 4.

Annex 1: Who Indicators for Physical Water Access

Table 29.1: Service level and quantity of water collected, **Source**: Howard (2003).

Service level	Distance/time	Likely volumes of water collected	Needs met	Intervention priority and action
No access	More than 1 km/ more than 30 min round trip	Very low (often below 5 liter/capita/d)	Consumption can not be assured, hygiene practice compromised, basic consumption may be compromised	Very high provision of basic service
Basic access	Within 1 km/ within 30 min round trip	Average unlikely to exceed approximately 20 Liter/capita/d	Consumption should be assured, hygiene may be compromised, laundry may occur off-plot, e.g. away from home	High hygiene education provision of intermediate level of service
Intermediate access	Water provided on plot through at least one tap (yard level)	Average of 100-200 liter/capita/d	Consumption assured, hygiene should not be compromised, laundry likely to occur on-plot, e.g. within the confines of the household	Low hygiene promotion still yields health gains encourage optimal access
Optimal access	Supply of water through multiple taps within the house	Average of 100-200 liter/capita/d	Consumption assured, hygiene should not be compromised, laundry will occur on-plot	Very low hygiene promotion still yields health gains

Part VI International Water Law

30 Legal Framework of Groundwater Management in the Middle East (Israel, Jordan, Lebanon, Syria and the Palestinian Territories)

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Abstract

The aim of this chapter is to present the existing legal framework for the management of groundwater in the Middle East (Israel, Jordan, Lebanon, Syria and the Palestinian Territories) and possible recommendations to achieve sustainable development. In Israel, Jordan, Lebanon and Syria, a legal regime for groundwater exists. Nevertheless, in these states, groundwater is facing serious quality and quantity problems such as water level declines due to over-pumping, sea water intrusion in the coastal areas (Coastal Aquifer in Israel) or salinity increase (Highlands in Jordan).

The Palestinian Autonomous Territories represent a special case as the Palestinians still do not hold full sovereignty on their land and water resources. Their groundwater resources, whether transboundary or not, are subject to different water legislation: the Israeli Military Orders (since 1967) and the Palestinian Authority Water Legislation (after the Declaration of Principles (1993) and the Israeli-Palestinian Interim Agreement (1995)).

Sustainable management of groundwater, an important resource in the study area, can be achieved through a suitable legal and institutional framework regulating risk and uncertainty, groundwater extraction and use, groundwater pollution and groundwater related environmental issues, effectively implemented and enforced. In the case of the Palestinian Territories, the key issue is the Palestinian sovereignty on its land and natural resources with a bilateral treaty on the transboundary groundwater.

Keywords: Groundwater, ownership, control of extraction and use, pollution, Interim agreement, Joint Water Committee, water rights, water law

30.1 Introcuction

Located in an arid and semi-arid zone, countries of the Middle East have limited surface water and rely much on their groundwater resources. Groundwater is mainly developed for agriculture which is by far the largest water consumer. Groundwater management has become one of the key challenges in the area, where unsustainable groundwater use has led to overdraft and vast pollution problems.

The aim of this chapter is to present the existing legal framework for its management in the Middle East (Israel, Jordan, Lebanon, Syria and the Palestinian Territories) and possible recommendations to achieve its sustainable development. The first part will present and compare national regulations concerning groundwater in Israel, Jordan, Lebanon and Syria, as independent and sovereign States examining the situation of the groundwater in these States and the problems it is facing, and pointing out the failures in the

1 The views expressed in this chapter are personal.

existing legal regimes in dealing with these problems. The second part will deal with the special case of groundwater in the Palestinian Territories, whether under occupation or the autonomy regime fashioned by the Interim Agreement (1995).

30.2 Groundwater in the Modern Law of Sovereign States (Israel, Jordan, Lebanon and Syria)

Modern water law tends to include specific provisions for the use and development of groundwater regarding its special nature, in comparison to surface water (Burchi 1999; Caponera 1992), whether in a same or separate text. Each of Israel, Jordan, Lebanon and Syria has its own legal regime for water resources, with special measures for groundwater in a law or by-law. Before going into the general provisions of 'the groundwater texts', it is useful to have an overview of the legal tools required for a proper groundwater management.

30.2.1 Legal Tools for Proper Groundwater Management

For groundwater the major issues that need to be covered are (Caponera 1992):

- its legal status, in other words its ownership;
- the protection against depletion, or the control of extraction and use;
- and finally the protection against pollution.

Public ownership or a state controlled regime of water resources in general, and groundwater in particular, gives the state authorities or the government a major authority for regulating water use and allocation. On the contrary, in a private ownership regime, the government has a limited authority in regulating groundwater extraction, and ultimately resource allocation.

The permit system offers a wide range of control over groundwater, as it may cover groundwater prospecting or exploration, well construction and groundwater abstraction and use. Usually the permit or the license sets the terms and conditions of the quantity of water that may be taken, the rate of abstraction, the purpose to which the water is being extracted, the time and period of extraction and use, and the modalities of abstraction and use. The permit can be granted for a limited period in time. The permit system enables the water administration to control the water abstraction. In a sustainable system, groundwater permits should be consistent with the hydro geological reality of an aquifer, i.e. consider the respect of the safe yield, take into account declining groundwater levels, decreasing well yields and deteriorating water quality.

Metering the water wells is another important control measure. It serves to quantify the amount of water extracted and also as a basis for charging users for groundwater abstraction. Generally it limits excessive water extraction. It is a main tool for checking the user's compliance with the permit's terms, regarding the authorized quantity to be abstracted.

Groundwater protection against pollution can be achieved through the regulation of selected land uses such as restrictions of certain cropping patterns, or limitations of use of fertilizers and pesticides and of direct and indirect discharges. Such measures are introduced through water legislation in order to ensure that land uses do not have negative repercussions on groundwater resources. The *Environmental Impact Assessmen*t can be required in case of projects and activities that might have a negative effect on the conditions of an aquifer. And finally the *Declaration of Protected Areas* is established to protect sensitive zones of an aquifer such as groundwater supply works and wells, or vulnerable aquifers against the risk of pollution, or aquifers at risk of overexploitation.

30.2.2 Groundwater Management Failure from a Legal Perspective

In Israel, Jordan, Lebanon and Syria groundwater is facing a severe crisis, with serious quality and quantity problems such as water level declines due to overpumping, sea water intrusion in the coastal areas, or salinity increase, despite an existing legal regime regulating its management.

30.2.2.1 Water as a Public Property

At the time of their independence, Israel, Jordan, Lebanon and Syria inherited in their legal arsenal the *Mejelle*, or *Ottoman Civil Code* (Laster 1980; Mallat 1997). While Israel and Jordan have repealed the Mejelle, and replaced it by modern legislation, in Lebanon and Syria its water related sections (articles 1234 to 1328) are still in force. Following the Islamic tradition, the Mejelle defines water as a common good (article 1234), which could be privately owned following very specific conditions.[2] However, this can never be the case for groundwater, article 1235 states: "Water flowing under ground is not the absolute property of any person." In the modern laws of Israel and Jordan, water is owned by the state.

The *Israeli water law of* 1959 opens by stating: "The water resources in the State are public property; they are subject to the control of the State and are destined for the requirements of its inhabitants and for the development of the country."[3] In the *Jordanian Law No* 18 *of* 1988, the Water Authority of Jordan law, indicates that: "All water resources available within the boundaries of the Kingdom, whether they are surface or ground waters, regional water, rivers or internal seas are considered State owned property" (article 25).

Lebanon and Syria still live under a system established before their independence. Besides the Mejelle, Lebanon and Syria have inherited from their common past two texts dating back to the French mandate. These texts are: *Order no 144/S of the High-Commissioner* "on the definition, delimitation and temporary occupation of the public domain" of 10 June 1925,[4] and *Order No* 320 concerning the conservation and use of the waters of the public domain of 26 May 1926.[5] These two texts form the basis of the legal regime of water in Lebanon and Syria. Order no 144/S defines the public domain as "all things which are by destination affected to the use of all or to a public service. It is inalienable and imprescriptible" (article 1). Article 2 enumerates the components of the public domain, without giving an exhaustive list[6]. According to this article all water resources including groundwater resources are part of the public domain.

30.2.2.2 Regulation of Groundwater Use

In each of these countries, groundwater falls respectively under the legislation mentioned above, as general water legislation, but also under a specific text. These 'groundwater texts' are the following:

- In Israel: *Water Drilling Control Law* 1955
- In Jordan: *Underground Water Control By-Law* (By-law No 85 of 2002)[7]
- In Lebanon: *By-Law* 14438 *of* 1970 (2 May) organizing the prospecting and use of groundwater.
- In Syria: *Law no* 165 *of 27 September* 1958 concerning pumping of water from surface and groundwater for agricultural purposes, to which numerous ministerial resolutions have been added.[8]

In the following tables (30.1, 30.2, 30.3), the most important and relevant provisions of these texts are detailed and compared. The articles mentioned are those of the respective groundwater text of each country, except for Israel where the reference is mainly to the Water Law of 1959.

The reading of the tables calls for the following remarks:

- All four countries have instituted a permit or license system for drilling wells, extracting and using groundwater. Nevertheless groundwater resources are seriously threatened with water levels decline due to over-abstraction beyond the safe yield. There are three main reasons for this:
  - *Unlicensed wells*: i.e. wells drilled and exploited without any licence. In Syria almost 50 per cent of the total number of wells in the country are unlicensed leading to severe overdraft (World Bank 2001). Lebanon faces a similar situation with numerous unauthorized wells in the Beka'a Valley. In Jordan, the issue of illegal wells is limited in some basins and more wide-spread in others (Chebaane et al. 2001).
  - *Non-respect of the abstraction limit*: This is the main issue of concern in Jordan where at least 60 per cent of the wells are private ownership, and mostly not controlled or have broken meters.
  - *Over-allocation*: A report of the State Comptroller on the management of the water sector (1990) in Israel found that over-extraction of groundwater is a major contributor to the deterioration of the quality of the water (coastal aquifer and mountain aquifer). The report emphasized that despite the water deficit in the aquifers; the Water Commissioner (in charge

2 In order to be considered as private property, water has to be captured intentionally and its flow interrupted, for example water collected in a jar.

3 Water Law 5719–1959 Chapter one: Preliminary, section 6 (Unofficial translation, in J. M. Trolldalen (Ed.) 1998).

4 Lebanese Republic, Official Journal No 1880

5 Lebanese Republic, Official Journal No 1998 (supplement)

6 Article 2 uses the following terms: "are notably part of the public domain…"

7 Available at: <www.mwi.gov.jo> (last accessed 09/09/2004).

8 It is notable that the groundwater use in Syria is regulated in a text concerning agriculture. Agriculture remains in Syria an important political target to achieve food security.

Table 30.1: Ownership of Groundwater in Israel, Jordan Lebanon and Syria

Israel	Jordan	Lebanon	Syria
– a person's right in any land does not confer on him a right in a water resource situated therein… (chapter one, section 4)	– Groundwater is owned and controlled by the State (article 3 A) – Ownership of the land does not include ownership of groundwater therein (article 3 B).	– Groundwater is part of the public domain (article 2 paragraph 1 (Order no 144/S 10 June 1925)	– Groundwater is part of the public domain (article 2 paragraph 1 (Order no 144/S 10 June 1925)

Table 30.2: Protection against pollution of groundwater in Israel and Jordan

Israel	Jordan
– very broad definition of water pollution: "a change in the properties of water in a water resource in physical, chemical, organoleptic, biological, radioactive or other respect, or a change as a result of which water is dangerous to public health or likely to harm animal or plant life or less suitable for the purpose which it is used or intended to be used" (Water Law 1959 chapter 2 article 1 A, section 20A). – Prohibition of any pollution (chapter 2 article 1 A, section 20B).	– The Ministry (of Water and Irrigation) performs the monitoring of the quality (article 4 A) • Anyone who is granted a license to extract underground water is hereby obligated to refrain from causing any water pollution.

of the management of the country's water resources) authorized extractions and continued the same policy (Adam 2000).

- The potential risk of pollution of groundwater resources is considered only by Israel, and Jordan. In Lebanon, the by-law of 1993 concerning the organization of the Ministry of Environment contains a general provision on the protection of water resources, but no specific measures. In Syria, a draft water law was submitted in 2001 to the Council of the People. The draft is not yet adopted. The draft law had instituted the polluter-pay principle. No other provision exists for the moment. Despite its specific provisions on water resources pollution, Israel is facing a process of degradation and deterioration of its water resources (Adam 2000). Even the institution of the Ministry of Environment did not improve much until now.

30.3 In Search of Self Management: Groundwater in Palestine

This part will deal with the legal situation of groundwater in the Palestinian Territories (West Bank and Gaza Strip) from the military occupation of 1967 to the peace process, i.e. under the regime designed by the Declaration of Principle of 13 September 1993, and the Israeli-Palestinian Interim Agreement on the West Bank and Gaza Strip of 28 September 1995 (Oslo II). It will proceed with a study of the Palestinian regime deriving there from. In the interim agreements the only source of water referred to is groundwater, as Palestinians' rights to surface water (the Jordan River) are not yet recognized.

30.3.1 From the Military Orders to the Interim Agreement: An Illusive Step towards Self-management

30.3.1.1 The Military Orders

After the June 1967 war and the military occupation of the West Bank and Gaza Strip, a series of Military Orders were issued allowing Israel to acquire full control of the water resources. With these Military Orders all responsibilities for managing the water resources were vested in an Israeli official who had the power to decide about licences of wells to be drilled, the shutting down of existing water installations, and therefore the water use (van Edig 1999; Daibes 2003). Separate but similar Military Orders were issued for the West Bank and the Gaza Strip.

30.3.1.2 The Interim Agreement

The Gaza-Jericho Agreement of 4 May 1994 had already organized a transfer of authority from the

Table 30.3: Control of extraction and use (protection against depletion) of groundwater in Israel, Jordan, Lebanon and Syria

Israel	**Jordan**	**Lebanon**	**Syria**
– a drilling license for drilling of, or alteration to any well. (article 4). The Water Commissioner may refuse to grant a drilling license, cancel a license or set conditions for the license *"in order to prevent the depletion or salination of the water source ..."* – a production license shall indicate: 1. the production and supply quantity of water allowed within a period of time (chapter 2 article 3 section 24) 2. any condition which seems necessary in order to ensure efficiency of the supply, storage, conveyance or distribution of water, or to prevent the depletion of water resources (chapter 2 article 3 section 25) – Obligation to preserve water: "A person shall: 1) deal efficiently and sparingly with water coming under his control; 2) keep any water installations under his control in proper condition, so as to prevent waste of water; 3) refrain from blocking up or depleting any water resource; 4) prevent the blocking up and depletion of the water resource from which he produces water. (chapter 2 article 1 section 9)	– License for water extraction (article 3 A, article 29): Prescribes : • the usage • the extraction quantity within a period of time • the installation of a water-meter: (the water extracted is charged for, the water prices are detailed in article 38 • and any other condition – Anyone who is granted a license to extract undergroundwater is hereby obligated to refrain from causing any water depletion (article 10) – The licence is granted for a period of one year, renewable once for a similar period (article 21 D) – Licence of drillings rigs and drillers (article 32): Necessary in order to be allowed to possess or use directly or indirectly a drilling rig. – The licence is valid for one year and renewable for a similar period (article 33).	– a permit is needed for all works of prospecting or drilling wells (article 2). • The permit is granted for one year • Fixes an annual fee (article 6) (*only when the depth of the well is more than 150m article 7*) – a permit is needed for the use of groundwater (article 11). • The permit is granted for a duration of 1 to 4 years (article 12) • Fixes an annual fee (article 15) • Fixes: Purpose of the water Surface of the benefiting good Maximum limit for the allowed water quantity	– a permit is needed for drilling a well and pumping water (articles 1 and 3). The possibilities of the water resources in each basin are considered, the surface of the land that it is possible to irrigate as well as the limits that need to be fixed for water extraction, and the conditions for its protection. (article 3). – - The duration of the permit is ten years. An annual fee is due, depending on the power of the pump (article 11). Installation of a counter on every well to establish the quantity of water extracted (article 2 Resolution no 2165)[a].

a. Resolution No 2165 of the Ministry of Irrigation defining the maximum quantity of authorized waters and the areas, which should be irrigated by this quantity, 16 August 2000, Official Gazette, No 37, 27 September 2000 p.3; (www.fao.org/Legal/default.htm)

Israeli military government and its Civil Administration to the Palestinian Authority in matter of water and sewage for the Gaza Strip (except the colonies) and the Jericho area[9]. The Interim Agreement of 1995 extends and develops this transfer of authority, and introduces further provisions concerning the water resources in the West Bank[10].

A limited transfer of authority. According to Annex III article 40 §4 of Oslo II: “The Israeli side shall transfer to the Palestinian side, and the Palestinian side shall assume, powers and responsibilities in the sphere of water and sewage in the West Bank related solely to Palestinians.” This transfer of power and responsibilities is limited. Two limits are mentioned in this sub-article:

- The transfer of powers and responsibilities concerns the Palestinians only. Therefore it excludes the Israeli settlers living in the West Bank territory.
- This transfer does not concern the issue of ownership of water and sewage related infrastructure in the West Bank (sub-article 5), which will be addressed in the permanent status negotiations as specified in sub-article 4.

The third limit comes from the institution of the Joint Water Committee (Nasser 2003). The Joint Water Committee (JWC) is established by the Israelis and the Palestinians “in order to implement their undertakings under this Article” (i.e. Article 40, sub-article 11). Its function “shall be to deal with all water and sewage related issues in the West Bank” (sub-article 12), such as the coordinated management of water resources, the protection of water resources and water and sewage systems, or the resolution of water and sewage related disputes[11]. The JWC is comprised of an equal number of representatives of each side, and all its decisions shall be reached by consensus. It is notable that the JWC deals with water decisions in the West Bank and only in the West Bank. Through this mechanism Israel maintains a veto power (therefore a control) over all decisions (licensing, drilling, increased extraction…) in water resources management in the West Bank, including over proper Palestinian resources such as the Eastern basin of the Mountain Aquifer (Abouali 1996/97, 1998). On the contrary, no joint mechanisms exist for any Israeli action on a transboundary water resource such as the Western basin for example.

Legalising the existing situation. The Oslo II Agreement seems to have made a real step foreword regarding the Palestinian rights as it states “Israel recognizes the Palestinian water rights in the West Bank” (article 40§1). However, no further precision appears in the Agreement, except that these rights will be negotiated in the permanent status negotiations. And on the other hand the Agreement stipulates that “both sides agree” to maintain “existing quantities of utilization from the resources” (sub-article 3§a). With this provision the Agreement legalizes the existing situation resulting from the military occupation, and allows Israel to continue to use inequitably the water from the Mountain Aquifer[12].

It is also notable that the Oslo II Agreement does not refer to any principle regarding the use and allocation of water. The only principle it refers to is the ‘no harm rule’. For instance article 40§3a mentions the agreement between the two sides to prevent “the deterioration of water quality in water resources”. Further, paragraph e refers to the parties “taking all necessary measures to prevent any harm to water resources, including those utilized by the other side.” This principle only refers to the protection of the resource, and not to the rights of the parties. The transfer of powers and responsibilities in the Gaza Strip lies on the same principles as for the West Bank (Schedule 11). The water use in the Settlements and the Military Installation Area is also protected and maintained in the “existing quantities of drinking water and agricultural water” (schedule 11§3).

30.3.2 Palestinian Water Authority Legislation: Narrow Margin of Action

A Palestinian water law was enacted and issued on 17 July 2002[13]. Its aim is to develop and manage the water resources, increasing their capacity, improving their quality, and preserving and protecting them from pollution and depletion (article 2). It declares the water resources in Palestine public property (article 3). A licence is needed to drill, explore and extract water for commercial facilities. A fee for licensing will be imposed. A hierarchy of the water uses is estab-

9 Agreement on the Gaza Strip and the Jericho area, 4 May 1994, Annex II Protocol concerning civil affairs, Art. II §31.

10 Israeli-Palestinian Interim Agreement on the West Bank and the Gaza Strip, Washington, 28 September 1995, Annex III Protocol concerning civil affairs, Appendix 1 Article 40.

11 An non-exhaustive list of these issues is included in sub-article 12.

12 In the 1990s the water use from the Mountain Aquifer was of 440 to 550 mcm/yr for an Israeli and of 116 to 121 mcm/yr for a Palestinian (Nasser 2003).

13 Palestinian water law no 3, Ramallah 17 July 2002, reproduced in (Daibes (ed), 2003)

lished (article 5) giving priority to domestic uses. The rest of the law concerns mainly the institutions dealing with water such as the Water Authority, and the National Water Council. The text remains general with very broad principles, and focuses more on the institutions than on the water resource itself. The possibilities of its application are severely limited, mainly for the reasons discussed above on the role of the Joint Water Committee. As an institution created by an international agreement the JWC supplements the national authority.

Two other texts were adopted by the Palestinian Water Authority (Daibes 2003):

- The Palestinian National Water Policy (September 1995): it addresses the important issues of water resources management and planning.
- The Water Resources Management Strategy (May 1998): its objective is to translate the messages of the Palestinian National Water Policy into strategic imperatives.

30.4 Conclusion

In spite of specific regulations including provisions to control groundwater extraction, in order to avoid over-abstraction which may cause depletion and pollution by sea-water intrusion, groundwater resources in our study countries are facing these problems. Abstraction often exceeds recharge. Protection against pollution provisions is almost non-existent. Even, in Israel where they are the most developed, pollution problems are very serious.

This leads to the obvious conclusion that in Israel, Jordan, Lebanon and Syria, the main problem from a legal point of view is enforcement. It also raises the question of the institutions that are not covered in this chapter. The institutions in charge of the management of the water resources are an important component in the proper application of the law. In the countries studied, water management is distributed among different institutions leading to inefficiency. The need to reinforce provisions on the protection against pollution is also an issue of concern. The Palestinians do not hold control on their water resources, whether transboundary or not. Sovereignty on their land and natural resources is a prerequisite to any bilateral agreement with Israel on the transboundary groundwater.

Sustainable management of groundwater resources can be achieved through a suitable legal and institutional framework regulating risk and uncertainty, in addition to groundwater extraction and use, groundwater pollution and groundwater related environmental issues, and ensuring an equal right of access to water. Countries in the Middle East have a way foreword to achieve the sustainable use of their water resources for the common benefit of their populations.

References

Abouali, G., 1996/97: "Continued control: Israel, Palestinian water and the interim agreement", in: *Palestinian Yearbook of International Law*, IX, 64–113.

Abouali, G., 1998: "Natural resources under occupation: the status of Palestinian water under international law", in: *Pace International Law Review*, 10,403: 411–574.

Adam R., 2000: "Government failure and public indifference: a portrait of water pollution in Israel", in: *Colorado Journal of International Environmental Law and Policy*, 1,11: 256–376.

Burchi, S., 1999: "National regulations for groundwater: options, issues and best practices", in: World Bank (Ed.): *Groundwater Legal and Policy perspectives* (Washington, D.C.: The World Bank): 55–67.

Caponera, D., 1992: *Principles of water law and administration, national and international* (Rotterdam: Balkema).

Capes, J.T (Ed): Mejelle [Ottoman Civil Code, English translation of the Turkish text based on the work of C.A. Hooper], available at: <http://majalla.org/books/2003/mejelle.pdf> (last accessed 11 October 2006).

Chebaane, M., Naber, L., Radaideh, K.; Abu Hiljeh, A., 2001: *Groundwater management action plan, Amman-Zarqa basin highlands* (Amman: Ministry of Water and Irrigation).

Daibes, F., 2003: "Water-related politics and their legal aspects-a progressive approach for solving the water conflict", in: *Water in Palestine Problems-Politics-Prospects* (Jerusalem: PASSIA): 5–56.

Laster, R., 1980: "Legal aspects of water quality management in Israel", in: Shuval H. (Ed.): *Water quality under conditions of scarcity: Israel as a case study* (New York, Academic Press):. 263–286.

Mallat, H., 1997: *Droit de l'urbanisme, de la construction, de l'environnement et de l'eau au Liban* (Paris: LGDJ).

Nasser, Y., 2003: "Palestinian water needs and rights in the context of past and future development", in: *Water in Palestine Problems-Politics-Prospects* (Jerusalem: PASSIA): 85–123.

Trolldalen, J.M. (Ed.), 1998: *Water Laws, Water Institutions and Water Supply Economics in the Hashemite Kingdom of Jordan, the Palestinian Authority, the State of Israel* (Oslo: CESAR).

Van Edig A., 1999: *Aspects of Palestinian Water Rights* (Ramallah: Ramallah Center for Human Rights Studies).

World Bank, 2001: *Syrian Arab Republic, Irrigation Sector Report* (Washington, D.C.: World Bank).

31 Palestinian Water Authority: Developments and Challenges – Legal Framework and Capacity

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Abstract

Water in Palestine is the most scarce resource and Palestinians have no control over their water resources. The complex political context has exacerbated the limited water resources of Palestine. Palestinians and Israelis share several aquifers that serve as their long-term storage basins but have yet to reach a resolution to the conflict over control, management and equitable use of the riparian resources. Against this background, the Palestinian Water Authority was established to manage and supervise the water resources in Palestine. It faces major challenges especially since the water supply for Palestinians are inadequate and remains under the control of Israel. This chapter looks that the legal and regulatory framework of the Palestinian Water and the water sector in Palestine and the laws that governed it during successive governing regimes.

Keywords: Palestinian Water Authority, National Water Council, ground water, water rights, water law, water legislation

31.1 Background

Water is a central issue and highly politicized in the entire Middle East because it is one of the most water-stressed regions in the world. Demand exceeds supply and rights issues are intertwined and lead to continued disputes. For historic and political reasons, water issues including rights, management and use between Israel and Palestine have been difficult. Sharing of water resources has not been equitable. At the heart of their dispute is the Jordan drainage basin[1] and the underground aquifers of the West Bank, both of which constitute the main resources of water available to Palestine and Israel.

This chapter deals with the institutional and legal capacity of the *Palestinian Water Authority* (PWA). But to understand its limited role, the bilateral dispute over water must be underscored. Since 1967, in the West Bank, Israel has controlled, managed, allocated and sold water to Palestinians on its terms and without due regard to their needs recognizing only minimal drinking needs. Many West Bank and Gaza villages often experience shortage for domestic use. Use for industry and agriculture and economic needs are of little consequence to Israel. Israel ignores international law, rules and norms on riparian use. As an occupier Israel has an obligation to use Palestinian water resources only to the extent necessary for the maintenance of its military occupation. It is not permitted to appropriate the water of the occupied territory for the use of the population in Israel proper, much less for the illegal settlements.

Palestine has accepted international law regulating how its freshwater resources should be allocated. Palestine is entitled to an equitable and reasonable share of these freshwater resources, including those in the groundwater aquifers and the Jordan River. Israel has

1 The headwaters of the River Jordan are located in northern Israel, the occupied Golan Heights and in southern Lebanon (including Israel's self-proclaimed ‘security zone’). This water feed Lake Tiberias, Syria and the Yarmouk River.

ignored international law and has opted for unilateral decisions.

The *Declaration of Principles* (DOP) signed between Israel and the PLO in 1993 postponed water issues until the final status talks, thus maintaining the status quo. The DOP left the Palestinians without control of their own water resources; it failed to deal with the water issues on an equitable basis between riparian parties. Being an issue reserved for final status, water was equally not dealt with in the Interim Agreement signed in 1995. The Interim Agreement gave the Palestinians allocations of water and limited functional administration of water resources within Palestinian areas with full control maintained by Israel. At present, the situation is precarious as the Wall being erected by Israel endangers the prospects for shared water resources and prejudices any equitable solutions in the future.

31.2 Legal Framework for Water and Water Institutions

Throughout history, various governments and occupying forces have administered the Palestinian territories. Both the West Bank and the Gaza Strip have been under the jurisdiction of a number of rulers each of which imposed its laws atop others, all with the intention of furthering its interests and control over the water sector. A new ruler usually did not impose immediately a new legal system but enacted, overtime, a new set of norms as supplementary to the existing ones. Only when politically convenient, the new ruler repealed the existing laws and enacted new ones.

For political reasons, the West Bank and Gaza Strip do not form a singular contiguous geographical unit and were, at times, also separate legal units. Both areas were under the Ottoman Rule until the end of World War I, when they fell under British Military Rule (1918–1920), then came under a British Civil Administration (1920–1922) and subsequently became part of the British Mandate proclaimed by the League of Nations in 1922. The two areas were separated in May 1948 after the termination of the British Mandate and the establishment of the State of Israel.

In the course of the 1948 War, the West Bank came initially under the Jordanian military rule and was subsequently formally incorporated in the Hashemite Kingdom of Jordan in 1950. Following the 1948 war, the Gaza Strip came under Egyptian military rule. The Egyptians did not view the Gaza Strip as part of Egypt, refrained from incorporating the Gaza Strip into Egypt and maintained it as a separate legal unit, subject to Egyptian military rule and orders proclaimed by the military commander. Thus the laws of Egypt were not applied to the Gaza Strip and the pre-existing legal norms, in so far as not amended by orders of the Egyptian military commander, remained in force in the Gaza Strip. Following the 1967 war when the Gaza Strip came under Israeli military rule, a military commander was appointed for the Gaza Strip and the pre-existing legal norms were maintained, thus the West Bank and the Gaza Strip were governed by distinct legal norms.

31.2.1 Basic Regulatory and Policy Framework

31.2.1.1 Historic Legislation

Shari'a Law (Muslim Religious Law). This was the legal norm upon which the courts of the Ottoman Empire based their rulings in disputes between nationals of the Empire prior the enactment of the original Ottoman legislation in the second half of the 19^{th} century. The Shari'a provides in principle that water is God's property and as such it is free for all. Ownership can take place upon effective possession. There are rights of use, mainly for purposes of drinking and irrigation. Payment for water use is questionable although in practice payment is demanded.

Ottoman Legislation in Palestine (Pre–1918). The Ottoman rule prevailed in the region from the 16^{th} century until 1918. In the course of an extensive legislative process, which took place during the reign of Sultan Abed El-Majid in the second half of the 19^{th} century, two important laws containing rules relating to water were enacted:

1. The 1858 *Ottoman Law on Land* provides that in disputes as to the rights of watering crops and animals (*haq-i-shurb*) of irrigation and over water channels only *ab antiquo* usage is taken into account.
2. The 1870 *Ottoman Civil Code* (the 'Mejelle') provides that water, grass and fire are property not owned by any one person but owned jointly by all members of mankind. Groundwater is also considered ownerless and, likewise, public wells not dug by any known person are (ownerless) property of all people.

British Mandatory Law in Palestine (1922–1948). Article 46 of the 1922 King's Order in Council proclaimed that "The jurisdiction of the Civil Courts shall be exercised in accordance with the Ottoman Laws in force in Palestine on 1^{st} November 1914, and such Ottoman Laws as have been or may be declared in force by Public Notice, and such Orders in Council, Ordinances and Regulations as are in force in Palestine at the date of the commencement of this Order, or may hereafter be applied or enacted". The British Mandatory Government enacted a number of original pieces of legislation on water resources management, as follows:

1. *Municipal Corporations* (sewerage, drainage, and water) *Ordinance No.6/1936*: This ordinance provides that "once the municipality decides to supply water to the municipal residents, it becomes responsible for the provisions of pure water, appropriate pressure, and obtains certain powers concerning pollution, pricing, etc."
2. *Safeguarding of Public Water Supplies Ordinance No.20/1938*: This ordinance enabled the Mandatory Authority to control the scarce water resources and to ensure adequate water supply for domestic use, it defined the public water supply as a supply of water to be controlled by the government and which is primarily used for domestic purposes.
3. *Water Survey Ordinance No.2/1938:* This ordinance authorized the Mandatory Government to drill experimental boreholes on private lands for the purpose of conducting a hydrographic survey of the land.

Jordanian Legislation in West Bank (1948–1967). The Ottoman laws on water as well as the Mandatory Ordinances remained in force in the West Bank upon the assumption of the Jordanian rule in 1948 as well as following the proclamation of the joint constitution in 1950. The Jordanian Government enacted a number of laws in the sphere of water resources management, as follows:

1. *Land and Water Settlement Law No.40/1952*: The law provides for a settlement and registration of land and water rights in the Jordanian Land Registry. The law provides for procedures on the registration process.
2. *Water Control Law No.31/1953*: This law prescribes rules relating to the construction of irrigation structures in irrigation areas. Water allocation tables were prepared to detail the quantities allocated to each land parcel and the quantity of irrigated land.
3. *Municipalities Law No.29/1955:* This law detailed the powers of the municipalities and stipulated that the council would be responsible for the provision of water to the residents, and for the determination of the means used for this purpose including installation of pipelines, the organization of water allocation, determination of tariffs and fees, and the prevention of pollution of springs, canals, pools, and cisterns.
4. *Law on the Organization of Matters of Drinking Water in the Jerusalem District No.9/1966*: This law created a Municipal-Regional Water Authority with the responsibility as well as the powers for the supply of water in the district of Jerusalem, including to Ramallah, Bethlehem and their neighboring townships and villages.

Egyptian Legislation in the Gaza Strip (1948–1967). Egyptian law was not applied to the Gaza Strip. The legal norms applicable upon the termination of the Mandate remained in force upon the assumption of the Egyptian Military rule.

Israeli Military Orders (1967–1995). IThe Occupied Palestinian Territories have been subjected to physical and artificial restraints through a systematic program or building Israeli settlements, which stand at 224 in the West Bank; 29 in East Jerusalem[2]. Israel relied on the use of Military Order to take land for these settlements and for other issues that serve the occupation including the imposition of stringent restrictions on the Palestinians concerning the development of their water resources. After the 1967 war, Israel declared all water resources in the region as state property (Proclamation No.2/1967) and through military orders it prohibited the Palestinians from developing their resources.

The impact of the historic legislation on Palestinian water resources, management and rights is complex and restrictive. It has often reflected the interests of these external powers with little concern for the long-term strategic water needs of the indigenous population and never served as a platform for the development of Palestine. The most significant restrictions came during the Israeli occupation, whose impact remains operative to the present day.

31.2.2 Palestinian Legislation

When the Palestinian Authority (PA) took over, the administration and regulations of the water sector including were severely underdeveloped. This water sector was immediately recognized as one of the most important strategic sectors. The PA found that roles

2 See, https://www.cia.gov/cia/publications/factbook/geos/we.html

and responsibilities in the water sector were fragmented and unclear as administered during the occupation period which lent itself to inefficient management and uncoordinated investments. In 1995, when the Palestinian Water Authority was established, it found that there was an urgent need to restructure the water sector in order to regulate, monitor and supervise the management, technical and financial performance at the national, regional and local levels.

Accordingly, the Palestinian Water Authority embarked on preparing the necessary laws and regulations to guarantee sustainable development of the water resources. The goals of the PWA are the optimal utilization between beneficial users; regulation of the planning and production, and use of water resources in an effective and efficient manner. Present water administration and regulations in Palestine, which are stipulated in the water law, are derived from Islamic water law principles together with concepts and interpretations which have been imposed on pre-existing regulations, local uses and customs. The Palestinian legislation since the establishment of the *Palestinian National Authority* (PNA) includes:

1. *Presidential Decree No.5/1995* – The Decree established the Palestinian Water Authority.
2. *Law No.2/1996* – This law established the Palestinian Water Authority and defined its objectives, functions and responsibilities. This Law gave the Palestinian Water Authority the mandate to manage water resources, execute water policy, establish, supervise and monitor water projects, and to initiate coordination and cooperation between the stakeholders in the water sector.
3. *Presidential Decree No.66/1997* – The Decree established the internal regulations of the Palestinian Water Authority and the rules of procedures.
4. *Palestine Water Law No.3/2002* – The Law encompasses the whole water sector. It aims to develop and manage water resources, to increase capacity, to improve quality, to preserve, and to protect against pollution and depletion. As a leading principle, the Law states that all water resources in Palestine are considered public property (art 3). The Law provides further legal basis for the 'Water Authority', and it grants legal personality to the Authority. The budget of the Water Authority is part of the general budget of the PNA.

The Law stipulates that the Water Authority has the right to supervise and control/regulate regional utilities (art. 28) and that the Water Authority shall carry out control tasks including keeping records regarding water usage and licenses, setting times when licensed 'operators' of water or waste water facilities must give periodic reports, setting the necessary rules and standards for inspecting meters and controlling the leaking of water (art. 34.1). The Water Authority shall have also the right to inspect water resources and systems of supply, and any place where pollution is suspected (art. 34.2). The Law indicates that specific regulations will be issued for specific purposes (art. 3.2; art. 18; art 20; and art. 25).

The Law also sets the composition, tasks and responsibilities of the National Water Council, which is chaired by the Chairman of the Palestinian Authority. The National Water Council has members from the most involved Ministries, the heads of the water and environment authorities, the mayor of the capital, and representatives of selected stakeholder groups (Union of Local Authorities, Palestinian universities, regional utilities, and water unions and societies). The Council will primarily sanction policies and plans, ratify and approve the Water Authority's reports, guidelines and internal regulations. It is envisaged that the first meeting of the National Water Council will take place in the foreseeable future. The Law has a chapter on 'regional water utilities' that will be established on the desire of local authorities, and that the 'Water Authority' will have the right to supervise regional utilities. Further regulations will set tasks and responsibilities.

31.3 The National Water Plan

The *National Water Plan of* 2000 is the strategic plan for the water sector that sets the direction to the year 2020, and proposes actions for achieving these goals. The document describes the role of service providers. It says that 'regional water utilities' will be responsible for the following services: preliminary investigations and design; construction and/or rehabilitation; research; repairs; operations and maintenance. Moreover, it states that services would cover the fields of municipal and industrial water supply; waste water collection treatment and re-use; storm water collection, treatment and re-use; water and treated wastewater supplies for irrigation.

The 'regional water utility' assets will remain government owned, with a community representation on board. Employees will be seconded to a competitively selected private operator, who will be contracted for a set term to manage, operate and maintain all infrastructure and related services for a fee. All billing and collection procedures will also be placed in the care of the operator. The utilities will be administratively and fiscally autonomous, although tariffs will be reviewed, and water abstraction and discharge will be licensed and monitored by the PWA. The 'regional water utilities' will be required to seek full cost recovery in their operations and develop a customer charter.

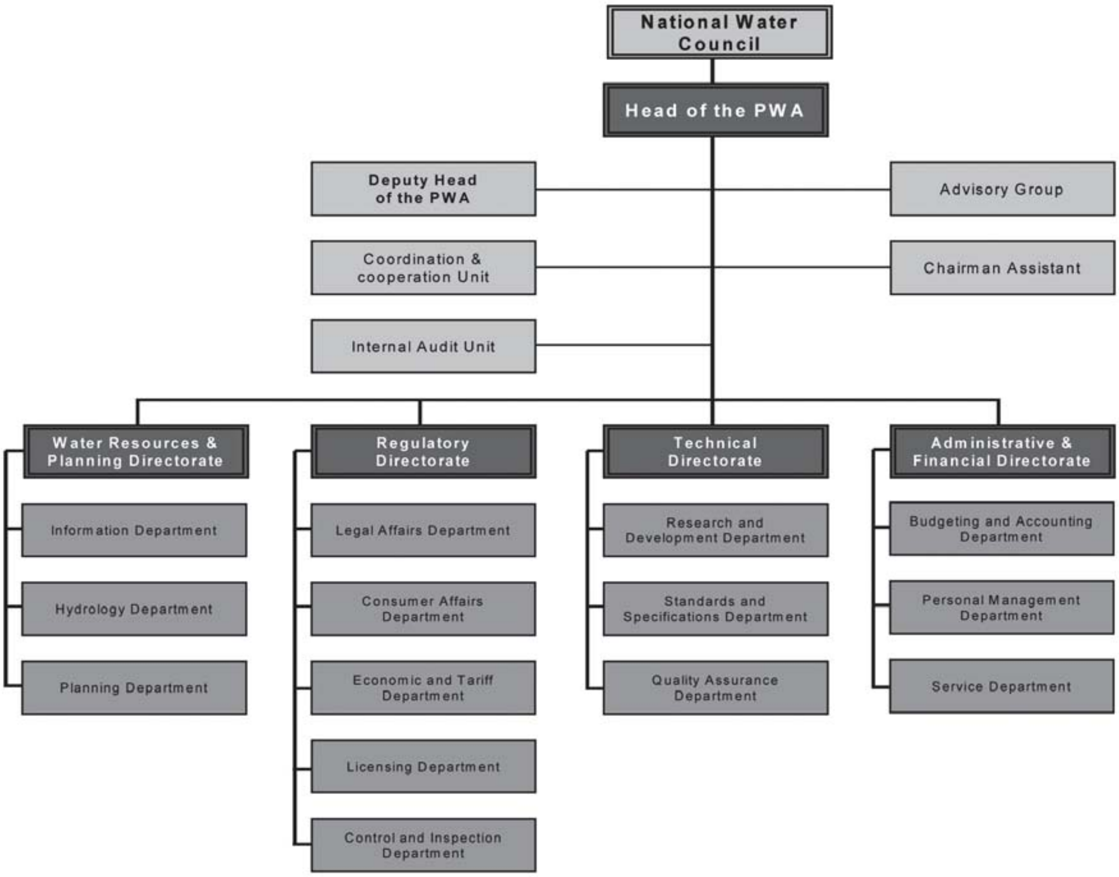
31.4 The Palestinian Water Authority

A Presidential Decree established the P*alestinian Water Authority* (PWA) in 1995 by Presidential Resolution No. 90. This follows Article 40 of the Interim Agreement of 1995. In 1996 Law No. 2 was promulgated and provided the legal framework for the PWA as an institution and enumerates its powers and authorities. It supersedes Presidential Resolution No. 90. The enactment of the Water Law no. 3/2002 on 18 February 2002 resulted among other things, in formalization of the scope of the authorities of PWA and more salient, it deemed water as publicly owned and managed by the PWA on behalf of the public for the public good. It legally eliminated the concept of private ownership of water (vested interests is a whole different matter. According to Article 7 of the Water Law the Palestinian Water Authority:

1. has full responsibility for managing the water resources and wastewater in Palestine;
2. sets the general water policy and work to implement it in coordination and cooperation with the relevant parties, and present periodic reports concerning the water status to the Water Council.;
3. surveys the different water resources, proposes water allocation and determines priorities of usage;
4. creates reserve areas for protection from the danger of pollution, and exercises oversight and supervision over such areas, and approves transfer of water between the different geographic areas;
5. licenses the exploitation of water resources including the construction of public and private wells, water exploration, drilling exploration, testing and production wells, and any other matters or activities relating to water or wastewater, in cooperation and coordination with the relevant parties;
6. studies water and wastewater projects, and projects that integrate them, and sets design standards, quality assurance, technical specifications and works to control implementation of the above;
7. rehabilitates and develops water departments for the bulk water supply at the level of the different national governorates, considering them national water utilities, and sets their tasks and responsibilities in accordance with regulations that are issued by the Cabinet of Ministers for this purpose;
8. coordinates and cooperates with the relevant parties to set plans, and program for regulating the use of water, prevent wastage, conserve consumption and carries out public awareness campaigns regarding this aspect;
9. supervises well drilling and qualifying contractors in the field of constructing water facilities in accordance with procedures that are set by the law;
10. sets plans and programs for training the technical staff working in the water sector to develop the management of water resources and supervises its implementation and development;
11. works toward achieving a fair distribution and optimal utilization of water resources in order to ensure the sustainability of ground and surface water resources through cooperation and coordination with the relevant parties and finds solutions and suitable alternatives in case of emergencies;
12. regulates and supervises research and studies relating to water and wastewater, and follows up with the concerned and specialized parties;
13. rehabilitates the centers for researches, studies and training working in the water sector in accordance with the procedures to be set by the regulations;
14. participate in setting approved standards for water quality for the different uses in cooperation with the relevant parties and insures promulgation;
15. works to develop and coordinate programs for international, regional, and bilateral technical cooperation in the field of water resources; holds conferences, and seminars to represent Palestine in regional and international meetings in this field;
16. prepares draft laws and regulations and issues directives concerning water resources and executes them, and gives opinions with regard to the technical aspect in all disputes relating to water resources; and
17. any other tasks that are to be assigned by virtue of applicable laws and regulations.

The Palestinian Water Authority consists of four directorates dealing with water resources and planning, water regulation, technical issues as well as administrative and financial problems (figure 31.1).

Figure 31.1: PWA Organization Chart. **Source**: The Palestinian Water Authority



The Regulatory Directorate includes: 1) the legal affairs department, responsible for all legal issues of the department, 2) the consumer affairs department, responsible for hearing and collection of complaints from the field, and for organizing public awareness campaigns, 3) the economic and tariff department, responsible for developing and implementing tariff system and, in Gaza, collecting of fees connected to licenses, and for doing economic and financial assessments, 4) the licensing department, responsible for issuing and renewal of licenses for water projects and 5) the control and inspection department, responsible for enforcement of issued licenses, inspection of the proper implementation of licenses and of potential illegal activities in the field.

The Technical Directorate has: 1) the standards/specifications department, 2) the R&D department and 3) the quality assurance department with two sections for reviewing designs as part of the licensing process, and monitoring the implementation of the works.

Other key stakeholders in the water sector are:

- *The Palestinian Legislative Council* (PLC) that has a mandate to recommend the enactment of different regulations and by-laws.
- *The Ministry of Justice (MoJ)* that has a mandate on justice and legal enforcement
- *The National Water Council (NWC)* that is responsible for overarching water policy and strategic maters. Its tasks and responsibilities are defined in the water laws as follows:
  1. sanction the general water policy;
  2. sanction the policy for development and utilization of water resources and the different usage;
  3. ratify plans and programs aimed at organizing the use of water, preventing waste, and directing consumption;
  4. ratify the tariff policy;
  5. confirm the allocation of funds for investment in the water sector;
  6. approve periodic reports concerning the activities of the Palestinian Water Authority and its work.

7. approve the Water Authority's guidelines and confirm the internal regulations that govern its administration and operations;
8. confirm the appointment of the board of directors of the regional utilities;
9. approve the annual budget of the Authority and present it to the Council of Ministers to confirm it:
10. implement the financial regulations prevailing in the Palestinian National Authority; and
11. any other tasks which are delegated to it according to the provisions of this law.

The *National Water Council* (NWC) consists of the following 13 members:

- *The Ministry of Agriculture* that is responsible for the development of the agricultural sector, which is the major water user in Palestine.
- *Ministry of Finance* that holds a mandate for the national economy, cost recovery and tariff issues.
- *Ministry of Health* that is responsible for public health aspects, water quality standards and the alleviation of water related health risks. In the Gaza Strip it conducts all water quality testing.
- *Ministry of Local Government* that is responsible for local (urban) planning, organization of the operation of the systems via the municipalities and participates in hearings regarding licensing.
- *Ministry of Planning and International Cooperation* that is responsible for the coordination of international cooperation and national planning issues. Its *Directorate for Urban and Rural Planning* (DURP) is responsible for overseeing general policies, plans and programs for spatial planning at the national and regional level.
- *Environmental Quality Authority* with responsibility for environmental policies, strategies, and criteria to ensure ecological and environmental sound development of the surface water and groundwater resources.
- *Ministry of Industry (MoI)* with responsibility for effluent standards, re-use of industrial wastewater and public enquiries about industrial water licenses.
- *West Bank Water Department (WBWD)* that is in charge for the provision of bulk water to the various water service providers in the West Bank. In addition, they are still involved in the rehabilitation, extension and construction of water facilities in the West Bank. In the near future they will be transformed into the National Bulk Water Utility. This is expected to become the National Water Utility (NWU).
- *Coastal Municipal Water Utility (CMWU)* is an association of 19 municipalities in the Gaza area with responsibility for the provision of water supply and sewage services to these municipalities. The tendering of a World Bank sponsored management contract for this utility is underway. It is anticipated that the CMWU will become one of the four *Regional Water Utilities* responsible for the provision of water supply and sewage services in Palestine. The other utilities will cover the Southern, the Central (the service area of the Jerusalem Water Undertaking) and the Northern part of the West Bank.
- *Other service providers* (until the Regional Water Utilities will be established) for water supply and sewage services will be offered by the municipalities and water user associations. In many cases various municipalities have already established *Common or Joint Service Councils* (C(J)SCs) that are in charge of the operation and maintenance of municipal facilities for water supply and sewage. As a rule, administrative and financial aspects remain with the municipalities.

31.5 Modest Prospects

Since its establishment the Palestinian Water Authority has taken great strides in water resource management. It operates the existing system of water, however, with limitations due to continued Israeli control over water resources. It manages an investment process and planning for the future of the water sector. It continues water delivery, repairs pipes and licenses water extraction to the best it can under the prevailing circumstances. It makes decisions about water pricing. It has improved governance by setting up a well organized institution and continues to improve its services. It has a well trained cadre of professionals and receives much donor assistance to rehabilitate the water systems of the West Bank and Gaza. It has passed a law and unified much of the fragmented legal framework and is working to harmonize activities of the municipalities and village councils with respect to water extraction from wells they own and water distribution. Considerable donor assistance has been geared for the water sector, however, the PWA has a long way to go and remains constrained financially. Investment requirements in the physical water infrastructure are huge.

The National Water Plan articulated important principles, salient among which is the water resource strategy. In this regard the PWA should deal with the following tasks:

- secure Palestinian water rights;
- strengthen national policies and regulations;
- build institutional capacity and develop human resources;
- improve information services and assessment of water resources;
- regulate and coordinate integrated water and wastewater investments and operations;
- enforce water pollution control and production of water resources:
- build public awareness and participation; and
- promote regional and international cooperation.

Most of these issues, however, need to be worked on regardless of how the water rights are accorded to Palestinians and how shared water resources are ultimately decided between Palestine and Israel. These factors are becoming increasingly more difficult as a result of the construction of the Wall separating Palestine and Israel whose parameters, boundaries and path engulf much of the West Bank Mountain Aquifer.

The PWA through its national policy plan has identified the following areas to deal with:

- water resource availability;
- water uses and consumption;
- water demand;
- domestic water demand;
- commercial and industrial water demand.

In achieving its objectives, the PWA is greatly challenged and works against time. The peace agreements with Israel have left much to be contended with. Although Israel continues cooperation in water-related matters, the PWA cannot deliver in the absence of full sovereignty and control over its water resources, thus it must know what belongs to it. The PWA cannot plan, manage and administer what it does not have. It will not be able to manage the increased demand as long as it has no role in managing and sharing the supply. It cannot address the needs of its people.

Of increasing importance and relevance is the potential that the Gaza withdrawal plan presents for cooperation in the water sector between Palestine and Israel. The withdrawal from the Gaza settlements and the related water infrastructure can be a significant step in giving sovereign control of water resources in Gaza to the Palestinians. The PWA faces formidable challenges in Gaza where water is scarce and groundwater is saline. Alternative water sources like desalination have long been considered in the Gaza context and work on such a plant stopped because of the difficult situation on the ground. There is renewed hope that such projects would move ahead in Gaza and begin to revive and rehabilitate its water sector to meet basic human needs.

Part VII Water Resource Management

32 Water Demand Management as Governance: Lessons from the Middle East and South Africa

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Abstract

Reviews of water demand management in the Middle East and in South Africa, two of the most water-challenged areas of the world, show that water demand management is occurring in almost all nations, but without the breadth or strength that is required by their increasingly difficult water situation. It is not absent as a policy goal, but it remains secondary to supply management and very much secondary to reducing government expenditures. There is therefore great scope for further analytical work on water demand management and even greater scope for work on ways to promote its adoption. What is needed above all is to treat water demand management not just as a technology to apply or a program to deliver but as a form of governance – indeed, a form that is as critical to improving social, economic and environmental conditions as it is to saving water. Application of this governance concept to Israel and Palestine shows the need for new institutions for water demand management, and that both existing and new policies need to be formulated in order for water demand management to play the role that it should.

Keywords*:* Governance; Israel; Palestine; South Africa; water conservation; water demand management

32.1 Introduction

> Natural resources such as water do not determine socio-economic development; on the contrary, socio-economic development determines water management options (Allan 2002).

It is not very radical to urge that *water demand management* (WDM) become *a* major option for resolving Israeli-Palestinian water conflicts. It is rather more radical to claim, as we do, that WDM should be *the* major option, and that as well as moving both nations toward sustainable water policies, it can also help resolve conflicts between them. The main purpose of this article is to provide evidence in support of that position. Further, we maintain that, if WDM can play so large a role in Israel and Palestine, it can do so anywhere in the *Middle East and North Africa* (MENA). In their natural endowments, Israel and Palestine fall near the middle of the regional spectrum – greater renewable supplies of fresh water than many MENA nations but less than others. As elsewhere in the region, Israel and Palestine also exhibit sharp intra-national variations – from north to south in Israel, and between the West Bank and Gaza in Palestine. Again as elsewhere in the region, they are both using fresh water unsustainably – mining aquifers, degrading water courses, and, in the case of Israel, using water that is not likely to be under Israeli control after a peace settlement. Rather differently from elsewhere in the region, water is an explicit part of negotiations toward a peace settlement, and even avowed advocates of peace can differ on proposed water policies (Alatout 2000).

32.2 WDM Decisions as Governance

In its simplest sense, water demand management means getting the most from the water we have. In more elaborated form, WDM includes any action that reduces the amount of fresh water we need, or that keeps water cleaner than it otherwise would be (Brooks 2006). The important point is the breadth of the concept, which remains the same regardless of whether it is less water per unit of output or service, or less water because of lower growth, different technical choices, or changes in habits. It is the same whether talking about surface water or ground water or whether talking about average or peak demand. Though based on science and engineering, in almost every aspect human desires and actions play decisive roles. Therefore, water demand management is a governance concept – governing (in both senses of the word: moderating and managing) our requirements for good quality fresh water. Yes, there are technical issues to be solved; and, yes, cost-effectiveness is an important criterion for decision-making. However, they are determined by, not determinants of, the way we govern water.

We know more about the technologies for water demand management than we apply, and we also know a lot about the cost effectiveness of various WDM techniques (though we tend to ignore many of their benefits, such as reducing the volume of wastewater to be treated). Despite considerable research on water conservation behavior by social psychologists and geographers, means for promoting changes in practices and behavior at larger scales and across sectors remain elusive (Thompson/Stoutemyer 1991; Dickerson/Thibodeau/Aronson/Miller 1992; Aitken/McMahon/Wearing/Finlayson 1994; de Oliver 1999). To paraphrase Homer-Dixon (2003) who was writing about renewable energy in Canada, the obstacles to water demand management in MENA are mainly social, and the ingenuity we must apply to overcome them is also therefore mainly social.

It is this governance approach to WDM that is distinctly missing in MENA. Few governments regard WDM as an activity worthy of explicit attention in its own agency. Only rarely is WDM the main impetus for policy action with respect to supply or disposal of water. Even if policies avow support for WDM, they commonly falter in application and implementation. If water demand management is to aid in the resolution of water disputes between Israel and Palestine, and become a base for sustainable development, we must identify culture- and region-specific ways of promoting attitudes, incentives, and policies to establish WDM as both means and ends for improving social, economic and environmental conditions. Therefore, in the next section we explore to what extent and how WDM is already in use in MENA. In the following section, we explore to what extent and how it is used in South Africa, which shares many ecological and socio-economic characteristics with the MENA.

32.3 Water Demand Management (WDM) in the Middle East

Over the course of 2002 and 2003, Canada's *International Development Research Centre* (IDRC), in collaboration with other donors, conducted four forums on water demand management for nations in MENA. The purposes were, first, to assess the extent to which WDM is being applied in the region and, second, to identify gaps in knowledge about WDM.[1]

Three of the four IDRC forums focused on water demand management. The remaining forum, on Public-Private Partnerships in Water, turned out to have little to do with WDM. Case studies from Jordan and Morocco show that government expenditures are down and performance of the water utility has improved, but not even the World Bank suggests that privatization will promote WDM (Grover 2004). The only direct link between private participation and WDM is reduction in unaccounted for water. This link is not surprising as it has a direct effect on revenue with benefit-cost ratios reported (in the Tunisian Drinking Water Case Study) as high as 5:1.

1 Key inputs to the forums came as national case studies followed by workshop discussions, all of which can be found on a tri-lingual (Arabic, English and French) CD-ROM entitled "Water Demand Management Forum – Middle East and North Africa: Advocating Alternatives to Supply Management of Water Resources", available from IDRC's offices in Cairo or Ottawa; see at: <www:idrc.ca>. The results of the forums are summarized in a review by Brooks (2004), from which most of the material in this section is taken. We are grateful for IDRC's permission to use this material. All references to costs or prices are based on US dollars in 2002.

Two general conclusions from the forums influence all other results. First, the main objective of government-funded WDM programs in MENA has been to cut budgets, not to save water. Effects on water use are assumed but rarely demonstrated and, even less often, quantified. Water management may be a general focus for research and policy in MENA, but specific focus on water demand management remains to be adequately developed. Second, few of the efforts for WDM in the region devote much attention to communities, families, or women. Though low-income people and small farmers receive water at low cost, little evidence has been collected on impacts on income or quality of life. Easing of women's work, and gains in maternal and child health, are mentioned but seldom evaluated. Water management is still largely not just a male domain but the domain of male engineers. As a result, we know a lot about technologies for water demand management, but little about the institutions or incentives that promote it. We know a lot about what does happen, but little about what could happen.

32.3.1 Water Re-Use (Rabat, Morocco; March 2002)

Re-use of urban wastewater is becoming more common throughout MENA. Most nations have major sanitation problems, and the need to manage wastewater is as much a driving force for re-use as is shortage of fresh water. Exceptions occur in coastal cities where sewage can be dumped directly into the sea. Rural areas also lag behind cities in re-use of treated sewage.

The main use for treated wastewater is irrigation, but there are many other uses: recharging aquifers, creating green belts, fixing sand dunes, watering golf courses, and providing cooling water for industry. Though most nations permit treated wastewater to be used for food crops, some nations have adopted restrictions that depend upon the level of treatment (and, in the case of Jordan, destroy crops violating those restrictions). Even so, many farmers continue to use raw wastewater for irrigation, particularly in peri-urban areas.

Economic information about wastewater re-use costs and benefits is disappointingly scarce. It would be particularly useful to know more about the *marginal* cost of wastewater re-use compared with normal wastewater treatment and release into wadis, or the *marginal* benefit to farmers from using recycled as opposed to fresh water. Some data did emerge from the case studies. The Tunisian case study indicates that tertiary treatment of wastewater adds 15 to 20 per cent to the cost of secondary treatment, but total cost is still 30 per cent below that of water from a new dam. The Algerian presentation suggests marginal costs of about 10 cents per cubic meter beyond those necessary for treatment and discharge.

Prices for treated wastewater vary widely from place to place, and typically are based on political judgment rather than cost. For example, golf courses in Morocco pay four times as much per cubic meter as do farmers. (Many nations aim to keep the price of treated wastewater for farming below that of fresh water, and, as necessary, provide subsidies to maintain the differential.) Even where cost is a factor, it is treated from the perspective of accounting rather than any recognition that failure to treat wastewater imposes its own costs, whereas appropriate treatment and re-use can support economic development.

32.3.2 Water Valuation (Beirut, Lebanon; June 2002)

Few people in MENA question the general practice of pricing water. However, difficulties arise from the wide range of objectives sought from water valuation – greater efficiency, higher revenues, regional development, social equity and others. Though each is valid to one degree or another, there is no purely rational way to determine the appropriate balance among them, nor is there much indication of how the trade-offs are balanced in any particular nation.

Water prices remain below costs in most sectors in all countries, and very much below costs in some (Saghir 2004). Indeed, despite enormous differences in climate, water prices in MENA nations other than Israel are not much above those in Canada. In only a few nations do prices rise sharply enough with use to have a significant conservation effect. Further, efforts to reform water valuation are concentrated in urban areas with governments moving slowly in the agricultural sector. This approach is politically understandable but questionable economically and ecologically given the share of water in MENA that goes to irrigation. Even where raising prices to cover full costs is avowed policy, it is typically applied only to a few sectors, notably tourism and industry.

Unfortunately absent from most of the discussion about valuation are data on price or income elasticity of demand. The common assumption – at least for household water – is that water is in such short supply that most nations are operating in an inelastic portion of the demand curve. However, in Tunisia, where attempts were made to identify impacts, a direct link was found between water prices and water use for households above subsistence levels. Similarly, when prices for irrigation water were raised, Tunisian farmers sensibly shifted to higher value crops. Estimates for Israel show that, at an equilibrium price, agricultural water use would drop by 24 to 36 per cent (Becker/Lavee 2002). Studies on price and income elasticity justify the policy of increasing block rates. Though not perfect – for example, higher rates could penalize poor people growing food in the city – they do tend to balance equity and efficiency.

Although WDM objectives may be served, the main objective of raising prices in most nations is solvency of the utility, not saving water and certainly not economic efficiency. The three goals are related, but they are not the same. Tariff structures designed to cut use would be higher than those to recover costs. The Jordanian case study showed that new water supply costs about $1 per cubic meter but is valued at over $5. Water priced to achieve economic efficiency would have typical families paying 5 per cent of more of their income for water. As well, it is easier to explain to citizens why price should cover full cost than why it should equal marginal value.

The most evident use of water valuation as social policy is the common practice of providing some water at low or no cost to poor households. This goal is typically accomplished by what is often called a "social tariff" for the first block of consumption – typically around 25 cubic meters per household each quarter. For a six-person family, this provides the 50 liters per person-day commonly regarded as the minimum for an adequate lifestyle (Gleick 2000). Unfortunately, rich and poor families alike benefit from the subsidy for the first block. Tunisia and Jordan are tackling the problem by having those who consume in excess of the social block pay at the higher rate for the full, not the marginal, volume; subsequent blocks are priced marginally.

Pricing of agricultural water adds special complications. Nations that are extending irrigation to new areas typically reduce water prices to encourage settlement. Except to the extent that they allow for differences in socio-economic conditions (*i.e.*, a form of rural development), such differential valuation is questionable. Differences in productivity or distance from market should influence farming systems and crop selection, not subsidy levels. However, most nations find it difficult to increases prices for irrigation water. At a minimum, increases must be coupled with: a) removal of price caps on the crops that use irrigation water; and b) controls on drilling and pumping, lest farmers simply shift from the priced to the un-priced source. A further complication is that illegal and informal markets in agricultural water are common. (Studies of those markets would give a good clue to farmers' valuation of water.)

32.3.3 Participatory Irrigation Management (Cairo, Egypt; February 2003)

The single most important conclusion that emerged from the forum on *participatory irrigation management* (PIM) is the need for institutions that go beyond permitting to promoting the concept. The whole approach of decentralizing management of water implies a shift in emphasis "from infrastructure investment-based projects to institutional development – investment projects, thus, become structural components of longer-term programs" (Van Hofwegen 2004). In too many cases, governments give PIM nominal support, but do not provide incentives, mechanisms and, as necessary, regulations to allow local management to flourish. Clearly, some governments are less enthusiastic about local water management than they claim – this despite strong evidence that PIM works. In each case study reported at the forum, water-use efficiency went up by 30 to 50 per cent and energy use for pumping was cut in half (Attia 2004). The increase in water efficiency does not necessarily imply a reduction in water use; more commonly, it means that tail-enders on the water system now get water regularly – greater equity and efficiency, but not less water use. Other, less well documented, benefits include reduction in conflict and a sense of empowerment that is said to improve family health and well-being (Brooks 2002).

32.4 Water Demand Management in South Africa

The South African water supply and sanitation sector experienced significant problems during the late 1980s and early 1990s. Political corruption, international sanctions and the falling price of gold resulted in a general diversion of funds away from central services like basic water services (Forster 2004). A history of misguided management decisions, based on apartheid's tenets, had wreaked havoc with the natural landscape and water allocations. As the apartheid state stumbled through its final days, the transition to democracy was not smooth for the water sector, particularly in rural areas.

In 1994 the new African National Congress (ANC) government was to lead a country inundated by urgent problems: a flagging economy based on a defunct social system; a population with high expectations and eager for immediate change; an out-migration of the professional corps because of perceived security problems and economic uncertainty; and a set of environmental conditions that limited economic development, including agricultural potential, and undermined the quality of life of the majority of citizens.

The ANC made many, far-reaching, environmental governance decisions in the post-1994 political climate. Of interest to this report are the water management decisions intended to lessen the gap between the water services enjoyed by the minority and those provided to the neglected majority, and the influence these institutional decisions have had on the rural sector. These decisions have included decisions related to water conservation and water demand management (WC/WDM), the terms commonly used in the South African literature. Water conservation and water demand management are slowly being incorporated into planning and practice at the local and national levels (Buckle 2004).

Two situations catalyzed the government's efforts to give greater attention to water management and legislative reform. First, a series of droughts in the early 1990s reinforced the need for immediate action and better, longer term decision-making (Buckle 2004). Second, the ANC was publicly committed to meeting its citizens' basic needs. In addition to education, employment, housing, and health care, these basic needs included the provision of services to the 14 million people without access to safe drinking water and the 21 million that lacked reliable sanitation in the rural and informal settlements (Rothert 2000). South Africa's quantitative realities – heavy water use by the agriculture and the mining industries, and rapidly escalating requirements because of population increases and urbanization – meant that decision-makers had to think about water management in new ways (Hazelton 2004). However, it was also the government's social, moral and historical obligations to the neglected majority that guided the ANC's early water policy and implementation efforts (Forster, L. 2004).

32.4.1 Local-level WDM (Hermanus, South Africa)

Water demand management and water conservation efforts are not unknown in South Africa's urban areas. However, these efforts have been predominantly short-term, technical responses to crisis situations, such as pressure management and leak detection, household or industrial retrofitting, and infrastructure upgrades. In contrast, the Hermanus campaign has been distinct in its comprehensive approach, considered "cutting edge" in its day (Turton 2004). It was also notable for its inclusion of "social" aspects of WDM, and may exemplify the South African government's commitment to water conservation and demand management – with all of its successes and controversies (Hazelton 2004; Turton 2004).

Situated along the coast of Western Cape province, one-hour east from Cape Town, Hermanus has grown from a small fishing village into a tourist destination for vacationing South African urbanites and foreigners. Its population fluctuates from 22,000 off-season to a peak of 67,000 during the holiday period (December and January) (Whittaker 2004). Of the regular population, 10,000 are considered "poor" and 6,000 "middle income" while the remaining 6,000 people are "affluent" (van der Linde 2004).

The municipality drew its water from the De Bos dam, built in 1976, and had an annual water allocation of 2.8 million cubic meters from the Department of Water Affairs and Forestry (van der Linde 2004). Development projections had indicated that this volume would be sufficient until 2010, but by the early 1990s the municipality had already exceeded its annual water allocation. New estimates suggested that continued development would require almost twice as much water (van der Linde and Buckle 2000). According to van der Linde (2004), the concern was not that they would "run out of water" but that their yearly supply was insufficient and the uncertainty left them vulnerable. This vulnerability was not surprising given that the water consumption by the wealthy residents was considered "excessive" (Hazelton 2004), the rapid rate of municipal growth and building (8,000 building plots available with only 3,000 plots supported by existing water supply numbers) (van der Linde 2004) and thousands of tourists oblivious to water conservation concerns (Turton 2004). Simultaneously, the informal settlements surrounding Hermanus have also expanded as rapid social changes have caused people to migrate from rural areas to developed centres in the search of employment.

To meet the water deficit, the Hermanus municipal council and the town engineer began to proactively explore their options (van der Linde 2004). Conventional supply augmentation, such as groundwater extraction and desalination, had high capital costs and would not be supported by the government (van der Linde 2004). Expanding the De Bos dam (Onrus River catchment north of Hermanus) was calculated to be even more expensive (Preston 1996). Therefore, in collaboration with the national Department of Water Affairs and Forestry (DWAF), the municipality began to turn its attention to WDM. The Greater Hermanus Water Conservation Campaign (GHWCC) began officially in October 1996 through a partnership with, and financial support from, the DWAF. The result was a 12-point programme:

1. an assurance of supply tariff
2. an escalating block-rate tariff structure
3. clearing invasive alien plants in selected catchments ("working for water" project)
4. school water audits (designed as a series of student projects to gauge water use and loss within the school and to, ultimately, educate a generation of low-water users)
5. water loss management
6. retro-fit programme
7. water-wise gardening
8. water-wise food production
9. pre-payment metering (security meter)
10. national water regulations (adopted as local by-laws)
11. communication strategies
12. informative and "creative billing (van der Linde 2004).

The campaign's overarching objective was to change the concept of water management away from supply management to demand management. This effort was understood by the program developers as not merely as the purview of water professionals, but also as the responsibility of every citizen (Whittaker 2004; van der Linde 2004). The campaign included both residential and business sectors, but the various campaign components were introduced in a rolling start.

After the first four months, and with only items 1, 2, 3, 4, 11 and 12 implemented, the Greater Hermanus Water Conservation Program (GHWP) documented that the consumption, calculated per erf (an erf is considered to be a standard garden plot size, and is approximately ½ acre, or 2 hectares), was significant. In 1997, the municipality was servicing 9,000 erven, an increase over the average of 8,233 between the 1993–96 period. Based on those figures, per plot, water consumption fell from 1,410 litres per day for 1993–96 to 960 litres per day for 1996–97, a decrease of 32.2 % (GHWCP 1997). This consumption decline was not sustained over the project duration. However, water usage remained below the pre-project levels. After one year, the program (compared to the baseline of the previous three years) there was a 20 % increase in revenue and a 96 % citizen approval rating (van der Linde and Buckle 2000; Whittaker 2004). The bills of households using between 25 and 50 k/month decreased.

Overall, the Municipality increased its revenue, to over R 1,5 million and used the extra income to address the Unaccounted for Water (UAW) rates (i.e., leakage), the retrofit programme and other, somewhat misguided, infrastructure expansions. Van der Linde (2004) estimated that while Hermanus' water supply issues were not completely resolved, the WDM program had delayed additional supply expansion by approximately seven years.

Other benefits of the campaign included improved access to water and supply assurance; job creation and skill training through the Working-for-Water program that eventually employed 120 residents (GHWCP 1997); children's environmental education; growth of community awareness; and attitudinal changes related to water issues (van der Linde 2004). The GHWCC also illustrated that, with a commitment to communication between the municipality and the consumer, regular feedback on water choices would promote conservation and higher levels of cooperation (Whittaker 2004). Another positive outcome has been the national and international recognition of the GHWCC as a role model in urban water demand management (Buckle 2004; van der Linde 2004; Rothert 2000; Turton 2004).

The Greater Hermanus Water Conservation Campaign (GHWCC) is not without its critics. Residential support for the campaign, determined initially to be 97 % with 2 % undecided, decreased as the water regulations were strictly enforced (McQueen and Pieters 1998). This decrease became particularly evident after a series of "wet" years altered the public's perception of water scarcity and the need for such comprehensive water conservation efforts. In some cases, municipal councillors were in the "hot seat," as the issues related to water conservation were politicized during a local election (Whittaker 2004) and then were later harshly, and publicly, criticized by the Minister of Water Affairs (Hermanus Times 2000).

Within the management structure itself, there were ongoing tensions between the Treasury and the Engineering departments as they struggled to find a compromise between allocating additional revenues to a central fund and allocating them to sustain water conservation efforts (van der Linde 2004; Whittaker 2004). This tension eventually coalesced as a contributing factor to the project's end. The Treasury made a (seemingly unilateral) decision to spend the funds accumulated by the WDM project. The funds had been earmarked for the ongoing communication campaign, to improve the infrastructure within the informal settlements and to continue the Working-for-Water employment program. However, the decision was made to extend a water pipeline to Vermont, a very wealthy, and white, Hermanus neighbourhood.

Unsurprisingly, this decision did little to endear the WDM campaign and, in particular, its well-recognized local practitioner and champion, to the community. It also seriously undermined its perceived intentions and legitimacy (Turton 2004; Whittaker 2004). The Treasury's decision reinforced the more serious criticism that the GHWCC actually exacerbated the socio-economic gaps between low-income residents (some of whom had difficulty paying the charges above the free block and had leaky or insecure connections) and visiting holidaymakers, or more financially secure, local people. People in some of the low-income households also felt that the low block tariffs for minimal use were still too expensive and that the charges themselves ran counter to their basic rights to water under the new South African Water Law (Turton 2004).

Finally, the challenges of managing an extensive and multi-faceted campaign were substantial in the absence of adequate human resources within the municipality (van der Linde 2004). The GHWCC was, according to van der Linde (2004), just a "two-man team" for its duration. As of 2004, after the loss of the communication element and significantly less comprehensive than the original strategy, the conservation campaign was being solely championed and managed by the town engineer who originally initiated the project. The Hermanus town council and the DWAF no longer actively supported it (Whittaker 2004).

This anecdotal evidence hints at some of the complexity associated with a community-based water conservation and demand management project. The Hermanus case had many successes including the reduced consumption numbers, the delayed construction, the economic and social progress through the Working-for-Water project, the extensive communication campaign and the international recognition. At the time of the field research, the program, which was "in a slump", was still making a 25% profit from its water revenues (van der Linde 2004). Problems, however, remained: the social inequity issues were not adequately addressed while the profits made by the WDM program were continuing to be deposited in to the municipal general accounts. These funds remained unavailable to program operations or program expansion, including a much needed communications campaign for the new areas of the recently amalgamated municipality.

The difficulties experienced by Hermanus, and its lone program champion without access to a functioning social network, can provide valuable lessons for other practitioners and municipalities. Van der Linde was, at the time of the field research, basically excluded from the WDM community. This was partially because of shifts in DWAF research and funding priorities and the cyclical nature of public attention. The invitations to international conferences stopped arriving and the newspaper interviews were no longer requested. This researcher was, by van der Linde's (2004) count, the first person to contact him about the program in about two years. His exclusion also likely stemmed from the spectacular collapse that the program experienced.

32.4.2 WDM in the National Government

South Africa's water legislation, originally derived from the Dutch legal model, underwent massive changes after the ANC took power (Odenaal 2001; Tsinde 2001; Arntzen 2003). The 1956 Water Act, which placed the priority on supply development and riparian rights, was unable to adequately address the social, political and environmental issues of post-Apartheid South Africa (Tsinde 2001). The antiquated 1956 Water Act was replaced with the new National Water Act in 1998. The new Act supported water demand management and conservation, which it defined as "the efficient use and saving of water, achieved through measures such as water saving devices, water-efficiency processes, water demand management and water rationing" (S.1 (1)(v)). In the National Water Act, water conservation is intended to:

> "ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors ... [the promotion of] the efficient, sustainable and beneficial use of water in the public interest" (S.2 (d)).

The National Water Act is also intended to ensure that:

- water is used beneficially in the public interest;
- the limited water resources are put to the best economic use;
- the injustices of the past in relation to access to water and to the benefits of water are redressed; and
- the environment is protected so that water use is truly sustainable (McKenzie *et al.* 1999: 116–117).

Finally, the Act also contains the *National Water Resources Strategy* (NWRS), which aims to "set out the strategies, objectives, plans, guidelines and procedures of the Minister and institutional arrangements relating to the protection, use, development, conservation, management and control of water resources," as well as to outline the "principles relating to water conservation and demand management" (S.6 (1)(h)).

Significant changes were also made through the Water Services Act (108 of 1997) and the restructuring of water institutions. Among those parts of the Act relating to conservation and water demand management are clauses for:

- national standards for sustainable use of water resources for water services (s.9 (1)(c));
- standards for water tariffs (s 10);
- efforts to be made by water services institutions (s.73 (1)(j)); and
- assisting, assessing, and monitoring local authority water services' water conservation development plans (S.12–16, 18).

To put its legislation into action, the federal government has pressed the WDM initiative forward through its Department of Water Affairs and Forestry (DWAF). In 1998 the DWAF assumed the mandate "to facilitate the development of policies, strategies, projects and initiatives that will result in the efficient utilization of water by all water consumers in South Africa" (Tsinde 2001). One of its first efforts was to initiate an ambitious, and highly visible, water efficiency campaign. The National Water Conservation Campaign (NWCC), focused on "changing the ethos of water management in South Africa away from a purely supply management paradigm to a demand management approach" (Abrams 1995: 5). This program used the Hermanus case as its first and most prominent example of what could be accomplished at the local level using water demand management (see Section 4.1.1.1). A Directorate of Water Use Efficiency, previously the Directorate of Water Conservation, was established in 1998 to promote and ensure implementation of South African WDM (Singh 2004).

DWAF, as an organization, was working within a radically altered political environment, exemplified by the White Paper on National Water Policy for South Africa (1997: 2), which stated that:

> It is time for us to extend our ingenuity in another direction. Water conservation programmes may be far better investments than financing new dams, new tunnels and pumping stations, new weirs and pipelines. Conservation programmes may both increase water supply (by for instance controlling land use practices) and manage demand (for instance through application of appropriate tariffs).

The DWAF pursued this new direction through stakeholder leadership, strategy development, technical support and advisory services. It also attempted to entrench support for the WDM initiative within its own staff. Rodkin (2004) observed that the "outlook about conservation demand management [was] a relatively new arena in South Africa; so we don't necessarily have institutionalized human resource capacities in all our regions, which means that we … carry a dual role." Gumbo *et al.* (2004) agreed and noted that a "major constraints to the adoption of WDM measures is the absence of well structured educational and training programmes or courses suitably targeted to all stakeholders in the water management chain."

In other words, the DWAF had to take responsibility for both water management and staff induction into the WDM approach. This process had to not only convey the necessary explicit knowledge (the tools used to support water efficiency across different sectors) but to challenge, alter and entrench an entirely new way of thinking, individuals' tacit knowledge. Only by including both would demand management be allowed footing alongside the conventional supply management. How successful this process was is discussed below.

Though DWAF staff expressed their support for WDM principles, some individuals expressed concern about a lack of transparency and collaboration, and staff at the regional offices anticipated problems with policy implementation (Tsinde 2001). Other criticisms were more serious: the former WDM director was critical of some of his experiences in the directorate and reported a decline in institutional support, budgets and the availability of human resources. He estimated that the directorate had less than 50 % of the human capacity needed (Singh 2004). Singh (2004) resigned his post at DWAF in 2004, described his last seven months as "miserable" and "frustrating." His responses were provoked by the culture at the DWAF, where all the necessary WDM documents and project plans were available, but where initiatives were continuously stymied by the traditional water management mentality, the endless committee meetings and the lack of acknowledgement by organizational leadership (Singh 2004).

Singh's (2004) account strongly contradicted an earlier external assessment by Tsinde (2001). The Tsinde report (2001: 14) said that "the inclusion of provisions supportive to WDM in legislation [was] indicative of political will at the highest level of government" and that this "political will [was] supported by a vision as described in DWAF's strategic business plan." It also argued that an effective communication strategy that conveyed the WDM mandate, priorities, collaborative opportunities and lessons was in place. The evidence from later research contradicts that early assessment: Singh (2004) argues that while the situation is slowly changing, and "immense progress" is being made, DWAF's "greatest failure is [that it has been] unable to conclusively formalize and institutionalize WDM into WRM procedures." Singh (2004) blamed this failure on the "institutional resistance, a lack of information and training, old habits and practices of the group."

These frustrations are echoed by others operating in the South African water sector. Hazelton (2002: iv), a long-time consultant and recognized WDM expert, has stated that the "entrenched supply-side management orientation and ethos of neglect for WDM means that water sector professionals are trained to build dams and install pipelines, but are rarely taught anything about demand-side management" and that "this bias for 'ribbon cutting' projects is maintained by political forces who believe that such projects are all that is needed to catch votes." Therefore, in contrast to the government documentation, the interview evidence hints strongly of unresolved intra-organizational problems within the DWAF and its water-efficiency directorate. It would seem that, though the explicit knowledge may have been dispersed through DWAF, the tacit knowledge was much less successfully addressed.

While traditional water management thinking still exists today, such as the construction (and likely expansion) of the Lesotho Highlands Water Project (Buckle 2004; Hazelton 2004), South African water managers at local and national levels, as well as in the private sector, have been exploring the potential WDM applications. McKenzie (2004), of WRP Engineering, recalled the significant changes in the South African water sector: "when we started the company five years ago, we were 100 % supply-orientated, and I started the new section for demand management, and the demand management work is now getting in 50% of our income, in five years. It's gone from nothing to 50 % in five years." In some cases, this shift seemed to be in direct conflict with the government's social agenda. The push to make water services more cost-effective, improve use efficiency, and increase municipal revenues through increased tariffs and controls seems to run counter to the basic water and wastewater service expansion and secure provision (van der Linde 2004).

32.4.3 Learning from South African WDM

Transition toward a viable, fully implemented WC/WDM strategy in South Africa remains difficult. The *South African* office of the *World Conservation Union* (IUCN-SA 2001) concluded that water demand management "is not yet an intrinsic part of water resource planning and management" within institutions or with water practitioners and decision-makers (World Conservation Union 2001: 4). Even though there is ample evidence of progress toward the conceptualization of WC/WDM, the findings suggest that there might be a serious disconnect between the WDM awareness or information and actual policy implementation in the region (Hazelton et al. 2002). Yet progress is being made within municipalities, through the efforts of non-governmental and private organizations, and through DWAF's activities. Recognizing this social contribution – in a sense, the equal importance of institutional capacity, individual capabilities, commitment, and a willingness for collaboration at all levels of decision making – is likely just as critical as having the available technical and financial elements in place.

32.5 Lessons and Issues for Israel and Palestine

In this section, key issues and opportunities to move water demand management toward a strong governance role in Israel and in Palestine will be briefly outlined. The specific ways in which that role is implemented are sure to differ in the two nations. Such differences do not have their origin in points of principle but in differences in states of: a) economic development – Israel has a much higher national income than Palestine; and b) political development – Israel is an independent, democratic nation, whereas Palestine has been occupied militarily for most of the past four decades and constrained in water management, among other aspects of dependence, throughout its history. Happily, both Israel and Palestine are well supplied with people experienced in water management in governments, in universities, and non-governmental organizations. Unhappily, in both nations water demand management continues to be treated as a technical issue without being embedded in its socio-economic and political context.

32.5.1 WDM and Saving Water

Though few people deny that WDM is important, most assume that WDM will reduce water use. This is not a good assumption, and it will be particular weak in Palestine. Analysis of linkages between WDM and saving water will likely show that the Israeli response will resemble what happens in richer nations (Gleick 2003). Water withdrawals will be decoupled from population and economic growth, which will lead to stable or even declining absolute levels of water use. In contrast, the Palestinian response to WDM will resemble what happens in poorer nations. Water withdrawals will not only track population and economic growth but, for some time, will increase more rapidly to meet unmet needs. However, specific water use (the volume of water need for some task) will decline as end-use efficiency increases in the domestic and agricultural sectors.

32.5.2 Institutional Design for Water Demand Management

Almost all case studies and national presentations at the four WDM forums sponsored by IDRC criticize their national institutions managing water. If this is not remarkable in itself, the strength of the criticism is. Words, such as *mismanagement*, *obsolete*, *outdated*, *anarchic*, and *lack of motivation*, frequently appear (Brooks 2004). Quasi-independent agencies, as with those that manage the Litani and the Jordan River basins, are regarded as performing better than other water agencies, but they are by no means exempt from criticism.

Apart from a common separation of the institutions for drinking water from those for irrigation, and from a tendency to centralize direction and decentralize operations, views on appropriate institutional design vary widely. It is not clear which tasks should and which should not be assigned to the central agency, or where agencies for WDM should be placed in bureaucratic hierarchies. Experience with energy suggests that significant progress will not occur unless some agency is given specific responsibility for water use efficiency and unless that agency has sufficient ranking in the bureaucracy and sufficient budget to affect decision making. No one argues that there is no one best way to organize for WDM, but greater success is apparent when responsibility for both fresh water supply and wastewater disposal lie within the same structure. Intellectual and judicial independence from central government also seems to help.

32.5.3 Extensions of Existing Policies

There is broad agreement in MENA about the need to allow water prices to increase until they cover full costs, but much less agreement about how to help those households that cannot afford to pay more. Saghir (2004) suggests that, instead of subsidizing the price of water, we instead subsidize access to water. As Palestine moves toward managing its own water systems, this approach could reduce budget outlays and increase effectiveness. Lower connection fees and increasing block rates would go far toward this result. If, however, governments prefer to offer water at subsidized prices to low-income people, they need to be more imaginative about designing the rate structure to avoid transferring the much of the subsidy to richer consumers.

Distortions in *pricing of agricultural water* are rationalized as a way either to support small or remote farmers, or to maintain national security and foreign exchange earnings. Both sets of criteria need to be justified, but almost surely the former are more appropriate than the latter. Even there, it would likely be more appropriate to find ways to improve farming practices and provide better ways to get products to market. On the other hand, great care should be exercised before removing existing non-price methods for allocating and distributing water among small farmers. Traditional methods always have some embedded elements of both efficiency and equity. Where they typically fail is in accommodating to modern market conditions.

The range of policies and practices for *pricing treated wastewater* is very wide. It is not even clear how to determine what is the economically ideal pricing patterns (taking account, among other things, for avoided environmental damages and lower total waste disposal costs). Related work should also seek to establish pricing patterns that put the burden of wastewater treatment on those who cause the pollution while simultaneously making farmers and industries that can use treated wastewater pay for the additional treatment and distribution costs. At local levels, pricing patterns that promote the re-use of greywater for market gardens, something that is becoming more common in Jordan and Palestine (Faruqui/Al-Jayyousi 2002), also deserves attention.

Making *multi-stakeholder participation* work over greater geographic areas and at higher management levels has great potential (delli Priscoli 2004). Can participatory irrigation management, for example, be extended from local feeder and district canals? And, if participation is so appropriate for irrigation, why not something comparable for household water in urban neighborhoods? Guidelines are needed for matching higher and lower levels of authority, with due attention to varying livelihoods, cultural patterns, and hydrological conditions (Narain 2004). Ironically, this sort of approach might be equally applicable to Israel's heavily centralized system and Palestine's somewhat chaotic decentralized system. Palestine could lead the way, given the role that NGOs such as the Palestine Hydrology Group and Ma'an have played.

32.5.4 Extending the Concept of WDM

To now, the role assigned to WDM has been limited, but, once conceived as governance, the opportunities multiply. We note a few very briefly below. In addition, macro issues, such as rates of demographic growth (Naff 1996) and changes in industrial structure (Beaumont 1994; Becker/Lavee 2002), should be considered as part of a full WDM strategy.

If *global climate change* models are correct, the region will experience more frequent and longer droughts in the future. Adaptive water demand management strategies could make MENA more resilient to drought, but significant study would be needed to determine which measures, and how and when they should be applied (Moench/Dixit 2004).

Though really a supply technology, *rainwater harvesting* is so much a part of local management, and so dependent on strategies to moderate demand, that it is conveniently considered as part of WDM. What is needed today are policies that can promote its role in water management at household and community levels, and that link rainwater harvesting to efforts to increase revenue generation from markets outside the local community.

Extraction of groundwater is more tightly controlled in Israel than in Palestine (Trottier 1999). The research question is not *whether* to control well drilling, but *how to do so*. Groundwater is a resource that belongs to the public, and, in principle, no one should have the right to withdraw it without payment for its value. Recent work on what is coming to be called the 6th Great Lake (the groundwater basin) in North America suggests the analysis needed in MENA to "take into account water quantity, quality and ecosystem integrity" (Galloway/Pentland 2003).

Israel is contemplating *private sector participation* for water (Chenoweth 2004), but not Palestine. Given Israel's essentially complete coverage of water meters and its relatively efficient delivery system, the record does not lead one to expect any major gains in WDM from the private sector. However, more imaginative approaches can be devised, as with energy service companies that take over energy management of industrial plants and residential complexes and make profits from re-designing the system for greater efficiency at no increase in cost to consumers. The WDM past of the private sector may not be a good guide to its future.

32.6 Conclusion

Apart from those issues specific to their conflict, the fresh water problems of Israel and Palestine do not differ markedly from problems elsewhere in the region. The MENA region includes nearly three-fourths of the nations in the world with internal renewable fresh water resources below 1000 cubic meters per capita. Despite scarcity, demand management has historically received far less attention than supply management. This situation has to change, and not just by introducing new techniques but by treating water demand management as a major component of governance. The region has both the opportunity to become a world leader in demonstrating how water demand management can bring about major improvements in quality of life and in standard of living for its citizens. Perhaps the message is getting through. The Conference on Water Demand Management held in Jordan in 2004 (see at: <http://www.mwi.gov.jo/IWDMCP/Index/MON.htm>), and attended by 742 people from 38 countries, would have been unthinkable just a few years ago.

Though linked in water scarcity with the rest of MENA, the greatest impetus for WDM in Israel and Palestine may come not from pressures to improve efficiency but from the imperatives of the peace process. Almost every significant watercourse on which they depend is shared by the two nations. When a peace treaty is signed between them, formal arrangements, much like those in Annex 2 of the peace treaty between Israel and Jordan, will have to be included. Only if both nations go much further in water demand management – not just intentions, but actual implementation – will such arrangements be feasible. Israel and Palestine have much more to gain from cooperation than from conflict over water, and a large part of that cooperation will be water demand management practices promulgated and enforced within each nation individually.

References

Aitken, C. K.; McMahon, T. A.; Wearing, A. J.; Finlayson, B. L., 1994: "Residential water-use – predicting and reducing consumption", in: *Journal of Applied Social Psychology,* 24.2: 136–158.

Alatout, S., 2000: "Water Balances in Palestine: Numbers and Political Culture in the Middle East", in: Brooks, D. B.; Mehmet, O. (Eds.): *Water Balances in the Eastern Mediterranean* (Ottawa, Canada: IDRC Books): 59–84.

Allan, J. A., 2002: "Hydro-peace in the Middle East: Why no water wars? A case study of the Jordan River basin", in: *SAIS Review,* 22,2 (Summer-Fall): 5–72.

Arntzen, J., 2003: "Incorporation of Water Demand Management in National and Regional Water Policies and Strategies." Report Prepared for the IUCN South Africa Office. WDM Southern Africa Project, Phase 2 (Pretoria: IUCN, June).

Attia, B. 2004: "Comparative Analysis: Case Studies of Tunisia, Turkey, Yemen and Egypt", in: IDRC (Ed.): *Water Demand Management Forum – Middle East and North Africa: Advocating Alternatives to Supply Management of Water Resources.* CD-ROM (Ottawa, Canada: IDRC).

Beaumont, P., 1994: "The myth of water wars and the future of irrigated agriculture in the Middle East", in: *International J. of Water Resources Development,* 10,11 (June): 9–21.

Becker, N.; Lavee, D., 2002: "The effect and reform of water pricing: The Israeli experience", in: *International Journal of Water Resources Development*, 8,2 (June): 353–66.

Brooks, D. B., 2002: *Local Water Management* (Ottawa, Canada: IDRC Books).

Brooks, D. B., 2004: *Lessons from the Water Demand Management Forums for the Middle East and North Africa*. Prepared as part of IDRC's contribution to the International Water Demand Management Conference in Jordan (Ottawa, Canada: Friends of the Earth Canada).

Brooks, D. B., 2006: "An operational definition of water demand management," in: *International Journal of Water Resources Development*, 22,4 (December): 521–28.

Buckle, J.S., 2004: "Water demand management: Philosophy or implementation?" in: *Water Science and Technology: Water Supply*, 43: 25–32.

Chenoweth, J., 2004: "Changing ownership structures in the water supply and sanitation sector", in: *Water International,* 29,2 (June): 138–47.

delli Priscoli, J., 2004: "What is public participation in water management and why is it important?", in: *Water International*, 29,2 (June): 221–227.

De Oliver, M. 1999: "Attitudes and inaction – a case study of the manifest demographics of urban water conservation", in: *Environment and Behavior*, 31,3: 372–394.

Dickerson, C.A.; Thibodeau, R.; Aronson, E.; Miller, D., 1992: "Using cognitive-dissonance to encourage water conservation", in: *Journal of Applied Social Psychology,* 22,11: 841–854.

Faruqui, N., and Odeh Al-J. 2002: "Greywater reuse in urban agriculture for poverty alleviation: A case study in Jordan", in: *Water International*, 27,3 (September): 387–394.

Forster, S., Interview. February 26th, 2004. Consultant. Pretoria, South Africa

Galloway, G.; Pentland, R.; 2003: *Managing Groundwater Resources in the Great Lakes Basin.* Working Paper #2, (Toronto, Canada: University of Toronto, Munk Centre for International Studies).

Gleick, P. 2000: "The Human Right to Water", in: Gleick, P. (Ed.): *The World's Water: 2000-2001*, (Washington, DC: Island Press).

Gleick, P. H., 2003: "Global freshwater resources: Soft-path solutions for the 21st century", in: *Science.* 302 (28 November): 1524–28.

Grover, B., 2004: "Overview of the Public-private Partnerships in the Domestic Water Supply Sector", in: IDRC (Ed.): *Water Demand Management Forum – Middle East and North Africa: Advocating Alternatives to Supply Management of Water Resources.* CD-ROM (Ottawa, Canada: IDRC).

Gumbo, B. P.; van der Zaag, P.; Robinson, L.; Jonker, ?; H. Buckle. "Training needs for water demand management", in: *Physics and Chemistry of the Earth*, 2004, 29 (15–18 SPEC.ISS): 1365–1373.

Hazelton, D.; Nkhuwa, D.; Robinson, P.; Mwendera, E.; Tjijenda, K.; Chavula, G., 2002: *Overcoming Constraints to the Implementation of WDM in Southern Africa.* Synthesis Report (Pretoria, South Africa: World Conservation Union (IUCN) – SA office).

Hazelton, D., 2004: "Interview", April 6th, 2004 (Pretoria, South Africa: . TSE Water Services).

Homer-Dixon, T., 2003: "Bringing Ingenuity to Energy", in: Heintzman, A.; Solomon, E. (Eds.): *Fueling the Future* (Toronto, Canada; House of Anansi Press).

van der Linde, J.; Buckle, J. S., 2000: Greater Hermanus Water Conservation Programme: A model for water demand management. Unpublished Report (Hermanus) van der Linde, J., 2004: "Interview", 10, 11, 17 March (Hermanus, South Africa: Greater Hermanus Municipality).

McKenzie, R. S.; van Rooyen, P.G.; Stoffberg, F. A., 1999: "The importance of water demand management in South Africa", in: *Water Supply.* 17,3–4: 113–120.

McKenzie, R. S., 2005: "Interview", 20 April 20th, 2004 (Pretoria, South Africa: . WRP Engineering).

McQueen, C., Pieters, D., 1998: *Greater Hermanus Water Conservation Programme: Residential Opinion Survey* (Pretoria, South Africa: Department of Water Affairs and Forestry, National Water Conservation Campaign).

Moench, M.; Dixit, A. (Eds.), 2004: *Adaptive Capacity and Livelihood Resilience: Adaptive strategies for responding to Floods and Droughts in South Asia* (Boulder, Colorado: Institute for Social and Environmental Transition).

Naff, T., 1996: "The Long Dark Shadow: Population, Water and Peace in the Middle East", in: *Population and Development* (New Delhi, India: Tata Energy Research Institute).

Narain, V., 2004: "Brackets and black boxes: research on water users' associations", in: *Water Policy*, 6,3 (June): 185–196.

Odenaal, P., 2001: "Dynamics of the South African water scene over the last 21 years - a research perspective" Water Sewage and Effluent, 21(5): 24–31.

Preston, G., 1996: "Faxed letter to Mr. James van der Linde at the Hermanus Municipality", 16 February.

Rothert, S., 2000: "Water conservation and demand management potential in southern Africa: an untapped river", in: *International Journal of Water*, 1 (1): 118–144.

Saghir, J., 2004: "Reflections on Water Pricing and Tariff Design: Key Principles. Presentation to the Water Valuation Forum", in: IDRC (Ed.): *Water Demand Management Forum –Middle East and North Africa: Advocating Alternatives to Supply Management of Water Resources.* CD-ROM (Ottawa, Canada: IDRC).

Singh, M., 2004: "Telephone Interview", 22 April (Pretoria and Durban, South Africa: City of Durban).

Thompson, S. C.; Stoutemyer, K., 1991: "Water-use as a commons dilemma - the effects of education that focuses on long-term consequences and individual action", in: *Environment and Behavior*, 23 (3): 314–333.

Trottier, J., 1999: *Hydropolitics in the West Bank and Gaza Strip* (Jerusalem: Palestinian Academic Society for the Study of International Affairs),

Tsinde Development Consultants, 2001: "Evaluation Of The Department Of Water Affairs And Forestry (Dwaf), Head Office Staff – Pretoria, Attitude, Perceptions And Behaviour Towards The Paradigm Of Water Conservation And Water Demand Management". Report for the Directorate: Water Conservation, Department of Water Affairs and Forestry, at: <http://www.dwaf.gov.za/WaterConservation/WordDownloads/AddendumA.doc>.

Turton, A., 2004: "Interviews", 6 February; 21 April (Pretoria, South Africa).

Van Hofwegen, P., 2004: "Water Demand Management Forum – Middle East and North Africa: Advocating Alternatives to Supply Management of Water". Resource Paper delivered to the IDRC Forum on Participatory Irrigation Management, in: IDRC,. CD-ROM (Ottawa, Canada: IDRC).

Whitaker, B., 2004: "Interview", 11 March (Hermanus, South Africa: Milkwood Communications).

World Conservation Union, 2001: *Water Demand Management Programme for Southern Africa: Phase II Inception Report #1. Incorporating Progress Report #1 August* 2000-*February* 2001 (Pretoria, SA: IUCN - South Africa Country Office).

33 Water Demand Management – A Strategy to Deal with Water Scarcity: Israel as a Case Study

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Abstract

The chapter deals with a potential strategy to combat water scarcities in the Middle East, a condition which might accompany the Middle East socio-economic policies for many years to come. That strategy is defined as 'water demand management', or 'water conservation' as well as the 'increase of water use efficiency'. These three definitions have become a major paradigm shift from the conventional supply management of water to the management of the demand side, producing additional quantities of water for the immediate needs of the society, through the creation of 'virtual' quantities of water, whether by conservation strategies or by increased agricultural and industrial production per unit of water, as well as the import of water intensive agricultural products and decreasing exports of such products. The experience of Israel in *Water Demand Management* (WDM) is presented as a potential and powerful instrument to enhance socio-economic prosperity and growth with limited water quantities, available for the societies.

Keywords: Water Demand Management, Water Conservation, Efficient use of Water,Water Economic Issues, Water Use Technologies, Legal Aspects, Virtual Water

33.1 Introduction

Israel was established in 1948, a semi arid country, having a population of 650,000, a GDP of $ 300/capita and was using approximately 300 m^3 of water per person annually for all uses. In 2003 Israel has reached a population of 6.8 million persons, a GDP of $ 15,000/capita, and maintained the approximate parameter of 300 m^3 of fresh water per capita, despite the large increase in personal and income.

The country balances its agricultural production for consumption exports and imports. Following the total development of its fresh natural water resources, an intensive national campaign of water conservation was started and improved efficiency in water use. In addition, a comprehensive waste water treatment and re-use – substituting treated effluents for farming fresh water allocations – and together with importing grains, saved thus saving large quantities of water, all of which make up part of its national water resources management and its Water Demand Management Strategy (WDMS).

The pioneering works and the resulting R&D efforts of Israel, have influenced a number of other countries and global regions, as water conservation is becoming an indispensable global need. As other countries in the Middle East suffer from similar, or more acute levels of water scarcities, they are beginning to Adopt the WDMS concept which Israel has developed. The global situation can be summarized in

1 The paper is partially based on papers appearing in other publications

the following paragraphs, while the situation in many developing countries is much more critical.

Recent studies indicate that more than 40 per cent of the world food and agricultural needs are produced on irrigated lands. As the developing countries and especially the urban populations in these countries continue to grow at a rapid rate, the forecast food and agricultural demand will increase the pressures on the dwindling water resources in both developed and developing countries. As most of the feasible water resources in river basins as well as in the aquifers, have already been connected and used, one can not avoid asking the questions, from where and how will the demand for more food and water be met.

33.2 Water Economic Issues Related to Water Demand Management (WDM)

The following three issues are the basis of the WDM policies in Israel: irrigation, urban and industrial water use. When population grows, the water it relies upon becomes scarce; there is not enough water to satisfy the needs and wants of everyone around. In a world of 6+ billion people, water is becoming scarce, in many cities and countries of the world.

In most cases, when water is scarce it is costlier to develop and to use. Therefore, when a person, a farmer or an industry uses water in an area where water resources are limited, that quantity of water is not available to another farmer, a city or an industry. The productive value of the water on the farm or the site where it is missing is the 'shadow cost of water'.

Efficient use of water means that the contribution of water to human welfare is the optimum that may be achieved. Where people are poor and where food supply is not always assured, the contribution to agricultural production is a contribution to welfare. Where water is used for human consumption, in urban or rural areas, it should be allocated to satisfy basic needs of all. This basic need is a human right.

The failure to realize that scarcity requires a careful allocation of water and that such allocation is often not assured in 'hands-off policies', is one of the roots of inefficient use of water. The other problem is the failure, or the absence of political courage, to realize that over-utilization and pollution of water destroys the water and economic resources – aquifers, rivers, soils, lakes, and habitats. This last failure is regarded sometimes as problems for future generations to solve. However, these generations are already living with us, and will suffer the consequences.

Experience in Israel has also taught us that, wherever successfully applied, markets and water prices could become highly efficient instruments of allocation, promoters of water use efficiencies and conservation, This would minimize the impacts and risks associated with water scarcity.

Correct water prices are cornerstones for economic policy in the sector and function in the following ways: We learned that the first role of prices, to provide information, is the least understood. The correct price will reflect the cost of water to society; that cost materializes only under scarcity. The product not produced where the water is missing is its cost. Shadow prices will thus reflect the cost of the resource; this was the basis for the decision on 'abstraction fees' that have been imposed in Israel since 2000.

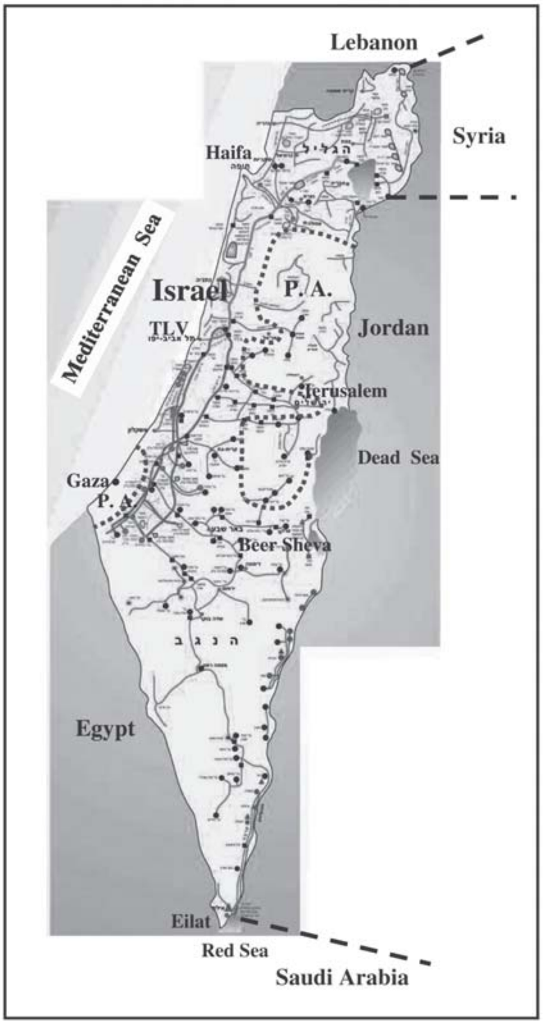
When water prices reflect their real economic value, farmers, industries and households will utilize water more efficiently. Prices are not intended to encourage people to use less water; their aim is to promote the use of the right quantity of water – on the farm, in industry, households and the urban sector.

However, prices also transfer income. Failing to understand the information and allocation role of the prices, farmers and urban dwellers usually oppose the adequate price system. They see it only as a means of income transfer. But prices will encourage efficient use of water, and will increase, not reduce, income in rural and urban communities alike. It will reduce the reliance of water users on the whims of the political powers-to-be and their servants. Water is intended to satisfy the *basic* needs of all members of society thus must be under public control, especially in water scarce regions and dry ones, when prices by themselves can not maintain the needed, just and adequate distribution.

33.3 The National Water Resources Management Strategy

The main instruments and components of the national '*water resources management strategy*' (WDMS) are the water supply and demand management programs (figure 33.1).

Figure 33.1: Map of the National Water System of Israel. **Source**: Mekorot -National water corporation.



33.3.1 The Supply Strategy

A nation-wide development of (surface and ground) water resources as well as the construction of regional projects connecting all resources to a network was completed when water surpluses were transferred from the relatively water abundant north to the water scarce center and south. This *National Water Carrier* (NWC) interconnected all regional projects, thus comprising the *National Water System* (NWS). That investment enables the authorities to maintain a balanced national pumping pattern, monitoring hydrogeological conditions at all times and throughout the country. Desalination of brackish and sea water has become the main instrument of adding water quantities when natural resources and re-use do not meet the growing demand for water.

33.3.2 The Demand Strategy

The main tools used to achieve the national demand water management objectives are:

33.3.2.1 Legal Basis, Pricing and Economic Policies

In 1959 the 'water law' was passed by the Parliament declaring all water resources to be public and establishing a water commission to regulate, monitor and manage the country's water resources. A total water metering system was completed as well with progressive block rates for every farmer, house, apartment and industry. Prices are updated automatically with a cost of living formula and a minimization of subsidies. In 2000 water abstraction fees were approved by the Parliament and implemented.

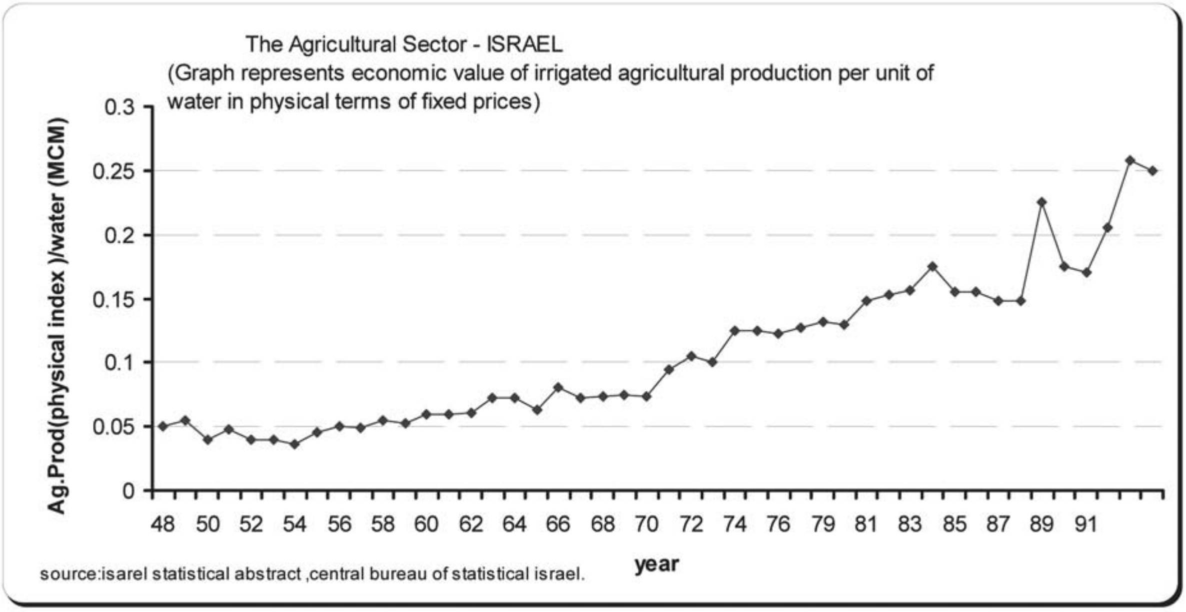
33.3.2.2 Re-Use of Sewage Effluents

Regulations have been legislated in order to increase the quality levels of sewage treatment plants and their effluents to maximize re-use potential and minimize the health and environmental risks. They are also enhancing the trading potential for their exchange for fresh water allocations, mainly for irrigation. Since the 1990s the allocation policy for irrigation has concentrated on reduction of fresh water quantities to the farming community and replacing fresh water with treated wastewater effluents. The total sewage costs are borne by the city, while the re-use component costs are borne by the water sector. Israel had reached a 65 per cent re-use levels, by 2003, or almost 50 per cent of the total irrigation sector is now using treated sewage effluents (see figure 33.6).

33.3.2.3 Water Conservation and Improved Efficiency of Water Use

Continued policies concentrate on mixed tools including: (a) allocations, norms and progressive block rates for each sector, and (b) research, development and implementation of agronomic techniques (the most famous of which were the large scale implementation of drip irrigation techniques and automation of irrigation) changing of cropping patterns based on the product value per unit of water (figure 33.2).
In parallel, there has been wide-scale implementation of technological means to improve water use efficiency and reduce water consumption in the urban and domestic sectors, commercial, industrial and the introduction of drip irrigation and automation to the urban parks and gardens (figures 33.4 and 33.5).

Figure 33.2: Real Agricultural Production per Unit of Water. **Source**: Prof. Yoav Kislev, Hebrew University Israel (based on Central Bureau of Statistics: Israel Statistical Abstract.



33.3.2.4 Water Allocation for Agricultural and Industrial Production

The irrigation water allocations are based on norms developed by the agricultural research community together with the farmers, reflecting the potential economic gains by introducing new irrigation technologies, changing cropping patterns, and moving away from crops where the product value per unit of water is relatively low, such as grains. A similar policy was adopted by the industrial sector following a survey done to move toward a reduction of water usage per unit of product as well as the reduction of the pollution caused by the industry. An implementation policy followed the surveys which prioritized strategies, engineered a work establishment of special funding instruments and sanctions, a nation-wide program for each industry, and finally ending with a normal allocation system based on water quantity per unit of production (figures 33.2 and 33.3).

33.3.2.5 Urban Sector Water Metering, Replacement of Older Pipes, Electronic Monitoring and Retrofitting Campaigns

The double-volume toilet flushing basins recently redesigned, manufactured and now enforced by law as well as flow and pressure regulators on taps and showers were the basis for 25 years of a program. The results are shown in figures 33.4 and 33.5. The urban consumption of Israel has hardly changed on a per capita basis, despite an increase of 300 per cent in the GDP during the last 40 or so years. Comprehensive and total retrofitting has yet to be completed.

33.3.2.6 'Virtual Water' Policy

In the 1960s, when realizing that water resources will not meet the demand, the authorities made the difficult decision to import a majority of its grain needs instead of growing them in Israel. In today's figures this means the 'Virtual Import' of almost 3 billion cubic meters of water annually, almost twice the total availability of fresh water resources in Israel.

33.3.2.7 Internal and Possible External Water Markets

The authorities as well as the Israeli Parliament have recently approved a change in the water code enabling holders of water allocations to sell their permanent or temporary allocations to others by transferring the actual transaction via the national water carrier, thus opening the sector for a market-like operation. This is a policy that the water commissioner's office has been implementing for years by trading fresh water with treated sewage effluents. This market concept could well serve and even promote peaceful exchanges of water between the countries of the Middle East.

Figure 33.3: The National Industrial Water Use per Real Term Value of Industrial Production. **Source:** Prof. Yoav Kislev, Hebrew University, Faculty of Agriculture, Department of Economics.

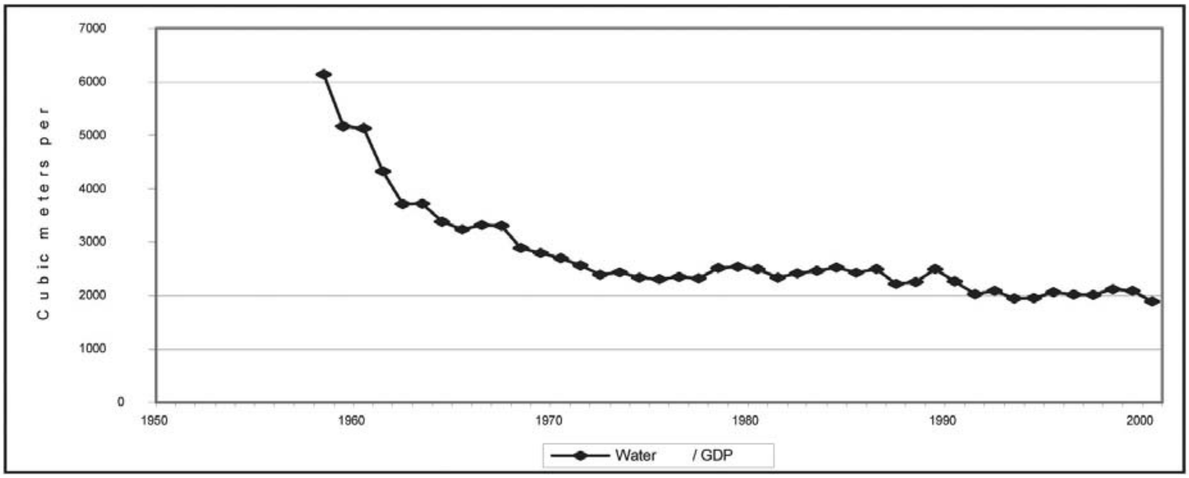
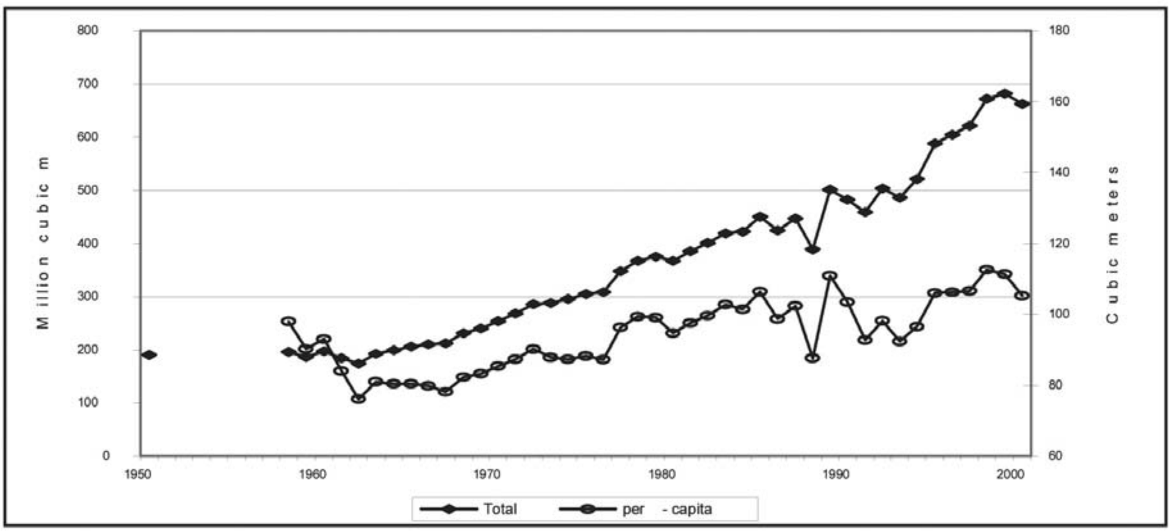


Figure 33.4: Urban Water Consumption Total and per Capita. **Source**: Prof. Yoav Kislev,Hebrew University, Israel (grey material).



33.3.2.8 Sea Water Desalination

As a result of the recent dry spells and growing water demand beyond natural recharge, the government has decided to initiate and accelerate the construction of the *Reverse Osmosis Sea Water Desalination Plants* (ROSWDP), adding about 10 % to the total fresh water availability of the country in 2005/6. This follows a period of intensive research and development and significant cost reductions of ROSWDP based mainly on local changes in the design of these plants, during the international tenders of Israel in 2001 and 2002. This decision also includes the completion of nationwide treatment and re-use of all of its treated waste water (tertiary and secondary treatment) and allocation of these new sources of water to the farmers in exchange for their fresh water allocations. This policy and investment will allow the country to indefinitely continue its socio-economic growth, despite the increase in population and standard of living, in addition to opening the door for potential solutions to water conflicts between Israel and its neighbors.

References

Arlosoroff, Saul, 1998: *Urban Water Demand Management*. UNCHS Publication (Nairobi: UNCHS).

Arlosoroff, Saul, 1998a: "Water Demand Management", Promoting Sustainable Consumption in Asian cities, report by UNCHS (Habitat) Fukuoka, Japan.

Figure 33.5: Urban Water Consumption per National GDP. **Source:** Prof. Yoav Kislev, Hebrew, University Faculty of Agriculture, Department of Economics.

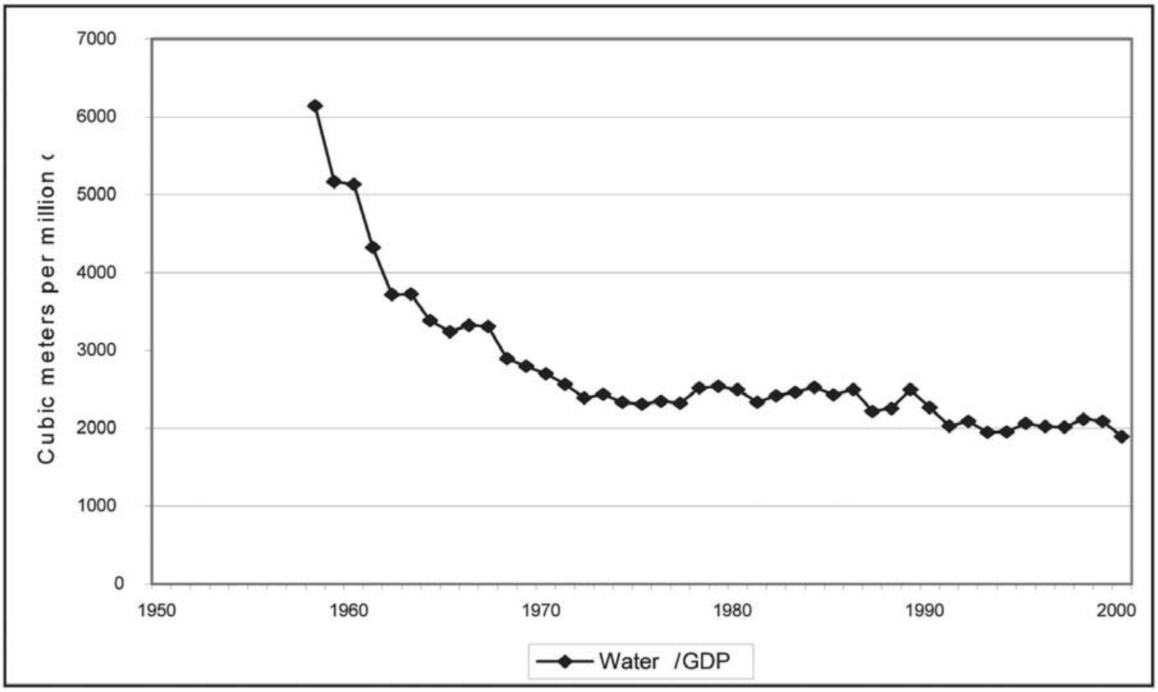
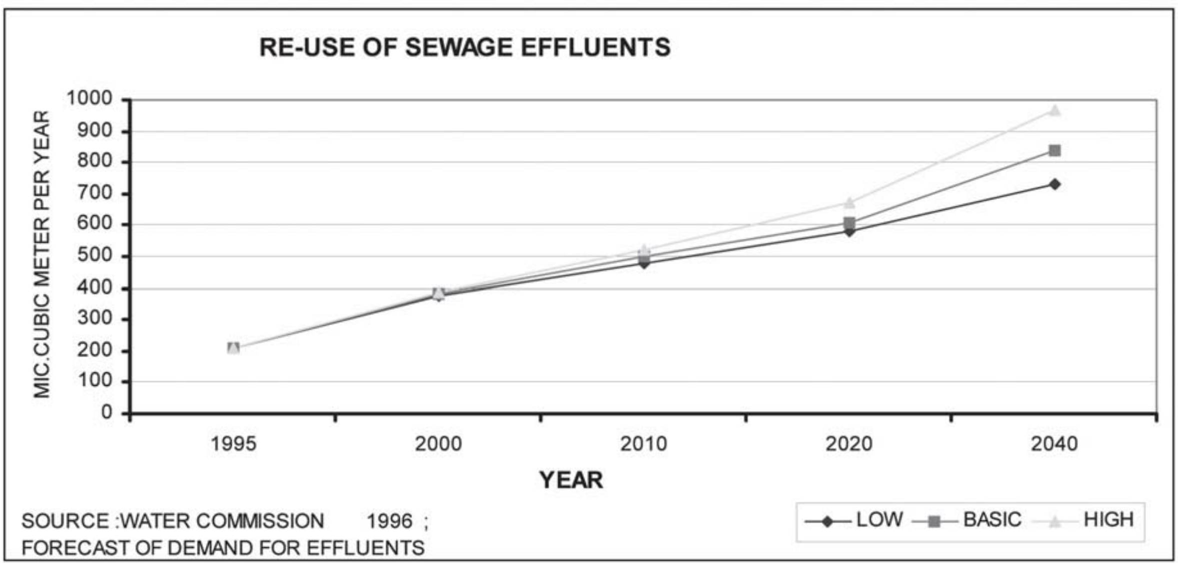


Figure 33.6: Forecast Re-use of Treated Sewage Effluents. **Source:** Israel, Water Commission (1998).



Arlosoroff, Saul, 1999: *UNCHS - Managing Water for African Cities* (Nairobi: UNCHS).

Arlosoroff, Saul, 2002: "Integrated water use management, World Food Prize" (Des Moine, Iowa, USA).

Forde, Lester; Arlosoroff, Saul; Tate, Donald, 1996: "Water Demand Management". Water Supply and Sanitation Collaborative Council (Geneva, Switzerland).

Forde, Lester; Arlosoroff, Saul; Tate, Donald, 1997: "Water Demand Management". Water Supply and Sanitation Collaborative Council (Geneva,Switzerland).

Haklai, Sara, 2002: *PPT Inputs* (Tel Aviv, Israel, Mekorot, National Water Corporation)

Kislev, Yoav, Various papers on Water isssues in Israel (Jersualem: Hebrew University, Faculty of Agriculture).

34 Using Socio-economic Indicators for Integrated Water Resources Management: Case Study of Palestine

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Abstract

As recognized internationally the Palestinian territories are among the most deprived countries in the world when it comes to the water resources. This is due to the fluctuating political, social and economic conditions which resulted in very weak institution performance indicators. This chapter used international social and economic indicators and *Water Poverty Index* (WPI) as a common ground for various indicators as an attempt to build future demand scenarios. An increasing gap was found between water supply and demand. Based on Falkenmark's (286.20 m^3/C/yr), *Water Availability Index* (-0.39) and basic water needs, it was found that water scarcity is the main constraint to life.

The conventional WPI-approach showed that availability, access and time were 22.49 per cent, 55.25 per cent, and 6.82 per cent respectively. The corresponding WPI value was 51.63 per cent. However, based on a holistic WPI-approach, the values of R, A, C, U and E were found to be 22.5 per cent, 52.8 per cent, 36.0 per cent, 69.0 per cent and 40.8 per cent respectively. The corresponding WPI was 44.2 per cent when equal weighing (0.2) was used. The WPI for the West Bank was lowest compared to neighboring countries. Moreover, the WPI decreases slightly as population increases rapidly. Finally, increases of 100 MCM/year and/or GDP slightly shift upward the WPI due to a lack of capacity and accessibility to resources.

Keywords: Accessibility, availability, capacity, environment, indicators, water resources, socio-economic, Water Poverty Index (WPI).

34.1 Introduction

34.1.1 Water Resources in the West Bank

The West Bank is the eastern part of historic Palestine. Water in the West Bank comes originally from rain water (150 to 700 mm/year (PHG 2004)). The total quantity of rainfall on the West Bank is 2248 *million cubic meter* (MCM), 68, 3.2 and 28.8 per cent of these quantities are distributed as evapotranspiration, surface runoff and natural recharge, respectively (Abu Zahra 2001). The main fresh water resource in the West Bank is ground water, this quantity is abstracted from three main aquifers, the eastern aquifer (Safe yield = 172 MCM/year), the north-eastern aquifer (safe yield = 145 MCM/year) and the western aquifer (safe yield = 362 MCM/year), whereas, 69 MCM per year are utilized by Palestinians in the West Bank (Article 40 of Oslo B agreement). 297 springs and seeps are distributed over the West Bank, of which, 291 (53 per cent of the total discharge) are discharging water of excellent quality (Abu Zahra 2001) and 6 springs or groups of springs are of a brackish nature. The total reported discharge of these springs is 24-119.9 MCM/year (Nuseibeh/Nasser Eddin 1995) that are mainly used for irrigation.

Seasonal wadis are also considered as a considerable water resource; their annual quantity is approximately 74 MCM/year (52 and 22 MCM/year in the eastern and western wadis, respectively). Only a low percentage of this quantity can be utilized as a result of a lack of infrastructure essential for collection, storage and distribution on a large scale. This is also true for urban (14 MCM/year) and natural (70 MCM/year) runoff (Abu Zahra 2001). Additionally, rain water harvesting in cisterns has been a considerable water resource in the West Bank, its annual quantity is estimated as 6.6 MCM/ year. Finally, the Palestine share of the Jordan River (257 MCM/year) has been inaccessible since 1967 due to Israeli military measures (World Bank 1997).

34.1.2 Water Supply in the West Bank

The actual available water is significantly lower than 1020 MCM/year due to the lack of accessibility to groundwater and infrastructure needed to fully utilize the surface water resources. The available water per capita (water supply) differs considerably among West Bank governorates; it ranges from 29 liter/capita/day in Tubas governorate to 200 liter/ capita/day in Jericho (PWA 2002, 2003). Most of the water available per capita is below the average value stated by WHO guidelines (150 liter/capita/day). This could be attributed to a lack of accessibility to water resources and poor water supply management.

34.1.3 Water Demand in the West Bank

Domestic water demand can be calculated based on WHO minimum domestic water consumption standards of 100 liter/cap/day. As the total population of the West Bank was 2,372,216 (2005), then the annual domestic water demand was 86.64 MCM. The agricultural demand is 266 MCM/year (Jayyousi 2000). The industrial demand is 201.36 MCM/year (Abu Zahra 2001). Therefore the total water demand for the three sectors is 554 MCM/year.

34.1.4 Water Poverty and International Measurements

Water poverty is a situation where a nation or region cannot afford the cost of sustainable clean water for all people at all times. To assess water poverty, it is often essential to identify meaningful indicators so as to get attention from decision makers and support from funding agencies (Feitelson/Chenoweth 2002). Indicators identify trends over time and provide a basis for international comparisons (UK, Department of the Environment, 1996). Useful indicators should be measurable and the necessary data should be easily obtainable (Gallopin 1997). They also need to focus on the structural implements for the sustainable supply of water, to facilitate policy responses.

Recently, efforts are targeted to develop meaningful and measurable water indicators. However, most of these indicators were shown to be lacking since they do not reflect the current agenda in water resource management nor do they direct data collection efforts (Feitelson/Chenoweth 2002). The Falkenmark (1989) water stress indicator is one of the most commonly used indicators for describing water availability in a country. According to Falkenmark, water availability of more than 1,700 m^3/capita/year is defined as the threshold above which water shortage occurs only irregularly or locally. Below this level, water scarcity arises in different levels of severity. Below 1,700 m^3/capita/year, water stress appears regularly. However, below 1,000 m^3/capita/year water scarcity is a constraint for economic development and human health and well-being. Finally, below 500 m^3/capita/year, water availability is a main constraint to life (Falkenmark 1989). Raskin, Gleick, Kirshen, Pontius and Strzepek (1997) criticized this indicator, as it does not reflect the significant differences in water use patterns between countries. But Falkenmark (1989) initially focused on sub-Saharan Africa, where she assumed countries need to be self-sufficient in terms of food, due to their low purchasing power. Hence she defined water scarcity and stress as a function of the ability to maintain food self-sufficiency.

The *Water Availability Index* (WAI) is another approach that has been used to measure water poverty. The WAI includes surface water as well as groundwater resources, and compares the total amount to the demands of all sectors, i.e. domestic, industrial and agricultural demands (equation 34.1). The month with the maximum deficit or minimum surplus respectively is decisive. The index is normalized to the range $^{-}1$ to $^{+}1$.

When the index is zero, availability and demands are equal

$$WAI = \frac{R + G - D}{R + G + D} \qquad \text{[equation 34.1]}$$

where, R = surface runoff, G = groundwater resources and D = sum of demand of all sectors. The basic human needs index is another approach for water poverty measurement that is based on water use of water instead on water availability. Gleick (1996) quantified the amount of water that a person needs for *basic water requirements* (BWR), such as drinking, cooking, bathing, sanitation and hygiene, as 50 liters per person per day.

These methods are useful in determining the water situation of a country. However, other basic aspects were not taken into account in these methods. Water quality and other water users, rather than domestic use, such as industry, agriculture and nature (environment) itself, were not considered in these approaches. Additionally, none of the indices noted so far indicates the severity of problems from the socio-economic dimension (Feitelson/Chenoweth 2002).

Sullivan (2002) advanced an alternative notion, suggesting that water poverty should be an aggregate index based on the percentage of water being used in a region combined with the percentage of the population with access to safe water and sanitation, and the percentage of the population with easy access to water for domestic use. This index was called *conventional composite water poverty index* (WPI). The formula that gathers these elements is:

$$\text{WPI} = \text{wa A} + \text{ws S} + \text{wt (100-T)}$$

[equation 34.2]

Where;

A: Adjusted water availability assessment (per cent)

S: Population with access to safe water and sanitation.

T: The index represents time and effort taken to collect water for household.

A,S and T are between 0 and 100.

wa, ws and *wt* : Are the weights given to each component of the index (wa + ws + wt = 1).

The resultant from equation (34.2) is divided by 3 to have a number between 0 and 100.

Salameh (2000: 471) described a WPI as "the ratio of the amount of available renewable water to the amount required to cover food production and the household uses of one person in one year under the prevailing climate conditions." While this index has the advantage of focusing on the domestic sector and poor people's need, it too does not incorporate water quality aspects, and does not assess the capacity to address water issues. Further modification in the WPI was reported by Lawrence, Meig and Sullivan (2002) where the WPI was stated in a holistic way, combining five components which are resources (R), access (A), use (U), capacity (C) and environment (E). Each of these components is derived from two to five sub-indicators which are normalized to a scale from 0 to 1. The overall index is generated as a total of the component values so that the value is between 0 and 100. Where, a value of 100 is only possible if a country ranks best in all five components. WPI can be calculated according to equation (34.3)

$$\text{WPI} = wr\,\text{R} + wa\text{A} + wu\text{U} + wc\text{C} + we\text{E}$$

[equation 34.3]

34.2 Results and Discussion

The current population of the West Bank is 2,372,216 (PCBS 2005), the safe yield of groundwater is 679 MCM/yr (Oslo agreement 1995). Therefore, the annual per capita water availability is 286.2 m^3/capita/yr. According to Falkenmark's approach, water availability in the West Bank is a main constraint to life. In addition, since domestic, agricultural and industrial water demand respectively are 86.64, 266.00 and 201.36 MCM/year. Therefore,

$$WAI = \frac{(0.9 * (257 + 70 + 14) + 679) - 554}{(0.9 * (257 + 70 + 14) + 679) + 554} = 28\%$$

However, the available ground water accessible by Palestinians (from wells and springs and cisterns) is only 124.6 MCM/year (Abu Zahra 2001). Consequently, actual WAI is:

$$WAI = \frac{(0.9 * (0) + 124.6) - 554}{(0.9 * (0) + 124.6) + 554} = -0.633$$

According to the WAI approach, water availability in the West Bank is not sufficient to satisfy water demand. Moreover, the value -0.633 means that the gap is large and new water resources have to be introduced to reduce this gap. In the West Bank, 86 per cent of the population has access to safe water networks (UNDP 2004). Table 34.1 shows the average water consumption for the connected and unconnected areas. According to the basic human needs approach stated by Gleick (1996), the average water use is higher than 50 liters/capita/day. Therefore, the basic human needs are available except in few communities such as Tubas (29 liter/cap/day). Feitelson and Chenoweth (2002) argued that the key word in discussing scarcity is availability. However, Sullivan, Meigh *et al.* (2003) claimed that the availability of safe water doesn't automatically lead to poverty alleviation. This may be so, but the fact that access to safe water is a necessary condition for an adequate life. In the West Bank, accessibility to safe water is connected with availability.

Table 34.1: Seasonal Water Consumption for Connected and Unconnected Households in the West Bank. **Source:** PHG (2002).

Connected Areas	Unconnected Areas
Average family size 7.49 persons	Average family size 8.36 persons
Average monthly water use in summer 26.06 m^3	Average monthly water use in summer 18 m^3
Average monthly water use in winter 20 m^3	Average monthly water use in winter 13 m^3

34.2.1 Water Poverty Index: The Conventional Approach

The conventional WPI (equation 34.2) can be calculated as follows: *Adjusted water availability (A),* as mentioned before, domestic, agricultural and industrial water demands are 554 MCM/ year. Consequently,

$$R = \frac{124.5}{554} = 22.5\%$$

Access (S) as the percentage of population with access to safe water and sanitation respectively, are 86 and 24.5 per cent Therefore,

$$S = \frac{86 + 24.5}{2} = 55.25\%$$

(100-T)

The median monthly income is 1,600 NIS (PCBS 2005). In the connected areas, the average monthly water bill in summer and winter are 121.55 and 69.5 NIS[1], respectively. However, for the unconnected areas, the average monthly water bill in summer and winter are 194.64 and 35 NIS, respectively (PHG 2002). Accordingly, if the winter time is considered as 4 months then the weighted average of monthly water bill is 104.03 and 141.42 NIS for the connected and unconnected areas, respectively. Therefore, this amount is equivalent to 6.5 and 8.8 per cent of time. Therefore,

$$T = 6.5*86\% + 8.8*14\% = 6.82\%.$$

$$\text{And } (100\text{-}T) = 100\text{-}6.82 = 93.18\%$$

According to the water situation in the West Bank, availability of water is considered the main problem, accessibility is considered less important and time is considered the least important. Therefore, the suggested two weighing methods that were considered in calculating the WPI according to the conventional method are:

$$Wa_1 = 0.4,\ ws_1 = 0.35 \text{ and } wt_1 = 0.25; \text{ and}$$
$$wa_2 = 0.5\ ws_2 = 0.35\ wt_2 = 0.15$$

Accordingly, the WPI according to the first and second weights are 51.63 and 44.56.

34.2.2 Water Poverty Index: The Holistic Approach

Resources (R)

As discussed before, the actual water resource is 124.6 MCM/year. The current water demand is 554 MCM/ year. Therefore,

$$\mathbf{R = 124.6/554 = 22.5\%}$$

Access (A)

- As mentioned before, the percentage of the population with access to safe water and sanitation are 86.0 and 24.5 per cent, respectively.
- The per cent of water demand by agriculture is 266/554 = 48.0 per cent

Therefore,

$$\mathbf{A = 52.83\%}$$

Capacity (C)

- GDP per capita = 1,051 (UNDP 2004) C1 = 1.051 %.

1 One US $ is equivalent to 4.5 NIS according to the current exchange rate.

- Under-five mortality (per 1000) = 25 (UNDP 2004) C2 = 25T%.
- Education enrolment rate = 86 % (UNDP 2004) C3 = 86 %.
- Gini coefficient = 0.32 C4 = 32 %.

Accordingly,

$$C = 36\%$$

Use (U)

- Domestic water consumption with total water quantity = 71.41/1020 = U2 = 7.0 per cent.
- Proportion of GDP derived from agriculture = 9.6 per cent (MAS 2004). The actual amount of water consumed by the agricultural sector is 90 MCM/year, so the agricultural consumption = 90/1020 = 8.8T%. U2 = 9.6/8.8=109 %= 100 %
- Proportion of GDP derived from industry = 14.7 % (MAS 2004).
- The Domestic and Industrial water consumption per capita in the West Bank 76 m^3/year (Abu Zahra 2001), therefore, the annual industrial and domestic water consumption is 180, 29 MCM/year, hence quantity of water consumed by industry = 108.88/1020 = 10.7 %. U3 = 14.7/10.7 = 131.21 %. U3 = 100 %.

Therefore,

$$\mathbf{U} = \frac{7+100+100}{3} = \mathbf{69.0\%.}$$

Environment (E)

Dissolved oxygen (DO), turbidity and *total dissolved solids* (TDS) were in compliance with WHO guidelines for drinking water. Average DO in the West Bank is 5.84 mg/liter, therefore, DO index is calculated as follows:

$$DO\,index = \left(\frac{DO}{1.2 * DO}\right) = \left(\frac{5.84}{5.84 * 1.2}\right) = 83.33\%$$

The maximum allowable TDS concentration according to WHO guidelines for drinking water is 1000 mg/liter. However, as TDS concentration increase, water quality is deterio-rated, accordingly, the TDS index is calculated as follows:

$$1 - \frac{Average\,value\ for\,TDS}{1{,}000 * 1.2} = 1 - \frac{501.2}{1200} = 58.2\%$$

The nitrate concentration was used instead of phosphorus, this is justified by the increa-sing concentration of nitrate in the ground and surface water as a result of pollution by wastewater from cesspits, cess pools and agricultural activities (such as fertilizers, pesticides and herbicides). The average nitrate concentration is 42.1 mg/liter (PCBS 2005). The highest allowable concentration for nitrate according to WHO guidelines is 50 mg/liter. Therefore, the nitrate index can be expressed as follows:

$$1 - \frac{Average\,value\ for\ NO_3^{\,-}}{50 * 1.2} = 1 - \frac{40.2}{60} = 29.5\%$$

According to WHO guidelines for drinking water, the maximum allowable concentration for turbidity is 5 NTU. In the West Bank, the average value for turbidity is 1.03 NTU; therefore, turbidity index can be expressed as follows:

$$1 - \frac{Average\,value\ for\,Turbidity}{5 * 1.2} = 1 - \frac{1.03}{6} = 82.83\%$$

Therefore:

$$E_1 = \frac{97.3 + 58.2 + 29.8 + 82.8}{4} = 67.0\%$$

The total agricultural land area = 1.65 Million dunums. Out of this quantity, 1.53 and 0.12 million dunums are rain fed and irrigated (PCBS 2003). Additionally, 96.6 per cent of irrigated land uses pesticides, while pesticides are used in 87 per cent of rain fed land. Moreover, the percentage of land using fertilizers/total cultivated land = 243,100/1,650,116 = 14.70 % (ARIJ 1997). Therefore,

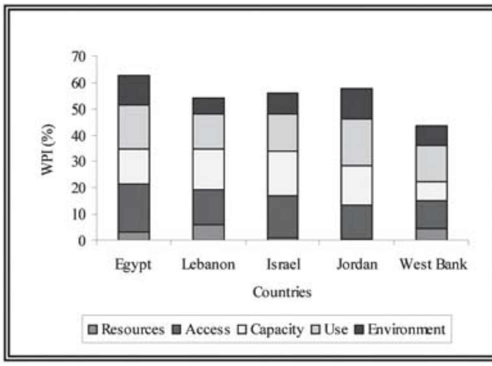
$$\rightarrow \mathrm{E}_2 = \frac{(87.70 + 14.70)}{2} = 51.2\%$$

The percentage of threatened mammals and birds are respectively, 5.3 (5/94) and 3.2 (12/378) % (PCBS 2003). Therefore,

$$\mathrm{E}_3 = \frac{(5.3 + 3.2)}{2} = 4.25\%$$

$$E = \frac{(E_1 + E_2 + E_3)}{3} = \frac{(67.0 + 51.2 + 4.3)}{3} = 40.8\%$$

Figure 34.1: WPI Components in the Neighboring Countries Compared to the West Bank. **Source:** Sulivan, J.R Meigh et al. (2003).



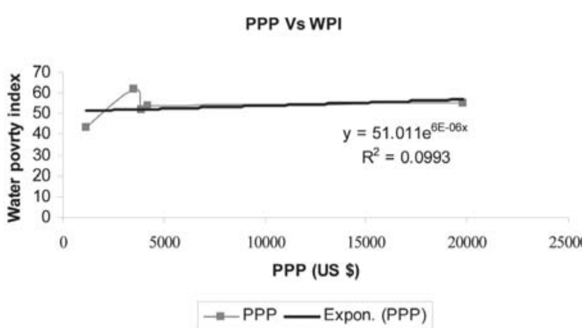
Country	R	A	C	U	E	WPI
Egypt[1]	3.	18.	13.	16.	11.	**61.9**
Lebanon	6.	13	15.	13	6	**53.8**
Israel[1]	0.	16.	16.	14.	7.5	**55.4**
Jordan[1]	0.	12.	14.	18.	11.	**51.9**
West	4.	10.	7.2	13.	7.1	**43.1**

Therefore, WPI-holistic with equal weighting is 44.2 per cent. However, as the water capacity and accessibility are the main reasons behind water stress in the West Bank, the weights of C and A were taken as 0.3 each. and the weights of U and E were reduced to 0.15 and 0.05 respectively. The corresponding WPI - holistic is 43.54 per cent. Palestine's WPI value makes sense when compared to WPIs of other countries. Four neighboring countries were selected and were compared to the West Bank in terms of WPI and components values, GDP, and Gini Coefficient.

Figure 34.1 shows that the water conditions in the West Bank are worse than those in the neighboring countries, knowing that water resources are similar when comparing the West Bank to Jordan and Israel.

Figure 34.2 shows the different GDP levels in the West Bank. The figure shows no correlation between WPI and the level of GDP. This could be ascribed to the limitation of accessibility to water resources.

Figure 34.2: Effect of Increase of GDP on WPI.



There are factors that are used in the calculations of the WPI that are highly dependent on the GDP which are the access and the capacity. Table 34.2 shows that the West Bank suffers from low access, and low capacity. In addition to the special conditions that characterize the West Bank and pose a sever water problem, the West Bank has other special problems such as:

- The increase in relative water scarcity;
- Water quality deterioration;
- Inter-sectoral and inter-regional water allocation conflicts;
- Poor cost recovery and operational performance, and
- Out-of-date institutional arrangements (Dinar/ Salteh 1999).

Table 34.2: Ranking of the West Bank with the Neighboring Countries in Terms of WPI Components.

WPI component	Highest	Lowest
Resources	Lebanon	Israel
Access	Egypt	West Bank
Capacity	Israel	Egypt
Use	Jordan	Lebanon
Environment	Jordan and Egypt	Lebanon

34.2.3 Future Water Situation in the West Bank

Three scenarios were selected to predict the future water situation in the West Bank as follows that assume no change in water resources (scenario 1), an increase in water resources and an enhancement of existing supplies (scenario 2), and improvements in the economical situation (scenario 3).

Table 34.3: Effect of Increase in Population Size on WPI Value for the Years (2005 to 2025). Agricultural and Industrial Demands were Assumed to be Constant Throughout the Tested Period.

Year	Population	Growth rate	Domestic water demand MCM/year	Domestic water consumption MCM/year	WPI %
2005	2,372,216	3.0	86.64	71.41	43.27
2010	2,736,899	2.7	99.94	81.58	43.21
2015	3,110,489	2.4	113.61	91.85	43.16
2020	3,451,099[1]	2.1	126.05	101.91	43.12
2025	3,773,082[1]	1.8	137.81	111.42	43.09

34.2.3.1 Scenario 1: No Change in the Water Resources

In the light of the population projection conducted by the PCBS (2005), the corresponding water demand is shown in table 34.3:

1: These figures were projected according to the population growth rate; the corresponding values for growth rate were calculated based on linear interpolation.
2: Demand is calculated depending on the WHO guidelines for minimum domestic water requirements.
3: WPI value according to weights given as follow: R,A,C,U and E equal to 0.2, 0.3, 0.3, 0.15 and 0.05 respectively

Population growth leads to an increase of water demand and consumption. This increase does not affect the values of WPI significantly due to the following reasons:

1. Agricultural and industrial demand were considered to remain constant
2. In the West Bank context, C and A are the main factors to affect the WPI rather than U and R.
3. Since the weights given to R and U were relatively low, 0.2 and 0.15 respectively, this resulted in a lower change in WPI.

34.2.3.2 Scenario 2: Increase in Water Resources: Enhancement of Existing Supplies

In this scenario the effect of increasing water resources on the WPI was assessed. For the purposes of this research, the increase in water resources is projected to be 100 *MCM* from Sea water desalination and external water resources with 50 *MCM/year* for each resource. As a result of the 100 MCM increase the available resources become 224.6 MCM. The increase in agricultural and industrial water consumption was not included in this scenario. Table 34.4 shows the results of increasing water resources by 100 MCM/year on the WPI .

Table 34.4: Values of WPI for the Years 2005, 2010, 2015, 2020 and 2025 After an Increase in Water Resources by 100 MCM/year

Year	WPI (%)
2005	46.85
2010	46.70
2015	46.56
2020	46.45
2025	46.34

By looking at table 34.4, the following can be concluded:

1. Due to the high increase in population, the increase in water resources did not have a significant effect on the value of WPI.
2. The WPI in the West Bank remained the least regionally (compared to Israel, Egypt, Lebanon and Jordan) after the 100 MCM increase in water resources.
3. Water resources change plays a minor role in affecting the WPI value; this is attributed to the low value of other WPI components.
4. The increase in resources is expected to create an increase in demand (supply push). Therefore, there will be a limitation for the positive shift in the WPI.

34.2.3.3 Scenario 3: Improvement in the Economical Situation

This scenario calculates the WPI as the GDP/capita changes. The current GDP/capita that is equal to $ 1051 and the GDP in the best case that was $ 2,500 in the year 1999. The effect of GDP variation on WPI values is shown in table 34.5.

Table 34.5: Effect of Increase in GDP/capita on WPI Value. Values of GDP/capita Were Taken According to the Worst and Best Cases Witnessed in the West Bank in the Years 1999 to 2005

GDP/CAPITA ($)	WPI (%)
1000	43.27
1051	43.27
1500	43.30
2000	43.34
2500	43.38

It is noticeable that the increase in WPI as GPD/capita increases is minor. This introduces the problem of the utilization of water resources. As the Palestinians do not have the accessibility to all water resources available due to the political barriers, the water conditions in the West Bank will not improve significantly unless Palestinians obtained full control over their resources and they were able to utilize them efficiently. Table 34.6 shows the values of WPI under the assumption of GDP/capita that equals $ 1051 and different cases of control over resources are available.

Table 34.6: Values of WPI for the Year 2005 Under the Assumed Condition of an Increase in Water Resources.

Condition	WPI %
Full control over Jordan river	52.55
Full control over ground water	63.52
Full control over 50% of ground water (due to the lost share to the Israeli usage of part of the existing water)	51.27

According to table 34.6, it is clear that the full control by Palestinians over their water resources will lead to the desired result of sufficient water resources. Further increase in WPI can be guaranteed if socio-economic and environmental conditions were enhanced.

34.3 Conclusions and Recommendations

The Palestinian water sector suffers from constant change in the political and socioeconomic factors and lack of access and capacity to their water resources. An increasing gap was found between water supply and water demand. Falkenmark's approach (286.20 m^3/C/yr) and the Water Availability Index (WAI = -0.39) showed that available and accessible water resources are not sufficient. In addition, the basic human needs index shows that basic needs of water are not achieved for many communities.

The conventional WPI approach showed that the values of availability, access and time were 22.49 per cent, 55.25 per cent, and 6.98 per cent respectively. The corresponding WPI value is 51.63 per cent. However, the WPI-holistic approach showed that the following values for R, A, C, U and E were found to be 22.50 per cent, 52.83 per cent, 36.00 per cent, 69.00 per cent and 35.36 per cent respectively. The corresponding WPI was found to be 43.14 per cent when equal weights were used (0.2). Finally, it was found that an increase of 100 MCM/year and/or GDP slightly shifts upward the WPI this is attributed to a lack of capacity and accessibility to water resources.

New water resources and local alternatives have to be introduced to bridge the gap between demand and supply. In addition, the proposed mega-projects will be unsustainable, politically unacceptable, and costly; and have a minimal effect on the improvement of the WPI. Moreover, the enhancement in environmental policies and awareness is recommended to shift the WPI. Finally, calculating the WPI at the community level is essential to develop policies based on accurate information.

References

Abu Zahra, B., 2001: *Water crisis in Palestine. Desalination Strategies in South Mediterranean Countries, in Desalination* (Laquaila-Italy), 136: 93–99.

ARIJ [Applied Research Institute Jerusalem], 1997: *The water conflicts in the Middle East from a Palestinian perspective* (Bethlehem, West Bank Palestine: Caritas ST).

Dinar, A.; Salteh, M., 1998: *Policy implications from water pricing experiences in various countries, in Water Policy* (London: Elsevier), 1: 239–250.

Falkenmark, M., 1989: "Fresh water–time for a modified approach", in: *Ambio*, 15: 192–200.

Feitelson, E.; Chenoweth, J., 2002: "Water poverty: towards a meaningful indicator", in: *Water Policy* (London, Elsevier), 4: 263–281.

Gallopin, G. C., 1997: "Part one. Introduction", in: Moldan, B.; Billharz, S.; Matravers, R. (Eds.): *Sustainability indicators: A report on the project on indicators of sustainable development* (Chichester: Wiley).

Gleick, P.H., 1996: "Basic water requirements for human activities: Meeting basic needs", in: *Water International*, 21,2: 81–192.

Jayyousi, A., 2000: *Localizing Agenda 21, Review of Chapter 18 of Agenda 21* (Nablus, West Bank, Palestine: An-Najah National University).

Lawrence, P.; Meig J.; Sullivan, C., 2002: "The water poverty index: an international comparison", in: *Keele Economic Research Papers* (Keele, Staffordshire, UK: Keele University, Department of Economics).

MAS [Economic Policies Research Institute], 2004: *Social monitor*. no 5, (Ramallah, West Bank: Economic Policies Research Institute).

Nuseibeh, M.; Nasser Eddin, T., 1995: *Palestinian fresh water spring: springs description, flow and water quality data 1970 – 1994.* (Jerusalem: Palestine Consultancy Group (PCG)).

Oslo B (Israeli – Palestinians Peace Interim Agreement), 1995: water section. Article 40 (Jerusalem)

PCBS [Palestinian Central Bureau of Statistics], 2003: *Agriculture statistics in the Palestinian territories*. (Ramallah, West Bank, Palestine: PCBS).

PCBS [Palestinian Central Bureau of Statistics], 2005: *Impact of Israeli measures on the economic conditions of Palestinian households*, *7th round.* (Ramallah, West Bank, Palestine: PCBS).

PHG [Palestinian Hydrology Group], 2002: *Pricing Policy, Willingness to Pay and Affordability in the West Bank* (Ramallah, West Bank, Palestine: Palestinian Hydrology Group).

PHG [Palestinian Hydrology Group], 2004: *Water for life, Israeli assault on Palestinian water, sanitation and hygiene during the Intifada*. *WaSH monitoring report* (Ramallah, West Bank, Palestine: Palestinian Hydrology Group).

PWA [Palestinian Water Authority], 2002: *Water Supply in the West Bank*, *Annual Report* (Ramallah, West Bank, Palestine: Palestinian Hydrology Group).

PWA [Palestinian Water Authority], 2003: *Water Supply in the West Bank*, *Annual Report* (Ramallah, West Bank, Palestine: Palestinian Hydrology Group).

Raskin, P.; Gleick, P.; Kirshen, P.; Pontius, G.; Strzepek, K., 1997: *Water futures: Assessment of long-range patterns and problems* (Stockholm: Swedish Environment Institute/United Nations).

Salameh, E., 2000: "Redefining the water poverty index", in: *Water Internationa*l, 25,3: 469–473.

Sullivan, C., 2002: "Calculating a water poverty index", in:. *World Development*. 30,7: 1195–1210. (London: Elsevier).

Sullivan, C.A.; Meigh, J.R.; Giacomello, A.M.; Fediw, T.; Lawrence, P.; Samad, M.; Mlote, S.; Hutton, C.; Allan, J.; Schoulze, R.E.; Dlamini, D.J.M.; Cosgrove, W.; Dellieriscoli, J.; Gleick, P.; Smout, I.; Cobbing, J.; Calow, R.; Humt, C.; Hussain, A.; Acreman, M.C.; King, J.; Malomo, S.; Tate, E.L.; O'Regan, D.; Milner, S.; Stey, I., 2003: "The water poverty index: development and application at the community scale", in: *Natural Resources Forum*, 27: 198–199.

UK, Department of the Environment, 1996: *Indicators of sustainable development for the United Kingdom* (London: Department of the Environment).

UNDP [United Nations Development Program], 2004: *Human Development Report 2004, Cultural Liberty in Today's Diverse World* (New York; UNDP)..

World Bank, 1997: "Resident mission in the West Bank and Gaza, water sector review workshop papers" (New York: UNDP).

35 Israeli Water Use Patterns: Resource Conservation and Transboundary Security

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Abstract

This chapter proposes that a successfully implemented water conservation management policy can play a role in Israel's ability to increase physical, human and environmental transboundary security. Fresh water reliability is critical to the security of any country, especially those which are arid and semi-arid in nature. In such regions annual rainfall is predictably unreliable and droughts are the norm. Thus, when water resources become additionally scarce due to compounding societal pressures, they may become a point of tension between riparian neighbors who find themselves in competition for increasingly scarce resources. Israel is tied by treaty, hydrology, and infrastructure to the water use of its riparian neighbors - Syria, Lebanon, Jordan and the Palestinians – and has some minor hydro-political ties to Egypt as well. As such, any analysis of Israel's water policy must consider domestic and transboundary security concerns.

Keywords: Environmental Security, Transboundary Water Resources, Hydro-politics, Water Conservation Policy

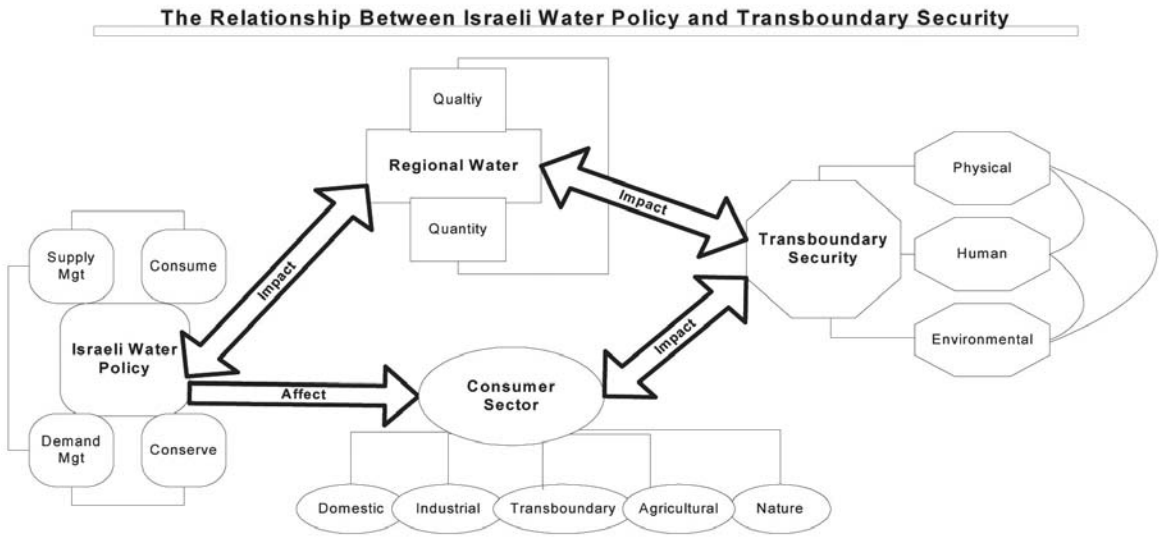
35.1 Introduction

Israeli water use patterns are defined to a large extent by two water policy processes. The first is the domestic allocations made by the Water Commissioner and the second is the determination of international water sharing. Each year the Water Commissioner's office sets both allocations of water for consumer sectors, defined by *The Water Law* as *agriculture*, *industry*, *domestic* and *nature*, and for water withdrawal from sources to meet those consumer allotments. This process is somewhat political and can be responsive to consumer sector interest groups who work to pressure the government to increase their personal share of the water available for any given year.

As the Water Commissioner is supposed to guard the long-term sustainability of the quantity and quality of Israel's naturally occurring water resources, he is limited in his ability to allocate water based on the hydrological conditions that exist in any given year; thus he utilizes 'red lines' as a tool to define the minimum level any given water source is allowed to drop and still be utilized in a sustainable manner. However, in reality the 'red lines' have not been strictly kept and the country's naturally occurring water resources have been over utilized to the point of continual deficit. The Water Commissioner is also limited by the amount of water determined by politics, diplomacy and international relations as a transboundary resource belonging to Jordan, the West Bank and the Gaza Strip. Though the quantity of designated transboundary water resources is fairly stable, in any given year they may have more or less of an impact on the total water balance available depending on rainfall.

In times of drought Israel tends to focus on conservation, as well as supply and demand management; however in the absence of drought conservation was traditionally downplayed. Recently, however, the Water Commissioner's office has looked toward long-term planning for sustainability of water resources in

Figure 35.1: Analysis of the Impact of Israeli Water Policy on Transboundary Security



Israel, supplemented by the production of additional non-naturally occurring water resources to meet consumer needs. Regardless of whether the water in question is naturally occurring, created, or imported, Israel is inextricably linked to the populations surrounding it.

Syria and Lebanon, which border Israel to the north and east provide the headwaters for Israel's main sources of fresh water – the Kinneret and the Mountain Aquifer. Jordan, which makes up most of Israel's eastern border along the Jordan River, is provided with approximately 50 mcm of water per year under the countries' peace treaty. The Palestinian Territories of Gaza and the West Bank sit on top of large parts of the Coastal and Mountain Aquifers and are serviced to some extent by Mekorot, Israel's water company. It is these links that make all Israeli water resources essentially transboundary. Therefore any Israeli water policy, whether based on conservation, consumption, supply side management or demand side management has a transboundary impact, and vice versa (figure 35.1).

Thus, conservation policy, which is focused on decreasing overall water consumption in Israel, maintaining and restoring water quality, and allowing naturally occurring water resources to flow along their natural courses outside of the boundaries of Israel can have an impact on transboundary security. Implementable water conservation policy for Israel would likely include a combination of technology to augment supply, carefully planned conservation measures and use restrictions to reduce demand and application of best practices in transboundary resource management.

35.2 Methods

Field research was conducted in Israel over a three and a half month period (May to August 2004) to answer the question: What is the relationship between Israeli Water Conservation Policy and transnational physical, human and environmental security? The methodology included conducting a series of qualitative semi-structured interviews with Israeli water elites and professionals (n=32) to develop a description of Israel's current water policy in terms of its implications for human, environmental and physical security issues.

35.3 Results and Discussion

35.3.1 Definitions

The results of this study rely upon the assumption of several key definitions, which were adopted at the beginning of the research process and held to throughout the study:

- *Conservation Policy*: Formalized mechanism whereby a government implements programs designed to reduce consumption and waste in a sector in a manner that is sensitive to the total human ecosystem.

- *Water Conservation*: The protection of naturally occurring water sources.
- *Physical Security*: Safe from harm, risk or loss, as contrasted with harm, risk or loss of life or destruction of material objects or structures.
- *Human Security*: Free from anxiety or doubt, confident, as contrasted with breakdown of political and or social systems or culture.
- *Environmental Security*: Not likely to fail or give way, stable, as contrasted with degradation or eradication of ecological systems.
- *Transboundary Resources:* Naturally occurring movement of a natural resource across the borders of more than one state or country.

35.3.2 Background

35.3.2.1 Brief History of the Use and Structures of Water in Israel

Israel was founded on a strong Zionist belief in making the 'desert bloom' and turning the state's Jewish population into self-sufficient primarily agricultural people who did not have to rely on the good graces of its hostile neighbors, or on a world that had just allowed the atrocities of the Holocaust to occur, for any critical resources. Of course, in order to accomplish this, the state needed a consistent and controlled supply of fresh water resources to meet domestic, agricultural, and industrial needs. This was a complicated matter due to Israel's arid to semi-arid Mediterranean to desert climate. In such an environment drought cycles are the norm and there are intermittent periods of above average rainfall.

It is the rainfall, occurring primarily in the winter months, which provides most of the naturally occurring water in Israel. This naturally occurring water flows through the Dan (occurring in Israel), Hasbani (occurring in Lebanon) and Banias (occurring in Syria and Israel) Rivers to accumulate in the Kinneret and runs south down the Jordan River (which forms the border between Israel and Jordan) to its natural output, the Dead Sea and recharges the country's two aquifers, the Coastal Aquifer, which sits under the coastal plane between Haifa and Gaza and the Mountain Aquifer which sits primarily under the West Bank and the Northern Negev. The north of Israel is typically the wettest and hosts the majority of the country's natural water sources. Because of this, the young state invested heavily in channeling the resources south as part of what is today known as the *National Water Carrier* (NWC), tapping natural springs and developing wells and pumping stations to harvest the aquifers. Fresh water reliability is critical to the security of any country, especially in those which, like the Middle East, are arid and semi-arid. Furthermore, natural water systems in such regions are frequently transboundary which can result, without good management in the benefit of one State at the expense of others which frequently leads to international tensions. For Israel and her neighbors, this has been the situation for over half a century.

35.3.2.2 Structure of Israeli Water Policy

Within Israel the guiding water legislation is *The Water Law*. Adopted in 1959, it provides that water resources are public property and cannot be privately owned, but that persons can have water allocated to them under a centralized prioritization system. *The Water Law* also assures that a sufficient quantity and quality of water will be allocated to all users by the Water Commissioner, who is currently situated within the Ministry of Infrastructure.[1] The Israeli government is further authorized to take steps to prevent water pollution, deal with scarcity and determine what sectors are the most important to provide water resources to.

According to documents provided by the Water Commissioner, which were written in 2002, "National water planning is, consequently, based on maximum water conservation, optimum management of water resources and careful water allocation". It is important that *The Water Law* includes the principle that consumers of water should be involved in the allocation system, thus providing the opportunity for strong interest group influence on water policy.

1963 saw the addition of *The National Parks, Nature Reserves and National Sites Law* which created the legal mechanism for a state-run system of National Parks and Nature Reserves to be managed by the Park and Nature Reserve Authority. Shortly thereafter, in 1965 Israel passed *The Streams and Springs Authorities Law*, creating the Stream Authority which was charged with preserving the landscape and nature

1 Until summer 2004 the Water Commissioner allocated water for *domestic*, *industrial* and *agricultural* uses. In 2004 the Water Law was amended to include *nature* as a consumer. All transboundary water allocations are determined by political and diplomatic processes which occur outside of Israel's legislative and water-oriented government processes. Thus, the discussion below is only relevant for the historic responsibility of the Water Commissioner to allocate among domestic, agricultural and industrial consumers by region.

of streams and springs for gardens and recreation for all areas outside of the national park and nature reserve system. There are three other primary government entities involved in Israeli water management. The Ministry of Environment has the authority to enforce environmental standards to prevent pollution to water resources. Mekorot, a government-owned company that builds and operates the National Water Carrier system, supplies most of the water to Israel and some to the Palestinians at a cost set by the government. Tahal, a government-sponsored engineering institute, traditionally acted as the country's water planner and information collector.

35.3.2.3 Understanding Water Security in the Middle East

If security, "is about the ability of states and societies to maintain their independent identities, as well as their physical and functional integrity" (Gleick (1993), then water security can generally be thought of in terms of maintaining a reliably adequate quantity and quality of resources for any given need. It becomes obvious that these needs are met when there is environmental, human and physical security, which will be able to occur when society is able to have the ingenuity to deal with unexpected, as well as expected, circumstances such as drought or other disasters which alter the reliability of available water resources (Homer-Dixon 2001).

Physical security issues may arise where there are limited resources that "can be easily exhausted or degraded" and are shared between and/or among states (Brunee/Toope 1997). Because of the nature of such resources, like water in the Middle East, peaceful cooperation between neighbors may cease to occur and potentially "hostile interstate relationship[s]" may be the replacement relationship (Gleick 1997). Where this hostility becomes actual aggression there is a legitimate hydro-political conflict. Though this is a rare occurrence, Postel and Peterson (1996) show how conflict most frequently arises between any two countries over natural resources, such as water supply under one or more of the following scenarios: 1) depletion or degradation of a resource (shrinking pie); 2) population growth that forces the division of the resource (smaller pie slices); or 3) unequal distribution (varying sizes of slices). In the Middle East this is recognized most readily in the Jordan River watershed where there is not enough water for the entire demand of the basin and political tensions between riparians of the basin arise, at least partially, because of this water crisis. Such tensions and hostilities may, in certain circumstances, lead to a direct threat of loss of life or destruction of the built or natural environment. A further threat to physical security in the region is the potential for "damage to or destruction of a nation's water supply and water quality infrastructure by terrorist attack [that] could disrupt the delivery of vital human services, threaten public health and the environment and cause loss of life" (Copeland/Cody 2002). This may involve a breakdown of technical and technological systems which contribute to the functionality of society.

Human security relates directly to the stability of social systems, government structures and the way of life of a culture or population. At its worst, human security situations involve mass migrations, as people flee a place because it has become unfit for human habitation due either to conditions related to physical conflict, ecosystem changes due to other activity, or naturally occurring processes which cause lack of sufficient supplies of water for food production, sanitation and direct consumption (Postel/Peterson 1996). At best, a lack of human security can significantly reduce the policy options available to a government (Brunee/Toope 1997). Thomas Homer-Dixon (2001) has considered this in terms of an "ingenuity gap," which occurs when a society cannot adjust to environmental stresses which may cause additional societal breakdowns such as riots and insurgency. This is an issue in the Middle East because it is questionable whether the minimum water requirement as defined by the Helsinki Rules, of 125 m^3/ person/day, defined by Hillel Shuval (1993) as essential for human survival in a developed state, can be met for even the current regional population. The region's water shortage is compounded by the externalities of agricultural, urban, and industrial development which cause negative effects on the region's water quality.

Environmental security is the basis for both human and physical security. In the Middle East this is an issue because the water quality problems when combined with the over utilization of naturally occurring resources are contributing to diminishing aquatic ecosystems which assures, as posited by John Lyle Tillman (1985), an unsustainable human ecosystem. Examples of this in Israel include the decline of the Dead Sea, the potential eutrophication of the Kinneret due to overloading of nitrates, the Kishon and Yarkon Rivers' toxicity and the pollution of aquifers. When aquatic ecosystems breakdown in an arid or semi-arid region in this way because of water quality problems related to the presence of bacteria and toxic materials and unsustainable harvesting, the remaining quality and quantity of water make it impossible to rely on what are known as "intergenerational resource transfers" (Allan/Mallat 1995). Where the resources in question are transboundary in nature the environmental security issues will inevitably become transboundary as well and lead to problems that are not always predictable (Brunee/Toope 1997). To avoid such a situation, as pointed out by Allan and Mallat (1995), it is necessary to find a way to optimize water resources for the welfare and security of maximum environmental, or natural, which would be capital for the entire population relying on those resources now and in the future.

35.3.3 Balancing the Water Checkbook in the Middle East

Reliable and sufficient fresh water resources are perhaps the most critical aspect of the Middle East's ability to support the human environment. The resource, however, is limited in its naturally occurring quantity, thereby placing natural controls on the carrying capacity of the region given population and development. The total impact on the natural resource can be analyzed in terms of the equation *Impact=Population*Affluence* Technology* (I=PAT).[2] Thus, to predict the conditions which will define naturally occurring water resources in the Middle East at any given time one can aggregate population projections and development indicators such as GDP/capita and technological and industrial advancement.

There are two ways to consider the water needs of the population relying on the transboundary resources in question; one is to consider sustenance level survival, which the World Health Organization has determined as 20 to 50 liters per day per person depending on climate and geography. Most indicators assume, however, that Southern Lebanon, Syria, Jordan, the Egyptian Sinai, Israel and the Palestinian Territories can all expect population growth and economic and technological developments in the coming decades. Thus, the other predictor considers the high standard of living desired for the region, a condition which puts the need for water somewhere around 125 m^3 per year per person (see chapter 1 by Shuval in this book). Thus, to meet the basic needs of the current population of about 14 million people, now, a minimum of 280 million liters of water a day is required. At the point when regional population has increased and the Middle East realizes its predicted economic and technological development potential, it will be more realistic to expect a need of 3,750,000,000 m^3 of water per annum.[3] Even if this projection turns out to be an exaggeration, as estimated by some in the region, the amount of water needed to sustain a developed population of the current size will overdraft the available natural resources and cause a great deal of competitive pressure between and among consumers of water. This pressure will only be increased as the water quality in the region continues to deteriorate and become more polluted and saline. This not only makes the water resources more expensive to consume, as salinity requires desalination prior to most consumptive uses and pollution requires treatment, but also decreases the balance of reliable fresh water resources available for some consumers.

35.3.3.1 Water Balance of the Region

Though precise quantities of naturally occurring water resources are difficult, if not impossible to quantify over the long run, it is possible to make projections based on averages. These averages provide a base-line in the region for long-term planning which is intended to guide regional water policy decisions. In Israel, the generally accepted yearly available bank of renewable water resources, or water that is expected to be recharged by rainfall rather than the total sum of quantities existing at any given time in the state, can be thought of in terms of its relationship to a 'red line'. In the public consciousness in Israel the 'red line' is equivalent to the minimum level that the government, in its management of the most highly visible public water resource, can allow the Kinneret to drop. This point, as set by government hydrological experts, is supposed to assure the sustainability of water quality, whether salinity or pollution.

For the major sources of water, the quantity of renewable water resources can be seen in table 35.1. Water security in Israel can thus be defined in terms of a stable and reliable quality and quantity of naturally occurring water resources that does not exceed the renewable quantity and quality of water. This security includes planning, over the long-term, for the demands of each consuming sector the country is responsible

2 I=P*A*T was originally posited by Paul Ehrlich and has been widely used as a method for assessing environmental problems. Water in the Middle East is considered an environmental problem in this chapter.

3 This is based on population projections provided by Arnon Soffer, Faculty of Geography, University of Haifa.

for serving and considering the additional regional resources affected by these water policy choices. In contrast, water insecurity in Israel can be defined in terms of deficit consumption to serve the demands of consuming sectors. This type of sustainable use allows for an increase in transboundary security because it contributes to mutual understanding of the reliability of shared water resources. Thus, planning for use of only the amount of naturally occurring water as available that is replenishable is an advantageous policy for Israel to adopt.

Table 35.1: The Long-term Potential of Renewable Water.

Resource	Replenishable Quantities (MCM/year)
The Coastal Aquifer	320
The Mountain Aquifer	370
Lake Kinneret	700
Additional Regional Resources	410
Total Average	**1,800**

Israel's internal planning and policy process however is only as important as its actual implementation of that policy and at this point does not give an accurate accounting of the condition of regional water. When water availability is considered in terms of groundwater withdrawal and pollution loads, Israel has the highest level of pollution in its available fresh water in the region and is among the highest consumers of groundwater, but ranks only fifth in terms of water availability per capita as measured by the average surface runoff and groundwater infiltration created by rainfall. Jordan, to whom Israel supplies a quantity of about 50 mcm of water from the Kinneret each year, faces a similar problem with water resource sustainability, as do the Palestinians.

35.3.3.2 Water Balance as Affected by Israel

Water management, whether domestic or transboundary, that is aimed at reducing the issues involved with unsustainable water consumption and natural resource quality issues can be approached from two angles; the first is to increase the supply and second is to reduce the demand. On the supply side, Israel has plans to construct large-scale desalination plants on the Mediterranean Coast and to purchase fresh water from Turkey. In addition, as pointed out by Yoav Kislev (2001), the country

> has imported virtual water for a number of years in the form of grains and other foods. By recent estimates, 55 per cent of the water used in households and industry is returned as sewage. Eighty per cent of the sewage is now collected and treated. Reclaimed water adds 30 per cent to fresh water used in agriculture. This ratio is expected to increase both as the allocation of potable water to farm use is decreased and as sewage collection and diversion of recycled water to agriculture intensify (Kislev 2001:).

Israel's water resources must be allocated among *domestic*, *agricultural*, *industrial*, *transboundary* and *environmental* consumers. Israel's policy considers demand management of each of these sectors under a national water policy planning and implementation process and to avoid balancing the water deficit. To date this planning process leaves each sector with varying, and sometimes unpredictable amounts and/or quality of water allocated each year (table 35.2).

Table 35.2: Water Allocation by Sector. **Source**: This was compiled by the author after looking at the entire set of research, including a series of qualitative interviews, on Israeli water policy. This is a constructed summary of description of water types.

Sector	Percent of Total Allocation	Description
transboundary	2.3	fluctuates based on peace negotiations
domestic	34.9	fixed pp in price, quantity and quality
industry	11.7	fixed price, and small % quantity, quality fluctuates
agriculture	54.1	fluctuates in price, quantity, and quality
nature	unknown	fluctuates in price, quantity, and quality

In 2002 the demand side of the water equation began to shift (Water Commissioner 2002). For the first time a national move to reduce consumption was considered when Israel had accumulated a deficit of 2 billion m3, at the rate of approximately 85 mcm per year, of naturally occurring water resources. Remarkable was a shift from agricultural allocation priorities to domestic and industrial (Water Commissioner 2002a). In 2001 a document outlined water allocation based on consumption and quality of water as it existed in 2001 with projections to 2010. Amazingly, this projection took into account water consumption by nature and landscaping, though The *Water Law* was not yet amended to consider nature as a consumer. These documents acknowledge an increasing need for water resources in Israel and take into account long-term planning for the manufacture of water through desalination. The Water Commissioner's hope is to move from deficit to water surplus, despite the projection of a 18 per cent population growth in the country and the commitment of water for *nature*.

The projected water supply was determined through Israel's internal planning processes, which is notable because the resource to population growth projection does not take into account regional growth. This may limit the reliability of the model somewhat, given Israel's hydro-geological and geopolitical ties to the populations immediately surrounding it. Without looking at regional population and development, it becomes difficult to be certain about the reliability of available naturally occurring water. This is true both for the resource needs of Israel and those of the rest of region. It is questionable whether Israel fully takes account of regional demographic and hydro-geologic realities in its supply and demand projections, but the country reflects at the planning level the principles of sustainability.

35.4 Conclusions

Water conservation includes both careful and sustainable resource use and environmental awareness. In Israel there is a strong water conservation ethic in the publications of the Water Commissioner which contain Israel's long-term water planning. This consists of at least three conservation philosophies. The *first* is to save water to avoid a crisis, the *second* centers around intergenerational equity and the *third* is to protect nature because it has a right to exist. While these ideas are not necessarily mutually exclusive, they are not equally shared by the Israeli population and they do not necessarily form the basis for a comprehensive *water conservation* policy that is actually implemented. As an official in the Water Commissioner's office described the publications, as "plans, not policies." To determine what Israel is actually doing to institute a water conservation policy, each sector must be evaluated individually. Water policy in Israel is focused on *domestic* and *industrial* sectors, while *agriculture* and *nature* are seen as more flexible in allocation.

With regard to nature. The *Water Law*, with its mandate for sustainability, has not yet begun to be implemented; however, if implemented in a thoughtful way this amendment could perfectly represent all three conservation philosophies, thus representing the interests of its population. In addition, the more water that is allowed to flow through its natural water course, thereby being allocated to nature, the healthier the aquatic systems will be which contributes to the perpetuation of these natural systems. It is anticipated that nature will be treated like any other customer and will see a yearly fluctuation in price, quality and quantity of water based on the hydrological conditions at the time. Domestic per capita water consumption has been rising in Israel as the population grows

Israel has taken some significant steps toward water conservation and decrease in consumption, especially in dealing with *agriculture*, which is meant to lead toward a balance between water availability and water allocation. This is important because a reduction in Israel's water deficit increases the amount available to other uses which could include transboundary uses, thereby increasing the water-based security of the region.

References

Allan, J.A.; Mallat, Chibli, 1995: *Water in the Middle East: Legal, Political and Commercial Implications* (London – New York: : I.B. Taurus).

Brunee, Jutta; Toope, Stephen J., 1997: "Environmental Security and Freshwater Resources: Ecosystem Regime Building", in: *American Journal of International Law*, 26,19 (University of Kassel, Center for Environmental Systems Research, WaterGap 2.1 – Waashington, D.C.: World Bank); at: <http://www.nationmaster.com/graph-T/env_wat_fre_pol/MID#>.

Copeland, Claudia: Cody, Betsy, 2002: "Terrorism and Security Issues Facing the Water Infrastructure Sector". *CRS Report for Congress, Resources, Science and Industry Division* (Washington, D.C.: CRS).

Glassman, Hillel, 2002: "The Right of Nature to Water" [in Hebrew], in: *Water and Irrigation:* 422.

Gleick, Peter, 1993: "Water and Conflict", in: *International Security*, 18,1 (Summer): 79–112.

Gleick, Peter, 1997: "Water 2050: Moving Toward a Sustainable Vision for the Earth's Freshwater". *Working Paper of the Pacific Institute, Prepared for the Comprehensive Freshwater Assesssment of the UN General Assembly* (Oakland, CA).

Homer-Dixon, Thomas, 2001: *The Ingenuity Gap: Can we solve the problems of the future?* (London: Random House).

Kislev, Yoav, 2001: "The water economy of Israel". Prepared for Water in the Jordan Valley: Technical Solutions & Regional Cooperation (Norman, Oklahoma: University of Oklahoma, International Program Center, Center for Peace Studies).

Lyle Tillman, John, 1985: *Design for Human Ecosystems: Landscape, Land use and Natural Resources* (New York: Island Press).

Postel, Sandra; Peterson, Jane A., 1996: *Dividing the waters: Food Security, Ecosystem Health, and the New Politics of Scarcity* (Washington, DC: Worldwatch Institute).

Shuval, Hillel, 1993, "Institutional Aspects of the Management of Water Quantity and Quality on the Shared Transboundary Water Resources of the Jordan River Basin", in: *Proceedings of the International Symposium on Water Resources in the Middle East: Policy and Institutional Aspects*, Urbana, Ill: IWRA, 24–27 October.

Water Commissioner of Israel, 2002: *The water sector of Israel, confronting the challenges* (Tel Aviv: Water Commissioner of Israel, August).

Water Commissioner of Israel, 2002a: *Water in Israel, consumption and production,* 2001 (Tel Aviv: Water Commissioner of Israel).

36 Holistic Regional Approach to Water Management

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Abstract

The availability of adequate freshwater of appropriate quality has become a limiting factor for development, worldwide. The water requirement of all users can be satisfied by proper technical means such as water imports or relocations, desalinization as well as proper prevention of pollution, remediation, clean-up and recycling; however, such measures if applied locally on an ad-hoc basis as an emergency procedure may impose an unbearable and unjust economic burden on some of the stakeholders and not necessarily those responsible for the problem. Such a situation is in all cases a pretext for discord and assignment of blame on those supposedly responsible for the deterioration of the water quality. The potential for friction is especially high under a trans-border situation. It is now recognized that the rational, equitable and economically advantageous utilization of water resources must encompass the total watershed if not the whole regional water cycle. Since all stakeholders have a common dependence on the same water resources, water management can then become an inducement for regional co-operation.

Keywords: Groundwater; surface water; trans-border resources; water quality.

36.1 Introduction

The availability of adequate freshwater has become a limiting factor of the quality of life, worldwide. More than the water availability per-se, the issue is often the quality of the water resources for the supply of potable water.

In semi-arid and arid regions water scarcity has always been a dominant problem and thus a cause for rivalry. Moreover, the interference with the natural hydrologic cycle as a result of over-exploitation of both surface and ground waters and of changes in land usage resulted not only in the reduction of the available water amounts but also in the deterioration of the water quality due to pollution from urban, industrial and agricultural practices and salinity build-up in soil and water. One is concerned with the salinity buildup in the aquifers in general, as the chemical composition of this salinity limits the utilization of the water. Moreover the presence of anthropogenic pollutants introduced by activities near the replenishment sites of the aquifers are another concern. Such a situation is in all cases a pretext for discord and assignment of blame on those supposedly responsible for the deterioration of the water quality, especially in view of the possible high cost and technical complexity of the measures that need to be taken for remedying and alleviating the situation. Under a trans-boundary situation the potential for friction is especially high when one party controls the upstream recharge areas and the other the downstream discharge sites.

The optimal and sustainable exploitation of the natural water resource and the preservation of its quality under a regime of development, possibly also its amelioration by preventive measures and clean-up operations, all require the joint planning, management and operation of the water resource by all stakeholders in the upstream recharge areas, the downstream discharge sites and by the population which utilizes the water (Haddad/Feitelson/Arlosoroff 2000).

Obviously, the prerequisite for rational action, free of discord, is a scientifically sound analysis of the geohydrological and bio-geochemical structure of the water sources. This should be based on a detailed monitoring network and an accepted hydrological model that should also account for the pathways of the chemical components and possible pollutants in the system. Further, the options for remediation of the system and their economic evaluation need to be recognized. This will permit to launch the required preventive measures and the cleanup operations for the continued sustainable operation of the water resources with an objective and clear understanding of the responsibilities and requirements of all partners on the water resource and the economic burden imposed by the alternative management options.

36.2 Water Resources of the Region and their Consumers

In the Middle East the climate ranges from semi-arid to arid, the latter extending over the southern (desert) regions and in the inland valleys, notably the southern Jordan valley. The region is characterized by large geographic and temporal disparities of the precipitation distribution, with relatively large annual amounts of precipitation in the higher mountain regions of the Galilee, Lebanon and Mt. Hermon and the longitudinal mountain chains of Samaria, Judea and (trans-) Jordan and much smaller amounts in the lowlands, rapidly decreesing towards the south. The Mediterranean climate further imposes a sharp seasonality in rainfall with a long rainless summer period devoid of any water inputs into the hydrologic systems, only slightly shortened by snowmelt waters in the northernmost part of the area. A relatively variable regime, with alternating drought and excessive rain periods further acerbates the situation.

The precipitation regime, coupled with the morphological structure of the area which is dominated by the feature of the Syrian – East Africa Rift, results in aquifers recharged predominantly at more elevated outcrops and draining to the west or east, discharging as small springs or subsurface outflow. The only major surface water system is presented by the Jordan River that channels the water excesses of the north southwards into the Rift Valley, finally to waste away in the Dead Sea under the beating sun in the arid desert.

From the dawn of history the pattern of human settlements was influenced by the availability of drinking water, with the location of preferred sites near the emergence of springs, along the course of a river or wherever shallow dug-wells encountered fresh underground water. As a rule, this dictated rather low-lying locations far away from the headwaters of the hydrological systems concerned, including places to which water could be conveyed by gravitational flow in aqueducts. The early settlements at higher elevations, which were preferred because of their security, milder climate and freedom from insect-borne diseases, had to rely on collected rainwater stored in cisterns or on small local springs. Such settlements were necessarily of limited size and extremely vulnerable in periods of drought.

The advent of mechanized pumping and deep drilling techniques made possible the increase and spread of anthropogenic activities further away from the visible sources of water. This enabled, on the one hand, the increase of the population in the mountainous areas, resulting in changes in land use and urbanization on or near the headwater of rivers and the sites of groundwater recharge thus causing interference with the natural replenishment regime and the introduction of pollutants. On the other hand, it encouraged the large-scale cultivation of the arable lands in the coastal plain and the inland valleys and of the more arid lands in the south. Since all of these are based on irrigated agriculture they required the supply of huge amounts of water; this then resulted in an increasing over-exploitation of the groundwater sources and the transport of water from the sources in the north, culminating in the *National Water Carrier* which transports water from the Sea of Galilee to the coastal plain and the northern Negev. These developments, often performed with best intentions but in violation of proper eco-hydrologic guidelines, resulted in widespread negative environmental impacts (table 36.1).

36.2.1 Surface Runoff Systems

The Jordan River System which includes the only fresh inland lakes, namely Lakes Kinneret and Hula (also known as Lake Tiberias or Sea of Galilee and Waters of Meron, respectively) is of an endorheic nature. Along the coast, rather short perennial rivers are fed primarily by springs draining the mountain aquifers and finally discharge into the Mediterranean Sea. In the arid regions of the inland valleys and the Negev, ephemeral flood-flows in dry-river beds (wadis) are the major surface water features; these play a crucial role in desert hydrology.

Table 36.1: Anthropogenic Effects on Aquifer Quality

1. Land use changes that affect the natural water balance and the rate and location of the groundwater recharge flux;
2. Introduction of chemical and other noxious materials on the surface or into the subsurface, in the pathway of the recharge waters;
3. Water extraction that affects the pressure distribution, flow rates and pathways in the aquifer;
4. The application of water inputs additional to the precipitation, such as irrigation water, sewage effluents or water imports, especially during the dry season;
5. Changes in the microclimate, affecting the water balance and/or the precipitation regime.
6. Effects on the self-cleaning capability of the system by microbial or chemical remediation processes.

Apparently plentiful and immediately accessible, the perennial rivers are being exploited excessively for activities along the banks of the rivers and lakes. They are also diverted to regions outside the natural borders of their respective watersheds. When river systems have widely fluctuating discharge, they become a common concern for water managers. This results in regulatory control measures, which in turn may affect the natural attenuation capacity of the overflow bank areas and the construction of storage facilities. Of special concern is the extreme vulnerability of the river systems to the flowing of surface contamination into the river following strong rain events, acerbated by the release of sewage or irrigation return flow following utilization in domestic, industrial or agricultural activities, an effect seen even under humid conditions (e.g. Martinelli/Gat/De Camargo/Lara/Ometto 2004). The apparent excess of the running water feeds the illusion of quasi-infinite flushing capacity and encourages the lack of concern with adequate pollution control.

In the Jordan River Basin a few additional factors are detrimental:

- the drainage of the Hula wetlands which results in the release of excess nutrients (especially of nitrates) and probably also further accentuates the seasonal fluctuations of the flow;
- the location in a deep Rift Valley with abundant remnant salinity, which results in increasing salinization of the waters along the river course;
- the damming of Lake Kinneret and curtailment of flow into the lower Jordan, especially during drought periods.

In the arid drylands the ephemeral flows are an integral link in the chain of formation of the local groundwater, as discussed below. Any interference with these flows thus affects not only the downstream users of the surface water but also the groundwater resources. Due to the episodic and intermittent nature of the phenomenon it serves to flush all surface accumulated materials, including saline residues of evaporation ponds, and thus these flows have a high pollution potential (Gat 1980).

36.2.2 Groundwater Systems

Groundwater is the major resource of fresh water in the region, serving the double function of water conduit and storage reservoir, compensating for the seasonality of the precipitation input. Groundwater was once thought to be relatively immune to the deterioration by anthropogenic activities when compared to surface waters, based on its natural remediation capacity, thus constituting a safe reserve for freshwater supply. One is learning, however, that it takes just a little longer before the full impact of the deterioration of the overtaxed aquifers becomes apparent. Four different aquifer types are discussed:

- the *mountain aquifers*, recharged at the higher elevations of the mountainous backbone in Judea, Samaria, the Galilee and the Carmel Ridge and then draining in a confined manner through limestone layers to the lower elevations in the east, south or west (see for example Harpaz/Haddad/Arlosoroff 2000);
- the phreatic *coastal aquifer*, that underlies the coastal plain extending from Lebanon to the Sinai coast. This aquifer drains naturally underground into the Mediterranean Sea;
- the deep Nubian *sandstone aquifers* of the Negev and Sinai, filled with palaeo-water.
- *aquifers recharged along the river beds*, especially by the flashfloods in the arid zone.

36.2.3 Mountain Aquifers

The following human interference with the mountain aquifers exist,

- an over-exploitation resulting in salinization by enabling encroachment of adjacent saline water bodies and in the curtailment of spring discharges which affect the flow in the rivers, especially their supposedly-stable base-flow component;
- widespread contamination of the headwaters of the aquifers as a result of the appreciable urban development on the mountainous recharge areas

of the main groundwater aquifers of Judea and Samaria, mostly without an adequate infrastructure for effluent treatment.

The interference occurred both in the headwater region of the aquifer in the mountains through hindrance of the natural recharge pathways and the exploitation of the water table region, as well as excessive pumping from deep wells in the downstream locations. Attempts to make up for the incurred water deficit by recharge of intercepted surface water during the rainy season improved the water balance to some extent, but resulted at times in water quality problems. Artificial recharge of imported waters from the *National Water Carrier* as a means to utilize the aquifer as a seasonal storage reservoir also affected the water quality of the aquifers due to the higher salinity of the extraneous water.

36.2.4 Coastal Aquifer

Situated beneath the most populated and intensively cultivated portion of the region and being of a phreatic nature, it is not surprising that the coastal aquifer shows the most severe environmental impacts. First there is widespread salinization due to water extraction by pumping in excess of the natural recharge resulting in the lowering of the water table, thus enabling encroachment of either seawater from the west or of saline groundwater from the east. Next is the contamination of the recharge flux by industrial, domestic and agricultural practices. Further, the blocking of much of the surface for infiltration by urbanization adds to the negative water balance.

The steps taken for making up for the water deficiency and for correcting this situation over the years consisted at first in channeling excess water into the region and recycling of treated urban effluents, mainly for irrigation purposes and only secondarily as a recharge flux to the over-exploited system. An ambitious recharge scheme of creating an artificial water mound along the coast in order to prevent the seawater incursions necessarily resulted in stopping the natural underground discharge of the aquifer into the sea and thus created in practice a semi-closed hydrologic system without outflow in which the salinity accumulates in the soil zone under the irrigated fields from year to year, to be flushed into the aquifer during the occasional wet rain-year. The saving grace of the coastal aquifer is that water flow in it proceeds along relatively short parallel paths, more or less perpendicular to the shoreline, so that there is little interference and cross-contamination in the north-to-south direction. This results in a situation in which parts of the aquifer have been preserved in a reasonably pristine state.

36.2.5 Arid Zone Aquifers

The hydrology of arid areas (drylands) differs considerably from that of more humid environments (CWST 2000). Due to a negative water balance the precipitation amount is usually not sufficient to overcome the water deficit in the surface that results from evaporation during the dry periods. As a result, direct infiltration and local groundwater recharge is rare. Any substantial groundwater recharge can materialize only following the accumulation of an appreciable water depth from surface runoff at a potential infiltration site (Schoeller 1959) and by bank infiltration from rivers originating outside the arid region. The most important aquifer systems in the Negev and Sinai Desert were recharged in the past during wetter periods (paleo-waters) and their utilization constitutes a ‘mining’ operation since replenishment by recent recharge is minimal.

36.3 Considerations for a Sustainable Water Supply

Due to the long period of uncontrolled operation and development, the occurrence of accidental spills as well as natural calamities such as a period of drought years, many of the water resources have deteriorated to an extent that their utilization is curtailed as a source of potable water or for indiscriminate use for irrigating sensitive crops. In dealing with the situation for optimal benefits of all, one must distinguish between:

1. the present state of the aquifers and the measures to be taken for their remediation;
2. the operational changes to be introduced into the present system in order to prevent further harmful effects;
3. the planning of future developments in a sustainable manner.

All of these require a detailed monitoring of the ‘health’ of the aquifers (a baseline study) in order to identify the problem sites. Further, as complete as possible a hydrologic model of the aquifers has to be provided that spells out the transit times, mixing and flow patterns, in order to be able to predict the future dissemination of the salinity or pollutants under different operational scenarios.

Table 36.2: Actions to Guarantee a Sustainable Supply of Clean Water

Action	Evaluation of existing situation	Actions to be undertaken for *immediate* amelioration	Improvement in the water supply system for sustainability under a regime of growth and expansion [moderate expense]	Planning of new developments	Management strategies for continued safe operation under both routine and unexpected climate scenarios:
Measures	• Survey of existing supply, requirements and effluents (quantity/quality); • Estimating the 'safe yield, (quantity/quality)' of the water sources; • Monitoring the 'health' of available aquifers and future projection based on hydrological models; • Consideration of potential alternative water resources,	• Clean-up or desalination prior to distribution to supply system; • Education for improved 'water culture'; • Prevention of effluent release or clean-up prior to recharge; • Local 'pump and treat'	• Separation of 'clean' and 'dirty' recharge pathways (protected and sacrificial aquifers); • Establishment of sewage treatment plants and recycling of water for operations requiring marginal water quality; • Increased exploitation of local water resources (flood interception, deepening of drillings, dew and fog harvesting, brakkish water sanitation	• Provide detailed hydro-geologic model and its eco-hydrologic links; • Establishment of 'clean water protection zones' and natural refugios; • Educated siting of development projects in relation to recharge pathways; • Regionally optimized water supply and discharge scheme.	• Provide reserve supply and discharge options and storage capacity; • Flexibility in infrastructure with inbuilt controllable redundancy; • Preference of regionally integrated varied local schemes to grandiose projects, which are less adaptable to changes in climate and technological advances; • Operate detailed monitoring regime for 'advance warning'.

Possible strategies for dealing with the deterioration of the water quality and the continuing supply of fresh water can then be considered. These are

- Prevention of release of contaminated water to the environment;
- Clean-up of effluents before discharge;
- Separation of 'clean' and 'dirty pathways of recharge (distinguish between protected and sacrificial systems;
- In-situ natural or enforced remediation (e.g. by reactive barriers);
- Pump, treat and recharge of treated water;
- Treatment and clean-up at pump head prior to distribution to consumers;
- Replacement, dilution or flushing by imported water.

The choice of the options adopted is dictated by the nature of the pollutant, its dissemination or containability, economic consideration as well as societal and ethical concerns. As an example of the latter, the choice of sacrificial aquifers (which is often the cheapest and easiest one to take) is unacceptable when both possible impacts on natural systems and the interest of future generations are taken into account.

The management options in each of the stages of development and planning are summarized in table 36.2. The water requirement of all users can obviously be satisfied by proper technical means such as water imports or relocations, desalinization, as well as proper prevention of pollution, remediation, clean-up and recycling. However these measures, if applied locally on an ad-hoc basis as an emergency procedure, may impose an unbearable and unjust economic burden on some of the stakeholders (not necessarily those responsible for the problem), one which could be reduced by the equitable planning and sharing of the local and regional water resources, based on an optimal hydro-economic scenario.

In order to do this properly, a clear definition of the water requirements must be first established, followed by the recognition that the basic 'water right' entitles everybody to an adequate supply of clean water for legitimate uses, rather than the conventional approach based on historic rights or location within the watershed (upstream vs. downstream location).

Obviously, the effort and cost of supplying the water will differ for various segments of the population depending on their location relative to the sources of supply, and the nature of their requirement (in terms of quantity and quality of the water). Further, the 'nuisance value' as far as the nature of the effluents produced and their effect on the natural water cycle must be taken into account. Depending on the degree of 'legitimacy' of the water use, a pricing index (or penalty) may be imposed The decision on the legitimacy of the water use is usually the most difficult one to take as it is not subject to objective criteria but involves value judgments, cultural and historical considerations as well as social concerns (Dooge 2000).

These are the types of discussions relative to the distributions and pricing of the commodity that apply in any dispute between the stakeholders. If one accepts such an approach also in the case of a transboundary situation, the political discussion is reduced to one relating to the onus of payment for the commodity. The parties must decide whether it should be based on the equal sharing of costs or a penalty to polluter ('polluter pays' policy), a discrimination between existing and new activities, etc. Prudence would then dictate that following the screening of all available options the economically most conservative scenario of water supply be adopted, certainly on the scale of the watershed and possibly within the whole regional context, where those who benefit from this scenario are expected to share in the cost of supplying water to more unfavorably located consumers. The full cooperation of all stakeholders in the adoption of the development plans is obviously mandatory.

References

CWST, 2000: *The management of water supply and effluent discharge for urban development in the arid zone*. Report on a workshop organized by the Center for Water Science and Hydrology of Ben-Gurion University.

Dooge J.C.J., 2000: "Water and Environment in Dry Land Development: Socio-Economic and Ethical Aspects of Water Management", in: *International Conference on "Water and Environment,- Resolving conflicts in the development of Drylands"* (Abstract Booklet of the Center of Water Science and Technology of the Ben-Gurion Univ. of the Negev).

Gat, J.R., 1980: "The relationship between surface and subsurface waters: water quality aspects in areas of low precipitation", in: *Hydrologic Sciences Bulletin*, 25: 257–267.

Haddad M.; Feitelson E.; Arlosoroff Sh., 2000: "The management of shared aquifers", in: Feitelson, E.; Haddad, M. (Eds.): *Management of Shared groundwater Resources; the Israeli-Palestinian case with an International Perspective* (Dordrecht: Kluwer Academic Publishers): 3–24.

Harpaz Y.; Haddad M.; Arlosoroff, Sh., 2000: "Overview of the mountain aquifer", in: Feitelson, E.; Haddad, M. (Eds.): *Management of Shared groundwater Resources; the Israeli-Palestinian case with an International Perspective* (Dordrecht: Kluwer Academic Publishers): 43–56.

Martinelli L.A.; Gat J.R.; De Camargo P.B.; Lara L.L.; Ometto P.H.B., 2004: "The Piracicaba River Basin: Isotope Hydrology of a tropical river basin under anthropogenic stress", in: *Isotopes in Environmental and Health Studies,* 40,1: 45–46.

Schoeller H., 1959: "Arid Zone Hydrology; recent developments", *UNESCO series on Arid Zone Research*, No. 12 (Paris: UNESCO).

Part VIII Impact of Climate Change

37 Impacts of Global Environmental Change for Water Resources of Israel and its Neighbors: New Security Dangers and Shifting Perceptions

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Abstract

The chapter argues that the conceptual ideas of David Mitrany, George Marshall, Jean Monnet, as well as of Mikhail Gorbachev were instrumental for 60 years of peace and security in Europe, for integration, overcoming the Cold War and contributing to the reunification of the continent. The chapter contrasts different security perceptions of narrow *national security threats* with a widened security concept that includes economic, societal and environmental dimensions and other levels of analysis and referents, with a special focus on *human security*. However, given the primary concern with the dangers confronting their 'national security', in the countries of the 'narrow' Middle East (Israel, Palestine, Jordan, Egypt, Lebanon and Syria), the emerging new common threats, challenges, vulnerabilities and risks for the environment and the people in these countries are not yet being widely perceived.

In the second part, the regional impact of global environmental change is projected until 2100 and potential extreme outcomes are discussed for the narrow Middle East. These environmental challenges are not yet perceived as common threats. A special focus is on water demand due to population growth, urbanization and food needs, and on the changing supply due to the impact of climate change on precipitation, soil erosion, drought and desertification in the region. The chapter suggests that these *common challenges to human security* should become an object of functional cooperation within the region, and that these efforts may contribute to long-term environmental conflict avoidance.

Keywords: global environmental change, climate change, conflict avoidance, functional cooperation, Israel, Jordan, Middle East, Palestine, security concepts, water resources.

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37.1 Introduction: Research Questions and Hypotheses

After centuries of conflicts, two world wars and the holocaust, since 1945 Europe has experienced 60 years of peace among EU members. The chapter addresses these questions:

1. Which roles did the common military threat, functional cooperation, conditionalized aid, the community process and the Gorbachev's 'new thinking' play? What have been major conceptual ideas, and the political circumstances that made a major change in Europe possible?
2. Can we draw conceptual lessons from this experience of fundamental change in state and human behavior that may be relevant for the conflict in the Middle East?
3. What role can functional water cooperation play in addressing the impacts of global environmental change in the Middle East in the 21st century in avoiding violent conflicts over water and contributing to a spill-over for cooperation among conflict parties?

The article is based on the following three basic assumptions:

1. If reality and our knowledge of reality are socially constructed then our perceptions and the factors that determine or influence perception matter: our intellectual traditions, worldviews, mindsets, cultural heritage, national and individual traumas and experiences.
2. Security concepts and especially subjective security threats, challenges, vulnerabilities and risks are influenced by those factors that contribute to the perceived social reality.
3. Philosophical, religious, political and conceptual ideas matter and they have been instrumental throughout human history in initiating major changes in science, society, politics and in the relations among states. Ideas often inspired action both for the better or worse.

37.2 Conceptual Pillars of Sixty Years of Peace in Europe

After centuries of wars in Europe four key ideas have contributed to a basic change that has resulted in nearly 60 years of peace in Europe and to a reunification of the continent.

Pillar 1: David Mitrany's Functionalist Concept of a Working Peace System

In the words of David Mitrany (1943), functionalism is concerned "with the ways of creating ... a working peace system. It involves a diagnosis of the problems of disorder in international society and a prescription for ways of shaping a better world" (Taylor/Groom 1975: 1). Functionally oriented transboundary cooperation in international organizations and the non-political problem solution by experts has survived crises and has often contributed to confidence building processes. "Functionalists argue that there is no need for a fixed constitution written in advance because the framework is developed and (ideally) modified as the function being fulfilled changes" (Groom 1975: 94). Functionalists in the tradition of Mitrany argue "that a 'working peace system' will evolve that will tend to diminish conflict by allowing cross-cutting loyalties, by developing superordinate goals, by removing barriers to intercourse and by creating a sense of security through fulfilling a necessary function rather than through a threat system. ... Functionalist organization should start from those spheres in which welfare is maximized through transnational cooperation so that the domain of legitimized politics gradually expands while that of power politics gradually contracts" (Groom 1975: 94–95).[2]

Pillar 2: George Marshall's Concept of Conditionalized Aid

The idea of the Marshall Plan was developed in 1944 in a report of the Committee of Economic Development (CED) in New York. The idea was not to punish the aggressor but to use conditionalized economic aid as a tool to open markets, to foster cooperation among those who won and lost World War II, and to build a common institution, the *Organization for European Economic Cooperation* (OEEC) that in

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2 See for more details on the debate on Mitrany's functionalist approach in political science: Mitrany (1943, 1944, 1965, 1975, 1975a, 1975b); Groom/Taylor (1975); Navrani (1995); Rosamund (2000); an extensive annotated bibliography on Mitrany's work and on political impact was compiled by: Gerhard Michael Ambrosi and can be found at: <http://www.uni-trier.de/ambrosi/files/publik/ambrosi/mitrany.html> and Long/Ashworth 1998; on the neofunctionalist approach to integration: Haas (1958, 1964, 1968, 1970); Lindberg, (1963), Lindberg/Scheingold (1970, 1971) and on the critique of both functionalist and neofunctionalist concepts: Hoffmann (1966), and on more recent reviews see Wolf (1999).

1960 became the *Organization for Economic Cooperation and Development* (OECD). The Cold War offered the legitimacy for its approval in the U.S. Congress. The Soviet threat and U.S. terms for cooperation resulted in an integration of the western part of Germany into the West and created favorable preconditions for European cooperation and integration.[3]

Pillar 3: Jean Monnet's concept of functional institution-building

Jean Monnet was the most successful political visionary in the 20th century whose ideas fundamentally changed French-German relations after World War II. Monnet became the intellectual founding father of the European Union.[4] In 1950, Monnet developed the Schuman Plan for a European Coal and Steel Community. He was convinced "that by altering the conditions under which people lived they would necessarily adapt to the new reality." He believed that new ideas "should be advanced at moments when the contradictions of the *status quo* forced political leaders to question their own assumptions" (Ball 1994: 13). Monnet had the political instinct to fundamentally transform the political thinking in France and Germany. His ideas became instrumental for the building of lasting structures of supranational cooperation (Duchêne 1994).[5]

Pillar 4: Mikhail Gorbachev's 'new thinking' to break out of the deterrence syndrome

The perception of the end of the Cold War differ according to the worldview of the analyst. For realists U.S. military superiority provoked the implosion of the USSR, for liberals détente contributed to accommodation, and for cognitive psychologists cooperation facilitated a change in perceptions of a new generation of Soviet leaders.[6] For Garthoff (1994: 756, 773) "the decisive factor in the end of the Cold War was a change in beliefs", where "Soviet leaders could discard a long-encrusted and familiar ideology only because of a powerful transformation in the way Gorbachev and some colleagues perceived reality, and because they were ready to adapt domestic and foreign policies to the new perception. ... The 'new thinking' ... facilitated a learning process, as past failures prompted rethinking and new approaches."[7]

These four ideas of Mitrany (UK), Marshall (USA), Monnet (France) developed during World War II, in the early Cold War, and during the Korean War, as well as of Gorbachev (Soviet Union) that emerged during a period of stagnation in the Soviet Union, changed the perception of reality and thus enabled fundamental changes of the political context. The political ideas and concepts behind the Marshal Plan by the liberal U.S. business community were to create an open international market but also to overcome proposals to punish and humiliate Germany thus trying to avoid a repetition of Versailles and enabled a transformation of a former enemy into a close partner. The conceptual ideas of Mitrany and Monnet outlined the functionalist cooperation (*form follows function*) and the federalist concepts (*function follows form*) that both contributed to the emergence of the European Union. Gorbachev and his advisers tried to overcome the logic of the 'Hobbesian fear' behind the thinking on deterrence.

In the Middle East modern notions of the absolute pre-eminence of 'national sovereignty', and of the Hobbesian and power-based logic of 'national secu-

3 There is an extensive literature on the evolution and implementation of the Marshal Plan and on its impact on Europe after World War II: Gimbel (1976), Mee (1984), Pisani (1991); for a brief bibliography on the Marshall Plan see at: <http://www.marshallfoundation.org/marshall_plan_bibliography.html>.

4 Jean Monnet was the deputy secretary general of the League of Nations (1919–23), in 1940 he headed the French-British coordination committee, from 1940–1943 he was in the U.S. contributing to the U.S. post-war conversion plan (Victory Programme), from 1943–44 he was a member of the French Resistance and from 1946–50 head of the Planning Office in Paris, from 1952–1955 he was president of the Coal and Steel Union and in 1955 he founded the Action Committee for the United States of Europe; for a brief biography see at: < http://www.historiasiglo20.org/europe/monnet.htm>; Brinkley/Hackett (1991).

5 See for more details at: Bromberger (1969); Donovan (1987); Duchêne (1994); Esposito (1994); Hogan (1987); Lipgens (1977); Meier (1991), Price (1955).

6 For cognitive psychologists cooperation "created favourable conditions for ideas to emerge which offered a way out of this predicament by fundamentally influencing the values, goals, and perceptions of a new class of Soviet leaders" and "values, norms, and ideas matter in international relations, that they have tremendous potential for bringing about fundamental change in world politics" (Grunberg/Risse-Kappen 1992: 144–45).

7 Research on the end of the East-West conflict concluded that a set of old mind-sets prevented many decision makers in the West from recognizing the fundamental changes initiated by Gorbachev's 'new thinking' (Checkel 1997). See for recent interpretations of the end of the Cold War: Herrmann/Ned Lebow (2004).

rity' have determined the policy-making among the conflict parties. The 'Hobbesian fear' of the other has contributed to distrust that has been a basic driver of the regional 'security dilemma' based on the use of 'military' or 'asymmetric' power in the name of 'national' security.[8] So far the functional cooperation among experts, in the case of this book of water experts, has been limited and there has – so far – been no 'spill-over' from the functional expert to the political level, rather a 'spill-back' from the political level that has affected also the cooperation in the Joint Water Committee between Israeli and Palestinian participants that has not met since the election of Hamas in January 2006. As of October 2006, they have not met.

As has been argued elsewhere (Brauch 2007a) the debate on soft security concepts (of environmental, societal, human, water, food, health and gender security) has been largely ignored by the political elites in all countries in the narrow Middle East – with the possible exception of Jordan. Within the Arab world Jordan is the only member in the region in the Human Security Network (HSN) and a sole promoter of human security within the Arab League.

For the Middle East new conceptual ideas are needed to break out of the cycle of violence. This implies, without giving up the legitimate concerns for the security and survival of the nation and the state, gradually broadening the scope of the security discourse in the region and the perception of the manifold new soft security threats, challenges, vulnerabilities and risks that will directly affect the 'security and survival' of human beings. Some of these people have already been confronted with a 'survival dilemma' (Brauch 2004) and forced to move from rural to urban neighborhoods or abroad, giving up their traditional livelihood for the hope of a better future elsewhere.

Thus, a key thesis of this chapter is that *global environmental change* (GEC) may pose such new threats that will directly affect the three elements: soil (erosion, desertification), water (drought and flash floods) and air (climate change). National climatic variation and anthropogenic climate change has affected hydrological processes in the Middle East (Issar/Zohar 2004, 2007) in the past (see chapters by Issar and by Al-Saad/Lucke/Schmidt/Bäumler in this volume) and may further reduce the level of precipitation and increase evapotranspiration due to projected temperature increases thus severely reducing water supply.

The projected population growth until 2020, 2050 (UN 2003, 2005), 2100 and even up to 2300 (UN 2003a) will increase the demand for 'blue' drinking water, it will further reduce the available amount of 'green' water and raise the need for 'virtual water' as has been projected by FAO (2000; Bruinsma 2003). While these challenges have been addressed by many experts in the region, a wider security discourse that addresses these new and interrelated regional challenges posed by GEC has been lacking within policy-making circles, the media and the attentive public in the region.

Reviewing the impact of new ideas in Europe may contribute to a reassessment of the mind-sets, political strategies and tactics that have led to the deadlock that ´has postponed taking joint decisions now to cope with the projected regional impacts of global environmental change in this century.

37.3 Security Perceptions Matter

According to Arnold Wolfers (1962): "Security, in an *objective sense*, measures the absence of threats to acquired values, in a *subjective sense*, the absence of fear that such values will be attacked." The perception of security threats depends on the traditions and mind-set of policy-makers. The English school has distinguished three basic traditions that of a:

- *Hobbesian pessimist* (realism) where *power* is the key category (narrow concept);
- *Kantian optimist* (idealism) where *international law* and *human rights* are crucial; and
- *Grotian pragmatist* where *cooperation* is vital (wide security concept).

With the end of the Cold War, many authors (Buzan/Waever/de Wilde, 1998) have observed a widening and a deepening of the security concept in 'postmodern' OECD countries, while a narrow security concept still prevails in the U.S. (Brauch 2001).

Selim (2003) and Kam (2003) have argued that the security discourse in Arab Masreq countries and in Israel has also focused on a narrow national security

8 The perception and interpretation of asymmetric military power has differed depending on the vantage point of the observer. What is being termed by some as 'terrorist' is being legitimized by others as an expression of the struggle for 'liberation' and national independence. In the name of 'national security' and for the sake of 'national survival' thousands of people from all conflict parties have lost their lives and may still loose their lives in the future until the logic that has legitimized the use of force is overcome and replaced.

Table 37.1: Vertical Levels and Horizontal Dimensions of Security. **Source:** Brauch (2003, 2005, 2005a, 2006c, 2007, 2007a).

Security dimension ⇒ Level of interaction (reference point) ⇓	**Military**	**Political**	**Economic**	**Social**	**Environmental ↓ (longer-term environmental challenges)**
Human →					Cause and victim
Societal/ Community					↓↑
National (short-term threats)	Middle East discourses on 'security dilemma'				↓↑ 'survival dilemma'
International/ Regional					↓↑
Global/ Planetary →					GEC

Table 37.2: Expanded Concepts of Security. **Source:** Møller (2003); Oswald (2001).

	Reference object	**Value at risk**	**Source(s) of threat**
National Security	The State	Sovereignty Territorial integrity	Other states (Sub state actors)
Societal security	Nations, Societal groups	National unity Identity	(States) Nations, Migrants, Alien culture
Human security	Individuals Humankind	Survival Quality of life	State, Globalization, Nature
Environmental security	Ecosystem	Sustainability	Humankind
Gender security	Gender relations, Indigenous people, Minorities	Equality, Identity	Patriarchy, totalitarian institutions (govern-ments, churches, elites)

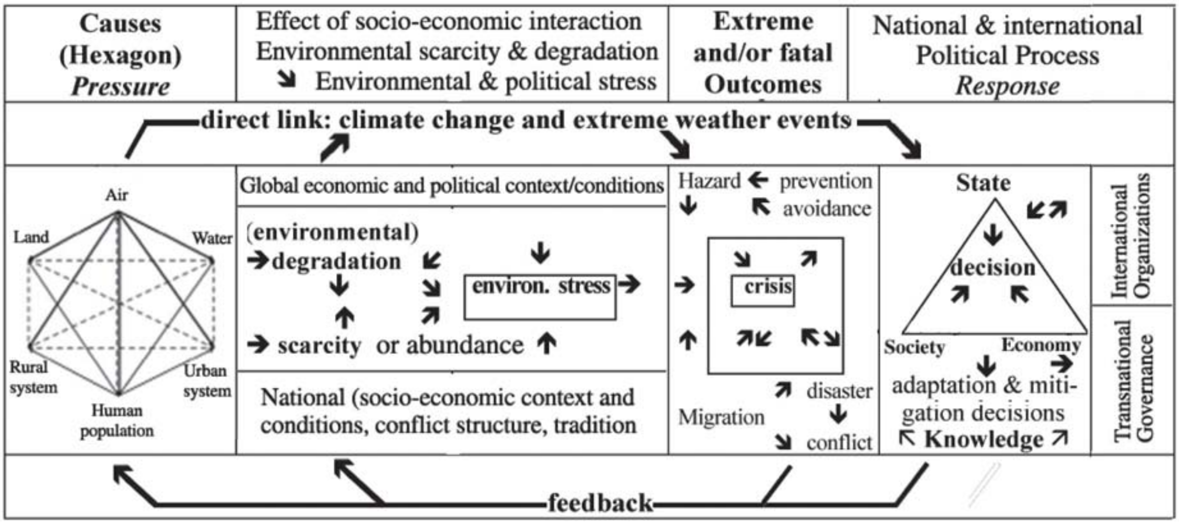
concept, and was influenced by the perception of a 'security dilemma' (Herz 1959).

Møller (2003) distinguished a traditional 'national' and three expanded security concepts of 'societal, human and environmental security' that differ on the reference object, the value at risk and the sources of threat (table 37.2). Oswald (2004) added gender security and proposed a combined human and gender security concept (HUGE). Brauch (2003, 2005) and Bogardi/Brauch (2005) suggested focusing the human security discourse on the environmental security dimension. The human economic behavior and global environmental change (GEC) may pose for people with a high degree of societal and environmental vulnerability a 'survival dilemma' (Brauch 2004, 2007b). From a Hobbesian worldview environmental and human security challenges are not perceived as threats. From a Grotian perspective environmental security challenges increase the societal vulnerability (Brauch 2000, 2005). From a Kantian perspective international environmental treaties pose obligations for governments and individuals.

Brauch (2000. 2003, 2005) distinguishes between six factors contributing to global environmental change (GEC, see figure 37.2 introducing a survival hexagon): three *supply-side* or *environmental* factors: 1) climate change, 2) soil degradation, erosion and desertification and 3) water (scarcity, degradation); and three *demand side* or anthropogenic factors: 4) population change (growth and decline that determine the domestic or blue water demand), 5) rural systems (agriculture and food production that is influenced by the available green water), and 6) urban systems (that consume water for drinking and industry). It is only the demand for agricultural water that can be replaced partly by the re-use of treated waste water, by 'virtual water' or growing food imports (see the chapters by Allan, Shuval and Nassar in this volume). The demand for industrial water can be reduced by more efficient industrial processes and improved demand side management (DSM) techniques.

These six factors contributing to global environmental change (GEC) interact in linear, exponential or chaotic ways and may contribute to environmental scarcity of soil, water and food which intensify envi-

Figure 37.1: PEISOR Model Combining GEC, Environmental Stress and Extreme Outcomes. **Source:** Brauch (2005: 16).



ronmental degradation and may result, taking the specific national and international context into account, in *environmental stress*. Depending on the system of rule and on the level of economic development, the interaction between state, economy and society differ, as will the role of knowledge in enhancing the national coping capacities for adaptation and mitigation. Climate change may increase the probability and intensity of extreme weather events (drought, floods) and thus increase internal displacements and migration. Again both factors may contribute to or cause domestic crises that may escalate to different forms of low-level violence (figure 37.2).

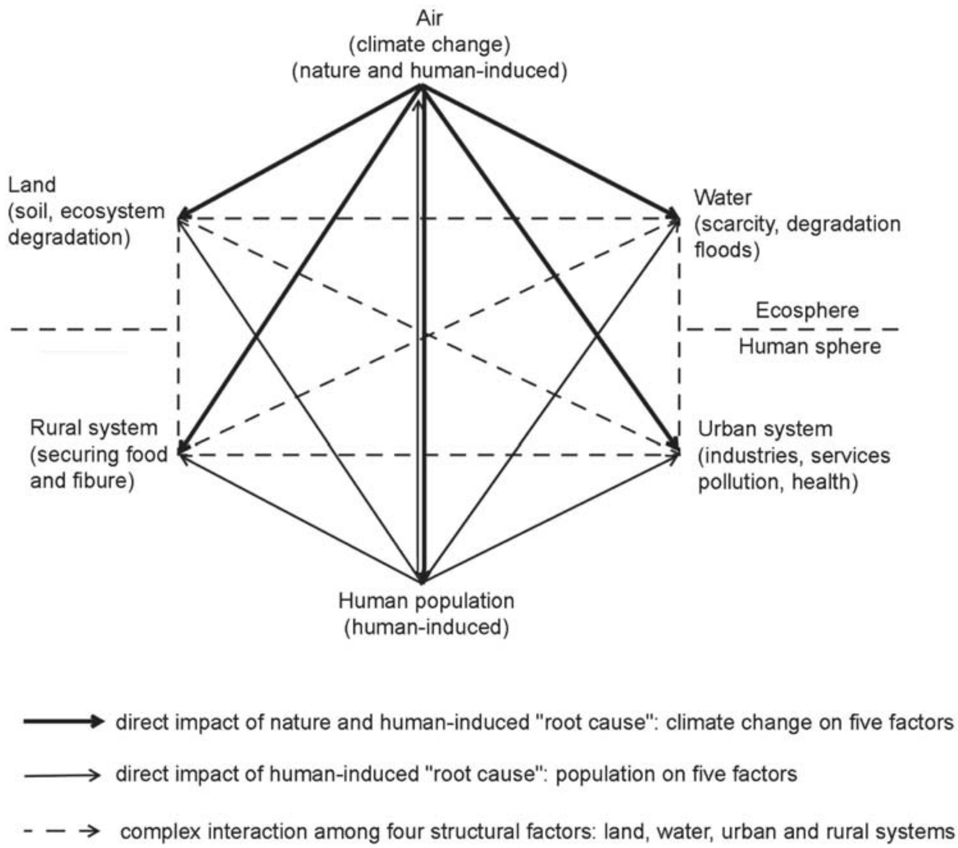
These complex interactions have been illustrated in the PEISOR model (Brauch 2005, 2007) where *P* (*pressure*) refers to six drivers of global environmental change (*survival hexagon*); *E* to the *effects* of the linear, non-linear or chaotic interactions within the 'hexagon' on environmental scarcity, degradation and stress; *I* to extreme or fatal *impacts* of human-induced and climate-related natural hazards (storms, flash floods, flooding, land slides, drought); *SO* to *societal outcomes*: internal displacement, migration, urbanization, crises, conflicts, state failure and R to *response* by the society, the business community, the state where both traditional and modern technological knowledge can make a difference. While natural and human-induced hydro-meteorological natural hazards cannot be prevented, their impact in terms of deaths, affected people, economic and insured damages can be reduced by a combination of policies and measures that link 'protection' with 'empowerment' of the people to become more resilient (CHS 2003).

This PEISOR model has been illustrated elsewhere for the impacts of the six factors of global environmental change on the environmental dimension of human security for the Mediterranean space during the 20^{th} and 21^{st} century that will have severe repercussions by posing new challenges to environmental and human security.[9] With some degree of uncertainty the six factors of a 'survival hexagon' can be projected globally, regionally and below for Israel and Palestine, as well as for Egypt, Jordan, Lebanon and Syria.

Less is known on possible interactions among these factors that may result in surprises. The trend projections of the demand side, as well as of climate change and soil erosion directly interact with hydrological processes that result in changes of precipitation, groundwater resources, intrusion of saline water, and increase in evapotranspiration that impact on the future yields of agricultural products. However, to move from trends to foresight requires integrated regional modeling what goes beyond the scope of this chapter and the expertise of its author. These trends may pose major environmental and human security challenges that will seriously worsen the quality of life in the region, posing for those with a high societal vulnerability a threat to their livelihood and for some even a 'survival dilemma' (Brauch 2004, 2007b).

9 Brauch 2001, 2003, 2006; see for many speeches by the author in Lecce (2004), Bonn (2005), Israel (2006), Mexico (2006), Thailand (2006) and Spain (2006), at: <http://www.afes-press.de/html/download_hgb.html>.

Figure 37.2: Interactions in the Survival Hexagon. **Source:** Brauch (2003, 2005, 2005a).



37.4 Regional Impacts of Global Environmental Change

Which impacts of GEC can be foreseen for Israel and Palestine, as well as for Egypt, Jordan, Lebanon and Syria based on trend projections? Have they been perceived as environmental challenges in Israel and Palestine? Are the people in Israel and Palestine ready to support functional cooperation in coping with these challenges?

Issar and Zohar (2004) analyzed the impact of natural variability of climate change, of warming and cooling and precipitation on the environment and civilization in the Middle East for the past 10,000 years by integrating the knowledge of archaeology with that of climate change on the background of opposing paradigms. Issar and Zohar (2004: 232) stress that climate change: "may endanger the economy of many countries in the region is a foregone conclusion ..., namely that a warm period is equated with a reduction of precipitation. ... Taking into account that ... agriculture still plays a significant role in the economy of the Near East, a severe reduction in precipitation will most likely damage the economy of most countries in this region." Crises resulting from water shortages have "been averted or mitigated" by human innovation based on "scientific research, engineering and agronomic innovations, together with the education of farmers to adopt new technologies". These advances "are interdependent processes that can succeed only when the vicious cycle of poverty and ignorance, religious fanatism and aversion to innovation, is broken" (Issar/Zohar 2004: 232–233).

In figure 37.2 six factors introduced above contributing to GEC are combined in a 'survival hexagon" (Brauch 2000, 2003, 2005). While the demand side factors can be projected, the interaction among the factors of the earth system is more complex, especially the impacts of climate change on the hydrological cycle. Steffen et al. (2004: 71) noted that "the behavior of the Earth System is typified not by stable equilibria but by strong non-linearities, whereby relatively small changes in a forcing function can push the System across a threshold and lead to abrupt changes in key functions".

They argue that "the potential for abrupt change is a characteristic that is extremely important for understanding the nature of the Earth System" (Steffen et al. 2004: 71) and that "the understanding of the natural rhythms and patterns of Earth System functioning is essential to understanding the impacts and consequences of global change" (Steffen et al. 2004: 72). Since 1945 the interactions among "population, technology and socio-political organization has changed dramatically" as have "the scope and degree of human alteration of the Earth System" (Steffen et al. 2004: 83). The syndromes approach may be a promising approach to assess critical developments in the Earth System (Schellnhuber et al. 1997; Petschel-Held/Lüdeke/Reusswig 1999; Lüdeke/Moldenhauer/Petschel-Held 1999). They concluded that "the last 50 years have without doubt seen the most rapid transformation of the human relationship with the natural world in the history of humankind" (Steffen et al. 2004: 131). They admit that at present it is not possible "to make any projection on how global change will progress over the next few centuries" (Steffen et al. 2004: 134).

Human action has specifically affected a) the carbon cycle, b) the nitrogen, phosphorous and sulphur cycles, c) the hydrological cycle and d) the climate system. Steffens et al. (2004: 196) concluded that "the human-environment relationship has changed fundamentally in the last few centuries, and particularly in the last 50 years. On the effects of climate change on the hydrological cycle and on water resources for humans, Steffens et al. (2004: 222) claimed that such an effect "may already be discernible above natural variability" and they stressed that "rainfall has likely decreased by about 3 per cent over much of the sub-tropical land areas", and in agreement with the IPCC they noted an "increase in extreme precipitation events over the past century in the Northern hemisphere". But they caution that "the effect of climate change on water resources in the future is difficult to estimate" (Steffen et al. 2004: 222).

As the *Intergovernmental Panel on Climate Change* (IPCC), they point out that the scenarios suggest a decrease in runoff in the Mediterranean and that the reduced streamflow and groundwater recharge may lead to a reduction of water supply by 10 per cent or greater by 2050. "Water supplies will decrease in many countries that are already water stressed and increase in others. ... Second, extreme events – floods and droughts – will increase. Thirdly, currently deleterious impacts on water quality will be amplified rather than damped by climate change". The latter can be traced in the Middle East for the past 6,000 years.

The demand and supply of water in the 'narrow' Middle East will be severely influenced by the other six factors of the 'survival hexagon' and their regional and local interaction that will require more systematic and multidisciplinary research. First the projected changes in the demand for water will be projected and then the projected changes in water supply in an age of climate change will be reviewed.

37.4.1 Changing Demand Side: Population Growth, Urbanization, Agriculture and Food

The Mediterranean region and especially the *Middle East and North Africa* (MENA) have experienced major demographic changes since 1850. While in the five South European countries (France, Greece, Italy, Portugal, Spain) the population has grown from 83 million (1850) to 177 million in 2000, the population may drop to 154 million by 2050 according to the medium projection of the UN Population Division's 2000 assessment. However according to the UN's 2004 assessment the population in these five countries may stabilize at 178 million people by 2050 due to a rapid increase of immigration that has been observed in Italy and Spain especially between 2000 and 2005 (Siegel 2006; IOM 2005).

In the MENA the population has grown from 25.6 million in 1850 to 232.3 million in 2000 and the population is projected according to the 2000 Revision to grow to 413.2 million in 2050 (Brauch/Selim/Liotta 2003: 972; UN 2001, table 37.3). The population in the 'narrow' Middle East (in the territory of Israel and its neighbors: Egypt, Jordan, Palestine, Lebanon and Syria) has steadily grown from 12.45 million in 1850 to 13.05 million in 1900 to 30.272 in 1950 to 101.713 in 2000. The UN's population projection for these six nations for 2050 was according to the 2000 Revision about 188.798 million and according to the most recent 2004 revision even 197.239 million (UN 2003, 2005, 2005a). This implies a population growth in the 'narrow' Middle East between the year 2000 and 2050 between 87.085 (2000 Rev.) and 95.526 (2004 Rev.) million people. These people need water, food and jobs for a decent livelihood in the region or they may be forced to move to other countries where these are more easily available.

In its 2004 World Population Data Sheet, for mid-2004 the U.S. Population Reference Bureau (PRB 2004) estimated the population of Israel at 6.8 million

Table 37.3: Population Growth in the Near East Countries, 1850-2050. **Source:** UN (2001, 2005) and Brauch (2002, 2006b).

	Real population development						**Projection Med. var.**		**Changes**	
	1850	**1900**	**1950**	**1980**	**2000**	**2025**	**2050**		1950-2050	**2000-2050**
					2000 Rev.	**2000 Rev.**	**2000 Rev.**	2004 Rev.	**2000 Rev. [2004 Rev.]**	
Egypt	5.5	10.0	21.834	43.749	67.884	94.777	113.840	125.916	92.006	**45.956**
Jordan	0.25	0.3	1.237	2.923	4.913	8.666	11.709	10.225	10.472	**6.796**
Israel			1.258	3.879	6.040	8.486	10.065	10.403	8.807	**4.025**
Palestine	0.35	0.5	1.005	?	3.191	7.145	11.821	10.058	10.816	**8.630**
Lebanon	0.35	0.5	1.443	2.669	3.496	4.581	5.018	4.702	3.575	**1.522**
Syria	1.5	1.75	3.495	8.704	16.189	27.410	36.345	35.935	32.850	**20.156**
Narrow Middle East	7.95	13.05	30.272		101.713	151.065	188.798	197.239	156.566 [166.967]	**87.085 [95.526]**
Eastern Med.	**12.45**	**16.05**	**29.247**	**62.613**	**89.497**	**142.899**	**173.776**		**144.529**	**84.279**
Only North Africa	**13.1**	**22.3**	**44.099**	**91.362**	**142.802**	**199.832**	**239.426**	**244.293**	**195.327**	**96.624**
Total (MENA)	**25.83**	**38.77**	**74.152**	**154.910**	**233.473**	**344.048**	**414.512**		**340. 360**	**181.039**
South Europe	**83.0**	**103.5**	**132.913**	**167.265**	**177.304**	**172.492**	**154.065**	**178.034**	**21.152**	**-23.239**

(annual increase 1.6 per cent), of the Palestinian Territory at 3.8 million (3.5 per cent), of Jordan at 5.6 million (2.4 per cent), of Lebanon at 4.5 million (1.7 per cent), of Syria at 18 million (2.4 per cent) and of Egypt at 73.4 million (2.0 per cent). Based on UN (2001) figures (table 37.3) the population in Israel has increased from 1.26 million in 1950 to 6.04 million in 2000 and may grow until 2050 by 4 million to 10.065 million (PRB: 10.6). For Palestine (Occupied Palestinian Territories, OPT) the UN stated an increase from 1.01 million in 1950 to 3.19 million in 2000 and it projected an increase to 11.82 million (PRB: 11.9) until 2050. From 2000 to 2050, the medium 2000 rev. projects for Jordan an increase from 4.9 to 10.47 (PRB: 10.2) million, for Lebanon from 3.5 to 5 million (PRB: 6.9), for Syria from 16.2 to 36.35 million (PRB: 35) and for Egypt from 67.9 to 113.84 (PRB: 127.4) million people.

The UN long-term population projection until 2300 projects for Israel a population decline to 9.37 million and for Palestine an increase to 13.5 million. All countries have experienced severe water scarcity, and due to the demand increase the water stress (scarcity, degradation) will further increase as will the competition between 'blue' drinking water and 'green' water for irrigation.

The urbanization rate (table 37.4) in the countries in the Near East has been above the average for Africa and West Asia. The growth of mega-cities (table 37.5) has also been significant from 1950 to 2000 and they will grow further to 2015 (UN 2002), which has significantly increased their vulnerability to earthquakes and hydro-meteorological hazards (drought, flash floods).

According to Bruinsma (2003) the self-sufficiency rates for cereals for the MENA region has declined from 86 per cent (1964–1966), to 65 per cent (1995–1997), and it has been projected to drop further to 56 per cent by 2030. Simultaneously, the net cereal imports have risen within 30 years from 5 million tons in 1964–1966, to 43 million tons in 1995 to 1997 and they have been projected to rise to about 102 million tons by 2030. According to FAO by 2030 the cereal import needs of the MENA region will be larger than those of Latin America and the Caribbean, Sub-Saharan Africa and South Asia combined. Increase in food demand, decline in crop yield due to climate change (temperature increase, evapotranspiration), the likely decline in precipitation and increasing demand for drinking water will be a key driver for growing food imports or 'virtual water'.

Table 37.4: Changes in Urbanization Rates in the Narrow Middle East, 1950-2030 (in Per Cent)**. Source:** UN (2002).

	1950	1960	1970	1980	1990	**2000**	2010	2020	**2030**
Egypt	**31.9**	37.9	42.2	43.8	43.6	**42.7**	44.0	48.2	**54.4**
Jordan	**35.9**	50.9	56.0	60.2	72.2	**78.7**	80.1	82.2	**84.4**
Israel	**64.6**	77.0	84.2	88.6	90.3	**91.6**	93.0	93.9	**94.6**
Palestine (OPT)	**37.3**	44.0	54.3	61.1	64.0	**66.8**	70.0	73.5	**76.9**
Lebanon	**22.7**	39.6	59.4	73.7	84.2	**89.7**	92.1	93.1	**93.9**
Syria	**30.6**	36.8	43.3	46.7	48.9	**51.4**	55.4	60.6	**65.6**
Western Asia	**26.7**	**35.0**	**44.4**	**51.7**	**62.0**	**64.7**	**67.2**	**69.8**	**72.4**

Table 37.5: Growth of Urban Centers in the Mediterranean, 1950-2015**. Source:** UN 2000.

City	**1950**	**1955**	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**
Istanbul	1.08	1.37	1.74	2.20	2.79	3.60	4.40	5.41	6.54	7.91	9.45	10.81	11.84	12.49
Cairo	2.41	3.00	3.71	4.61	5.33	6.08	6.86	7.69	8.57	9.53	10.55	11.61	12.66	13.75
Alexandria	1.04	1.25	1.50	1.75	1.99	2.24	2.52	2.84	3.21	3.65	4.11	4.59	5.05	5.53
Tel-Aviv	0.42	0.56	0.74	0.88	1.03	1.21	1.42	1.62	1.80	1.98	2.18	2.37	2.52	2.63
Amman	0.09	0.14	0.22	0.30	0.39	0.50	0.64	0.78	0.96	1.18	1.43	1.70	1.97	2.21
Beirut	0.34	0.43	0.56	0.72	0.92	1.06	1.21	1.39	1.58	1.82	2.06	2.24	2.37	2.47
Damascus	0.37	0.46	0.58	0.73	0.91	1.12	1.38	1.59	1.80	2.04	2.34	2.69	3.07	3.50
Aleppo	0.32	0.39	0.48	0.59	0.72	0.88	1.07	1.29	1.54	1.84	2.17	2.54	2.92	3.31

37.4.2 The Changing Supply Side: Climate Change, Hydrological Changes and Soil Erosion

For the 21st century the climate models assessed by the IPCC (2001) in its Third Assessment Report suggest for the Mediterranean Basin "warming greater than the global mean warming" and for the summer season, "this warming is in excess of 40 per cent above the global average warming". With regard to precipitation, the model consensus is "that there will be little change in winter and drying for the summer" and for some models a large decrease is predicted. Based on global circulation models (GCM) the projected mean temperature for the Eastern Mediterranean for the 2080s between July and September may increase between 3.0 and 5.0 °C. The Third Assessment Report of the IPCC (2001: 651–652) projected mean temperature and precipitation changes for summer in the 2080s, that will be quite severe for the MENA region compared with Europe.

37.4.3 Complex Interactions between Climate Change and Hydrological Cycle (Water Scarcity)

The Working Group II of the IPCC (2001a: 191–234) devoted one chapter on "hydrology and water resources" to the state of our knowledge on the known linkages at the global level:

- There are apparent trends in streamflow volume ... in many regions. These trends cannot be definitely attributed to changes in regional temperature or precipitation. ...
- The effect of climate change on streamflow and groundwater recharge varies regionally.
- Peak streamflow is likely to move from spring to winter in many areas. ....
- Glacier retreat is likely to continue, and many small glaciers may disappear.
- Water quality is likely to be degraded by higher water temperature, but this may be offset regionally by increased flows. ...
- Flood magnitude and frequency are likely to increase in most regions, and low flows are likely to decrease in many regions.

- Demand for water generally is increasing as a result of population growth and economic development, but it is falling in some countries.
- The impact of climate change on water resources depends not only on changes in the volume, timing, and quality of streamflow and recharge but also on system characteristics.
- Unmanaged systems are likely to be most vulnerable to climate change.
- Climate change challenges existing water resources management practices by adding additional uncertainty (IPCC 2001a: 193).

With regard to water availability, the IPCC (2001a: 193) stated that change "has the potential to induce conflict between different users" within the same area or between different parts of the river basin.

> Where there are disputes, the threat of climate change is likely to exacerbate, rather than ameliorate, matters because of uncertainty about the amount of future resources that it engenders. One major impact of climate change for agreements between competing users (within a region or upstream versus downstream) is that allocating rights in absolute terms may lead to further disputes in years to come.

The impact of climate change for water resources requires according to the IPCC's Third Assessment Report (TAR) more research with a focus on: a) creation of credible climate change scenarios; b) characterization of natural and hydrological variability, c) improved hydrological models, d) characterization of uncertainty, e) impacts on real world water systems and f) effects of adaptation. Effective adaptation to climate change in the water sector requires, according to the IPCC, efforts in five main areas: a) data for monitoring; b) understanding patterns of variability; c) analytical tools; d) decision tools and e) management techniques. Many scientific studies have addressed the climate-ocean interaction, the implications of climate and sea level change and the impact of climate change on coastal areas. More research is needed, at the regional and national level on the likely impact of climate change on the availability of water resources, on precipitation and evaporation levels.

The Near and Middle East has been water stressed for millennia, but with progressing population increase since 1850 to 2050 the available water per person has steadily declined. Water degradation due to over-pumping and intrusion of seawater has increased. The water projections until 2020 or 2050 due to both population (demand) growth and precipitation (supply) decline resulting from regional warming for Israel, Palestine and Jordan are very severe.

UNEP-GRID states: "The regions most vulnerable to domestic water shortages include those where access to water is already limited, the population is growing rapidly, urban centers are spreading, and the economy is burdened by financial problems and a lack of skilled workers. ... The impacts of climate change ... are expected to have varying consequences for the availability of freshwater around the world. ... An increase in the rate of evaporation will also affect water supplies and contribute to the salinization of irrigated agricultural lands. ... Current indications are that if climate change occurs gradually, the impacts by 2025 may be minor. ... Climate change impacts are projected to become increasingly strong during the decades following 2025".[10] However, for the Near East the impact will already be significant by 2025 for 'green water' availability for food production.

According to Hayek (2004) the available water per person in the Arab world declined since the 1950s to the present by two thirds, from 3000 m^3/y to 1000 m^3/y. For Jordan by 2010 the water demand may rise to 1436 mcm/y and by 2020 to 1647 mcm/y from the presently available water supply of 780 mcm/y. Hayek projected until 2020 a water deficit of 400 mcm/y or a decline to 140 m^3/y per person. According to the Water Commission of Israel the agricultural water use has declined since 1998 while the domestic water use has increased due to the immigration (Israel 2002: 75)

The water demand in Gaza may increase from 114 mcm (2000) to 228 mcm (2010) to 285 mcm (2020) and in the West Bank from 155 mcm (2000) to 394 mcm (2010) to 584 mcm (2020) (UNEP 2003).

> Martin Parry et al. (1999) have indicated major yield declines for an unmitigated emissions scenario of –2.5 to –5 per cent for the Middle East while the European Union, Japan, China and Canada may experience yield gains. With a 750 ppm stabilization scenario there may be less reduction in yield in semi-arid subtropical regions. Under the 550 ppm stabilization scenario the pattern is less obvious: lower CO_2 levels and their associated climate changes suggest less reduction in yields than in the 750 ppm scenario in southern Africa, eastern Europe, the northern Middle East and Australia. The soil in many parts in the Eastern Mediterranean is already highly eroded.

The national communications from five non-annex I Countries to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCC) provides the specific national perspectives of Egypt[11], Israel[12], Jordan[13] and Lebanon[14] that should

10 See for details at: <http://www.grida.no/climate/vital/37.htm>.

be reflected in the medium term projections on the estimated and modeled water supply changes due to climate change. Only Syria has not yet submitted such a report and as Palestine is not yet a state no such report for the Occupied Palestinian Territory exists.

37.4.4 Complex Interactions between Climate Change, Hydrological Cycle and Soil Erosion

What will be the interaction among the factors of the survival hexagon (figure 37.2) by 2025, 2050 or 2100? If one assumes linear interactions the impact for human and environmental but also economic security (of Arab countries with a high degree of the population living from agriculture) will be very severe. Obviously these serious trends have not been conceptualized as issues of national and regional security and survival in the MENA and Near East region.

David Newman (2004, 2007) has recently argued that "environmental issues have not occupied a prominent place in the Israeli public agenda". He noted that "the redefinition of notions of security which have taken place throughout the world, to include energy, food, health, livelihood, rights or global environmental change, are not considered part of the 'security' discourse as such, inside Israel, where the term 'security' retains a narrow and highly focused interpretation." This assessment applies also to neighboring Arab Masreq countries where security has been conceptualized primarily as narrow national security (Selim 2003, 2007).

To put the regional implications of global environmental change on the agenda of the security discourse, a widening of the prevailing concepts of military and demographic security is needed. However, such a political agenda-setting would require an improved area-specific knowledge of climate change impacts, i.e. both higher resolution regional circulation models, local and sub-regional climate case studies, as well as integrated climate models (e.g. Strzepek/Onyeji/Saleh/Yates 1995) that take other factors of the 'survival hexagon' into account based on different economic growth rates. Water supply and demand will be severely influenced by the impacts of these factors until 2050.

11 The first national communication of Egypt was submitted on 19 July 1999, see the full text at: < http://unfccc.int/resource/docs/natc/egync1.pdf>

12 The first national communication of Israel was submitted on 18 November 2000, see the full text at: <http://unfccc.int/resource/docs/natc/isrnc1.pdf

13 The first national communication of Jordan was submitted on 6 March 1997, see the full text at: <http://unfccc.int/resource/docs/natc/jornc1.pdf>.

14 The first national communication of Lebanon was submitted on 2 November 1999, see the full text at: < http://www.moe.gov.lb/MOE%20Site/ClimateChange/phase1.html>.

37.5 Impact of these Factors of Global Environmental Change on the Security of the Narrow Middle East

The analysis of the impact of these environmental threats, challenges, vulnerabilities and risks referred to above as demand and supply-side factors of GEC depends on the worldview and the mindset of the analyst and of the prevailing views of the national elites, the public awareness in the media and in the public at large. Francesca de Chatel has outlined persuasively (in her chapter in this volume) the role of religion, politics and technology in concealing the growing water scarcity in the Middle East.

So far no systematic scientific debate on environmental and human security issues has taken place in Israel (Newman 2004, 2007; Twite 2003, 2007) and in most Arab states (Dajani 2007; Selim 2007; Chourou 2005, 2007). However, as long as such a scientific and public debate is lacking in those countries that will be affected most severely by the projected impacts of GEC, the urgency to prepare adaptation and mitigation strategies for coping with these challenges will remain low. Until October 2006, no *National Adaptation Program of Action* (NAPAs) was prepared for any of these five countries of the narrow Middle East.

37.6 Relevance of European Experience for the Narrow Middle East?

Only the breaking out of the cycle of violence after 1945 made a fundamental change possible in Europe. The conceptual ideas of Mitrany, Marshall and Monnet mattered. The 'Soviet threat' helped and required cooperation among former enemies. However, the analogies between Europe and the Middle East are limited. The four intellectual pillars, created by conceptual thinkers, political visionaries and pragmatists from the four allied powers in dealing with the 'German problem' made a fundamental difference in Central Europe.

The environmental challenges confronting the new generation of Arabs and Israelis during their lifetime may severely undermine the welfare, health and even the survival of the poor. Monnet and Marshall were political realists with clear political interests and the political skill to realize their visions that fundamentally changed Europe and the perspectives of most Europeans from confrontation to cooperation. Developing a 'small hope' (Dajani 2004) in the region may gradually change the context towards cooperation. If the environmental challenges confronting the livelihood of human beings in the region during the 21st century are real for those who are now attending school, why are they not being taught about these challenges? Why are these challenges not being discussed within civil society, in the press and in parliaments? Why have they remained a concern only for a few scientific specialists?

Elsewhere, this author translated the functional concepts of Mitrany, Monnet and Marshall into a conceptual proposal for the Near East (Brauch 2004a, 2004b, 2006). The proposal is based on reconceptualizing security in relation to peace, environment and development (Brauch/Grin/Mesjasz/Krummenacher/Chadha Behera/Chourou/Oswald Spring/Kameri-Mbote 2007). The first proposal is probably the most difficult: to gradually shift from a narrow 'national military security' to a 'human, societal and environmental security' concept. It would require a basic shift from the state or the respective political group to the individual as a victim of violence. This will require a fundamental change in the mind-set of policy-makers, elites, communicators but also in the threat perception of the people in the street and a gradual shift from the focus on the ongoing conflict to the longer-term mutual environmental challenges that may threaten their livelihood. At present in all communities in the narrow Middle East environmental concerns have a low priority.

A basic shift in the perception of security threats, challenges, vulnerabilities and risks necessarily implies a shift away from the 'Hobbesian fear', the action-reaction patterns of zero-sum games, of the thinking in terms of a 'security dilemma' to a pragmatic thinking that focuses on functional cooperative potentials, on non-zero-sum games to enhance the coping capacities in dealing with the emerging challenges for individuals and their families. This may lead to two policy goals: a) *sustainable development* by optimizing resource efficiency and b) *sustainable peace* focusing on human, societal and environmental security and political peace with prosperity. The latter may be utopian for the present and the future.

What can we learn from the end of World War I and II in Europe? The Versailles Peace Treaty of 1919 may be interpreted as a combination of Hobbesian punishment, and of Wilson's vision of a better world based on democracy and the League of Nations. While after World War II a more realistic attempt was made for a 'UN with teeth', the world was divided into two camps where the perceptions of the 'Soviet threat' helped to overcome the fear of 'German resurgence'.

Marshall and Monnet succeeded during the post-war crises with their proposals for cooperation among former enemies. American policy-makers skillfully used the Marshall Plan to overcome objections. They succeeded in changing mutual perceptions in and of Germany. This context permitted a new generation to grow up where common European concerns gradually become more important than purely national ones. Can any lessons be drawn from the end of the Cold War for the narrow Middle East? The lessons depend on the worldviews, mind-sets, and theories of the observer. It was the breaking out of the arms race by conceptual innovation and learning that made the first global peaceful change in modern history possible between 1989 and 1991. Gorbachev's 'new thinking' fostered a readiness for change from the top that overcame the fear of the people to peacefully protest and to change their system of rule from below during the fall of 1989 in East Central Europe and in the former Soviet Union.

As long as the political leadership and the people in the region seem to adhere to a narrow hard security concept and perceive the basically asymmetric conflict as a 'zero sum game' the spiral of violence, of human misery producing permanent wounds on both sides may never end and the opportunity to address common challenges for the young generation may be lost. The war between Israel and Hezbollah in July and August 2006 again made this obvious.[15] One victim has been the environment in both Lebanon and Israel

15 In summer 2006, FoEME pointed to the negative environmental impacts of the War of Israel against the Hezbollah in Lebanon by pointing to the serious "environmental destruction ... in both Israel and Lebanon", resulting from the oil spill in Lebanon "of an estimated 15,000–30,000 tons of heavy fuel oil" and "some 600,000 trees have to date been burnt down in forest fires caused by Hezbollah Katyusha rockets"; see at: <http://www.foeme.org/projects.php?ind=107>

(Brauch 2007a), which will also have longer term impacts by throwing back reforestation projects with direct consequences for water related issues.

At present, neither 'objective security' as the absence of threats to acquired values nor 'subjective security', i.e. the perception that these values are not threatened, exists in the region. This remains a task of a regional peace settlement. But such a settlement may never be possible as long as the 'big dreams' prevail on either side. In the past, crises have often produced new ideas and policies. Thus, there may be a need for a fundamental shift in the thinking on security in the region away from exclusively Hobbesian 'national security' concept to a supplementary human-centered environmental security concept that permits a focus on joint challenges of regional, national and individual survival.

One major task is to gradually overcome the Hobbesian zero-sum games. None of the new en-vironmental challenges can be solved with this perspective. The daily experience of violence makes confidence and 'partnership building measures' (Brauch 2000) more difficult but at the same time more timely. During the Cold War, independent thinkers in East and West who analyzed the consequences of a failure of deterrence and the reality of a nuclear war in Central Europe started to work jointly on modest steps of military confidence building measures, on non-offensive defense and less threatening military doctrines (Brauch/Kennedy 1990, 1992, 1993). In the 1980s, these concepts were analyzed by Gorbachev's policy advisers and then were taken up, at least as declaratory policy goals (Grunberg/Risse-Kappen 1992; Herrmann/Ned Lebow 2004).

37.6.1 Functional Cooperation on Regional Impacts of Global Environmental Change

The recognition of new environmental challenges that affect the Israeli and Palestinian communities and cannot be solved with military means is a major step. This is a task of educators, motivated by an ethics of responsibility (*Verantwortungsethik*) for future generations (Jonas 1979). This *joint recognition* requires common frameworks and institutions for research. The next step is *agenda-setting* for this long-term educational agenda, for the public and policy-makers on both sides.

In the Near East there may be a need for cross-border environmental partnership building measures by addressing both the urgent and longer-term joint environmental challenges by cooperation on freshwater, wastewater, solid and hazardous waste, conservation and biodiversity. A second step may be to gradually build mutual trust by functional cooperation addressing the challenges to survival by water, soil and food specialists from Israel, Palestine, Egypt and Jordan. A third step may be to contribute to an *anticipatory learning* to adjust and to mitigate against the six projections and their possible linear or chaotic interactions.

Functionalists in the tradition of Mitrany have argued that a network of functional cooperation may gradually 'spill over' to the political realm. Although many political scientists have challenged this hypothesis, nevertheless functional cooperation may contribute to subjective security, to a gradual decline of the fear that basic values will be attacked by the other. Subjective security also requires satisfying basic human needs and overcoming the perception of humiliation and creating respect for the dignity of the other.

Only from a wider 'human security' perspective to environmental security challenges to humans matter and may be perceived as threats to human livelihood and survival. This requires a wider security concept that recognizes soft 'security' challenges and an understanding that they can be solved only by cooperation. Such strategies must build on existing forms of cooperation, like those of water specialists. The increasing water scarcity and degradation of joint aquifers have made the cooperation of water managers, specialists on conservation and distribution a matter of mutual survival. Can this functional cooperation be broadened by addressing: a) cooperation on re-use of wastewater for irrigation, b) cooperation on desalination, c) desertification strategies to combat soil erosion by sharing the mutual experience, as well as new methods in combating desertification, and d) on agricultural and food issues by an increased exchange of knowledge on farming in arid and semiarid areas, on cooperation in research, training and capacity building?

37.6.2 A Perspective for Functional Cooperation of Water, Food and Desalination Experts[16]

This cooperation could start building on existing foundations of cooperation among water, food and desalination specialists within the region with the goal to create regional interdependence that requires daily cooperation. This cooperation may focus on several components, starting with research, teaching and training and possibly later leading to joint activities.

37.6.2.1 Research on Common Environmental Challenges on Regional Implications of Global Environmental Change

This could become a major task for a quadri-national *Research Institute on Global Change in Taba, Eilat and Aqaba* (to be funded by international donors). Around such a high-level regional research centre, several technical institutions of higher learning with scholars from all four countries including outside scholars should be considered. At a later stage even a *joint technical university of the Gulf of Aqaba* with graduate schools in Egypt, Israel and Jordan may be considered addressing those technologies most in need to enhance the coping capacities of all four countries to adapt to and to mitigate the projected regional impacts of global environmental change. Such integrated advanced research centers could address the following areas for functional scientific cooperation:

1. Developing most advanced renewable energy technologies relevant for the region;
2. Schemes for desalination;
3. Sustainable food production;
4. Sustainable tourism;
5. New urban environments for jobs and living.

37.6.2.2 Ten Steps for Functional Cooperation in Addressing Common Environmental Challenges

The sponsors of such a joint research infrastructure for recognizing the common environmental challenges and for developing the adaptive and mitigation technologies could be the EU countries, the USA and Japan, with support of major international financial institutions (World Bank, IMF, and EIB). To realize this 'small hope' for functional scientific cooperation the following ten steps could be considered:

1st Step: *Problem Recognition and Creation of Awareness*: Establishment of an international Research Centre on Regional Impact of Global Environmental Change to Mitigate Environmental and Human Security Risks;

2nd Step: *Creating the Knowledge Basis for Mitigation*: Establishment of an International Technical University of the Gulf of Aqaba with international departments and faculty in Taba, Eilat and Aqaba.

3rd Step: *Setting up a Tri-national Integrated Infrastructure*, e.g. in *Taba*: a Centre and Laboratory on Renewable Energy: solar and wind funded by the EU; in *Eilat*: a Centre on Agriculture in Arid Regions in close cooperation with the Desert Research Center in Egypt and the Blaustein Institute on Desert Research in Israel with U.S. financial support, and in *Aqaba* a Centre for Hydrology and Desalination to be supported by Japan.

4th Step: *Supplying Fossil and Renewable Energy*. Initially such a pilot desalination plant could be operated with natural gas from Egypt and oil from Saudi Arabia, that could increasingly be replaced with energy from solar thermal with major plants in the desert and wind power installations along the Red Sea with excellent technical potential.

5th Step: *A Longer-term Goal could be the Creation of a Joint Infrastructure for a Local Hydrogen Economy Across the Gulf of Aqaba* as is presently being planned by DaimlerChrysler, Norskhydro and the Icelandic Electricity Company for Iceland.

6th Step: *Cooperative Mitigation of Water Scarcity* by a joint training institution for water experts on water efficiency, and building joint water desalination plants to serve all three countries; and finally

7th Step: *Creating New Jobs and Supplying Food* by joint research and training institutions for agriculture, irrigation, and desertification specialists for arid regions (ICARDA), and Centres for IT, computer, and software industry.

8th Step: *Develop Joint Advanced Medical Research Centres* where integrated teams of specialists and nurses would serve patients from all four countries. Besides desalination, the realization of regional health projects had the highest

16 The following proposal is based on the author's paper and presentation in Antalya in October 2004 (Brauch 2004a, 2004b). the technical proposal has been published as (Brauch 2006). This material is used below with the permission of Pierre Morel and Igor Linkov and the editor of the Springer NATO series Annelies Kersbergen with the Springer office in Dordrecht in the Netherlands. It has been developed further in light of the developments between September 2004 and October 2006.

support among Israelis and Palestinians (Brauch 2006: 27).

9th Step: *Build New Sustainable Cities and Tourism* by developing sustainable tourist centers based on renewable desalination, and developing sustainable cities with a low emission transport system, solar cooling and energy generation, as well as waste based electricity generation.

10th Step: *Gradually Create a Pride in Joint Achievements and Create a Culture of Cooperation and Tolerance*.

These ten small steps of functional cooperation among scientists and experts should avoid any national political preconditions. As in the case of the Marshall Plan, the donors should develop a united strategy and avoid becoming a victim of national politics in the region. These scientific institutions should be international institutions, and they could be under the management of UN agencies (e.g. UNEP, UNDP, UNU) or of high-level professional organizations, or even of new international private institutions that would guarantee with the support of the major donors both political independence and high academic standards.

37.6.3 Recognizing Common Challenges and Potential for Functional Cooperation in Responding to new Common Threats

This functional strategy of creating awareness and joint regional coping capacities will not realize the 'big dreams' of either side that cannot be mutually realized. These steps rather rely on the 'small hope' on what is scientifically possible, politically acceptable and economically feasibility with outside assistance. Multilateral frameworks may also assist in the post-conflict environmental reconstruction, especially of the OPT. Based on the functionalist credo that *form follows function*: the process should start with modest functional cooperation in areas the Israelis and Palestinians already support in such areas as water, environment, health, and food.

This requires also a gradual shift in the mind-set of policy-makers on either side to gradually shift from narrow military to wider human security concepts. A precondition is a recognition of the mutual challenges to survival (*awareness creation*), Thus, collaborative research should address these joint challenges, establish joint scientific and technological capacities in the region, use the energy potential of deserts for their greening and for the protection of the climate. The development of scientific, environmental and economic partnership building measures may contribute to a potential spill-over from functional cooperation to conflict resolution, and thus create preconditions for the development of confidence-building measures for the political and military realm.

Whether the Middle East conflict is a permanent conflict depends on the worldview and mindset of the observer or policy-maker and his or her preferred means in dealing with this conflict. The continued asymmetric cycle of violence will not produce peace but only continued hatred. It may be worthwhile to study the cases of successful peace-building and of overcoming centuries of conflicts, e.g. between Germany and France. It may be worthwhile to study the relevance of the simple but innovative political concepts of Mitrany, Marshall, Monnet and Gorbachev in shifting European policy after 1945 and especially also after 1990 from conflict towards West European and Pan-European cooperation..

This may require overcoming the traditional Hobbesian worldview and popular mind-set by maintaining, creating, building on and developing regional functional networks of water managers in Israel and Palestine on joint groundwater aquifers, of energy and food specialists as well as sustainable urbanization experts. The building of common institutions requires a certain degree of trust of the partners. The Gulf of Aqaba region could become a laboratory for a joint regional development. Such a process of cooperation could start with the technical education and expand to the economic sector, and finally hopefully contributing to a political 'spill over'.

The search for common strategies for 'human survival' that create joint coping capacities to adapt to and jointly mitigate the regional impact. This requires overcoming state-centred security concepts in which power is based purely on military means. requires to overcome state-centered security concepts based purely on power based on military means. Civil society may contribute to a gradual awareness for the common environmental security challenges with the goal of a stable human security. However, such a solution requires high political courage, President Sadat showed in 1979 by going to Jerusalem, and entering into a peace treaty with Israel. A 'new thinking' with a new generation of leaders, as with Gorbachev may gradually evolve, replacing some of the 'big dreams' of either side that can never be realized but that will only create more misery and deeper wounds on either side.

The basic hypothesis of this chapter is that ideas matter to overcome centuries of wars and conflicts between France and Germany, and to transform the Cold War peacefully. If "wars start in the minds of men" (UNESCO charter 1945), then ideas mattered in Europe and they will matter in the Middle East as well, once there is a willingness to break out of the confinements of Machiavellian or Hobbesian strategic thinking. The proponents of the *Geneva Initiative*, of the *Ayalon-Nusseibeh Plan: Vote for Peace* and of the many other peace plans have challenged the prevailing mind-sets of the past. Many small steps and new conceptual ideas are needed to break the ice.

Unilateral steps may contribute to a *gradual reduction in tensions* (GRIT) if they are part of a multilateral strategy. In the medium or longer-term there will be no alternative but to return to a multilateral peace process whatever its structure may be. One of the preconditions of success of the Marshall Plan was that the donor, in this case the U.S. government, used its conditionalized aid wisely. A strong and unified strategy of all donors and equal treatment of all recipients may be a necessary prerequisite.

Grants and credits should be conditional on the development of multilateral regional functional infrastructures with a premium for cooperation and sanctions for violation that would hurt the violator with the suspension of assistance. In the past, conflicts and crises have been times for learning and conceptual innovation. Thus, the present crisis may produce the conditions for a new 'small hope' for a step-by-step implementation. The conceptual ideas for multilateral functional projects should be developed by joint functional teams of scientists from Egypt, Israel, Palestine and Jordan. A multinational NGO consultation and planning process could be supported by the EU in the framework of the Euro-Mediterranean partnership or its Anna Lindh Foundation. Other functional projects may also be developed with the support of private foundations in Europe, North America (e.g. of the Carnegie, Ford or UN Foundation), and in Japan (by the Sasakawa or Nippon Foundation).

37.6.4 Summary and Conclusions

The key arguments and hypotheses of this chapter may be summarized in ten points:

1. The key goal of the chapter has been to develop conceptual ideas to gradually overcome the cycle of violence in the Middle East by increasingly recognizing the common regional impacts of global environmental change by addressing them jointly through a network of coordinated functional cooperation of water, soil, food, energy and health specialists of Egypt, Israel, Jordan and Palestine.
2. Periods of crises and conflicts have often been periods of conceptual innovation. During World War II, during the early and late Cold War and during the Korean War new conceptual ideas were developed by Mitrany, Marshall, Monnet and in the 1980s by Gorbachev that fundamentally changed the political thinking and strategy in Europe.
3. New ideas mattered in Europe and fundamentally changed the political context. Such a 'new thinking' and conceptual ideas are needed in the Middle East conflict to overcome the 'big dreams' and to develop the 'small hope' by functional cooperation of experts to visibly improve the quality of life of both Arabs and Israelis in the region.
4. There seems to be a will among Israelis and Palestinians in support of functional cooperation on desalination, health, environmental, agricultural, tourism and on other issues.
5. Future environmental challenges in the region may become so severe in the next few decades for many young Arabs and Israelis that they can only be addressed jointly.
6. There is a need for a fundamental shift in the perception of subjective and objective security threats, challenges, vulnerabilities and risks in the security discourses within all countries in the region: from a narrow military threat-based national security view to a wider security perspective that includes the economic, societal and environmental security dimensions and the human being as well as humankind as referent objects.
7. The European experience of functional cooperation on coal and steel matters and is a good model. It started in 1951/1952 during the Korean War and gradually expended to economic and nuclear cooperation in the Rome treaties of 1957 and later to other policy areas. However, cooperation should address not the most sensitive 'war industries' but the technological opportunities to cope jointly with the environmental challenges of the future.
8. Such a functional cooperation will not produce miracles and will not immediately break the cycle of violence. It must be robust and guided by conditions that apply to all countries in an equal and equitable manner and must be directed by a consortium of donors of the international financial and political institutions detached from domestic politics both in the donor and recipient countries.

9. If wars and conflicts start in the 'mind of men' then these minds of the citizens and policy-makers must be gradually changed to recognize the new common environmental challenges, to initiate a process of anticipatory learning by fostering the gradual emergence of joint coping capacities to address and to avoid those challenges to become threats to the security and survival of all people in the region.
10. While the donors should attach clear conditions on their support of cross-country functional cooperation in the region, the recipients should be persuaded to accept the support without political links to the prior realization of their respective 'big dreams'.

37.6.5 Proposal for a Network to Develop Feasible Functional Concepts

Given the ongoing conflict and the daily mourning over the dead and the wounded this functional perspective may appear unrealistic to many colleagues in the region due to experience and lack of trust. But in 1947, the ideas of Marshall and in 1950 those of Monnet or in 1986 those of Gorbachev were perceived by some – who were victims of their own mind-set - as dreams and by others as propaganda. Thus, the initial operational proposal is very modest:

1. A group of two functional (water, soil, food, energy) experts each from Egypt, Israel, Jordan and Palestine may be formed and 3 to 7 experts from Europe, Japan and North America should be added. This group should look for funding to make several meetings outside the region possible between 2007 and 2009.
2. These experts should be given a clear task: to explore areas where functional cooperation among experts in the region exists, where it appears to be possible and appears to be needed to address the challenges of the future.
3. These experts should be asked to develop a priority list of concrete proposals for functional cooperative projects that appear to be feasible at present.
4. These experts should ask private foundations for seed money to develop concept or pre-feasibility studies of most promising proposals for functional cooperative projects.
5. These experts should present these feasibility studies at a conference in Jerusalem or in the Gulf of Aqaba to representatives of the Middle East Quartet and to international donors and private foundations.

The Israeli-Palestinian Center for Research and Information (IPCRI) that co-organized the first and the second Israeli-Palestinian International Conference on 'Water for Life' in the Middle East in Geneva in 1992 and in Antalya in October 2004 may offer an appropriate organizational framework to get this process of searching for new cooperative ideas and areas of functional cooperation started.

References

Ball, George, 1994: "Foreword", Duchêne, François: *Jean Monnet. The First Statesman of Interdependence* (New York – London: W.W. Norton): 9–13.

Bogardi, Janos; Brauch, Hans Günter, 2005: "Global Environmental Change: A Challenge for Human Security – Defining and conceptualising the environmental dimension of human security", in: Rechkemmer, Andreas (Ed.): *UNEO – Towards an International Environment Organization – Approaches to a sustainable reform of global environmental governance* (Baden-Baden: Nomos): 85–109.

Brauch, Hans Günter, 2000: "Partnership Building Measures to Deal with Long-term Non-military Challenges Affecting North-South Security Relations", in: Brauch, Hans Günter; Marquina, Antonio; Biad, Abdelwahab (Eds.): *Euro-Mediterranean Partnership for the 21st Century* (London: Macmillan – New York: St. Martin's Press): 281–318.

Brauch, Hans Günter, 2001: "The Mediterranean 'Space' Beyond *Geopolitique* and *Globalization*. Common Space – Divided Region". in: Marquina, Antonio; Brauch, Hans Günter (Eds.): *The Mediterranean Space ant its Borders. Geography, Politics, Economics and Environment.* Collection Strademed 14 (Madrid: UNISCI – Mosbach: AFES-PRESS): 109–144.

Brauch, Hans Günter, 2002: "Climate Change, Environmental Stress and Conflict - AFES-PRESS Report for the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety", in: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Ed.): *Climate Change and Conflict. Can climate change impacts increase conflict potentials? What is the relevance of this issue for the international process on climate change?* (Berlin: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2002): 9–112; see at: <http://www.bmu.de/english/download/files/clim ges.pdf >.

Brauch, Hans Günter, 2003: "Security and Environment Linkages in the Mediterranean: Three Phases of Research on Human and Environmental Security and Peace", in: Brauch, Hans Günter; Liotta, P.H.; Marquina, Antonio; Rogers, Paul; Selim, Mohammed El-Sayed (Eds.): *Security and Environment in the Mediter-*

ranean. Conceptualising Security and Environmental Conflicts (Berlin-Heidelberg: Springer): 35–143.

Brauch, Hans Günter, 2004: “From a Hobbesian Security to a Grotian Survival Dilemma”, 40th Anniversary Conference of IPRA, Peace and Conflict in a Time of Globalisation, Sopron, Hungary, 5-9 July <http://www.afes-press.de/pdf/Sopron_Survival%20Dilemma.pdf>.

Brauch, Hans Günter, 2004a: “Impact of Global Warming and Non-Conventional Water Resources: Potential of solar thermal desalination to defuse water as a conflict issue - A conceptual contribution to conflict resolution and long-term conflict avoidance,” Paper at the Second International Israeli Palestinian Conference: Water for Life in the Middle East, 10th - 14th October 2004, Porto Bello Hotel, Antalya, Turkey; at: <http://www.afes-press.de/pdf/Brauch_Antalya_Paper.pdf>.

Brauch, Hans Günter, 2004b: “Impact of Global Warming and Non-Conventional Water Resources: Potential of solar thermal desalination to defuse water as a conflict issue - A conceptual contribution to conflict resolution and long-term conflict avoidance,” Powerpoint presentation at the Second International Israeli Palestinian Conference: Water for Life in the Middle East, 10th - 14th October 2004, Porto Bello Hotel, Antalya, Turkey; at: <http://www.afes-press.de/pdf/Brauch_Antalya_Presentation.pdf>.

Brauch, Hans Günter, 2005: *Freedom from Hazard Impact: Developing the Environmental Dimension of Human Security*, in: *Intersections*, UNU-EHS Policy Brief 2/2005.

Brauch, Hans Günter, 2005a: *Threats, Challenges, Vulnerabilities and Risks in Environmental Human Security, Source* 1/2005 (Bonn: UNU-EHS).

Brauch, Hans Günter, 2006: “Potential of solar thermal desalination to defuse water as a conflict issue in the Middle East - Proposal for functional cooperation in the Gulf of Aqaba”: in: Igor Linkov; Benoit Morel (Eds.): *Role of Risk Assessment in Environmental Security and Emergency Preparedness in the Mediterranean Region* (Dordrecht: Springer): 25–48.

Brauch, Hans Günter, 2006a: “Impact of Global Warming and Non-Conventional Water Resources: A conceptual contribution to conflict avoidance”, in: Hillel Shuval; Hassan Dweik (Eds.): *Water for Life in the Middle East. Proceedings of the 2nd Israeli-Palestinian International Conference on Water in the Middle East, Antalya, Turkey,* 10-14 *October* 2004 (Jerusalem: Israel/Palestine Center for Research and Information (IPCRI), January), vol. 2: 567–589.

Brauch, Hans Günter, 2006b: *Destabilisierungs- und Konfliktpotential Prognostizierter Umweltveränderungen in der Region Südeuropa und Nordafrika bis 2020/2050. AFES-PRESS Studie für den Wissenschaftlichen Beirat der Bundesregierung Globale Umweltveränderungen (WBGU).* Background Contract Study for WBGU (Mosbach, 14 June).

Brauch, Hans Günter, 2006c: *Conceptualizing the Environmental Dimension of Human Security within the United Nations.* AFES-PRESS Study for the Social and Human Science Division of UNESCO (Mosbach, July).

Brauch, Hans Günter, 2007: “Landscape Ecology and Environmental Security - Threats, Challenges, Vulnerabilities and Risks – Common and Differentiated Trends in the Mediterranean in the 21st Century”, in; Müller, Felix; Kepner, Bill et al.: (Ed.): *Use of Landscape Sciences for the Assessment of Environmental Security* (Dordrecht: Springer): i.p.

Brauch, Hans Günter, 2007a: “Environment and Security in the Middle East: Conceptualizing Environmental, Human, Water, Food, Health and Gender Security”, in: Pellant, Eric; Lipchin, Clive; Saranga, Danielle; Amster, Allyson (Eds.): *Integrated Water Resources Management and Security in the Middle East* (Dordrecht: Springer): i.p.

Brauch, Hans Günter, 2007b: “From a Hobbessian Security towards a Grotian Survival Dilemma”, in: Brauch, Hans Günter; Grin, John; Mesjasz, Czeslaw; Dunay, Pal; Chadha Behera, Navnita; Chourou, Bechir; Oswald Spring, Ursula; Kameri-Mbote, Patricia (Eds.), 2007: *Globalisation and Environmental Challenges: Reconceptualising Security in the 21st Century* (Berlin – Heidelberg – New York – Hong Kong – London – Milan – Paris – Tokyo. Springer-Verlag).

Brauch, Hans Günter; Grin, John; Mesjasz, Czeslaw; Krummenacher, Heinz; Chadha Behera, Navnita; Chourou, Béchir; Oswald Spring, Ursula; Kameri-Mbote, Patricia (Eds.), 2007: *Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts* (Berlin – Heidelberg – New York – Hong Kong – London – Milan – Paris – Tokyo: Springer-Verlag), i.p.

Brauch, Hans Günter; Kennedy, Robert., 1990: *Alternative Conventional Defense Postures for the European Theater, vol. 1: The Military Balance and Domestic Constraints* (New York Bristol Washington - London: Crane Russak: Taylor & Francis Group).

Brauch, Hans Günter; Kennedy, Robert., 1992: *Alternative Conventional Defense Postures for the European Theater, vol.* 2: *The Impact of Political Change on Strategy, Technology and Arms Control* (New York Bristol Washington - London: Crane Russak: Taylor & Francis Group).

Brauch, Hans Günter; Kennedy, Robert., 1993: Alternative Conventional Defense Postures for the European Theater, vol. 3: Force Posture Alternatives for Europe After the Cold War (New York Bristol Washington - London: Crane Russak: Taylor & Francis Group).

Brauch, Hans Günter; Selim, Mohammed El-Sayed; Liotta, P.H., 2003: “Security Concepts for Cooperation and Partnership in the Mediterranean: Conclusions and Outlook for the 21st Century”, in: Brauch, Hans Günter; Liotta, P.H.; Marquina, Antonio; Rogers, Paul; Selim, Mohammed El-Sayed (Eds.): *Security and Environment in* *the Mediterranean. Conceptualising Security and Environmental Conflicts* (Berlin-Heidelberg: Springer): 955–990.

Brinkley, Douglas; Hackett, Clifford (Eds.), 1991: *Jean Monnet. The Path to European Unity* (New York: St. Martin's Press).

Bromberger, Merry; Bromberger, Serge, 1969: *Jean Monnet and the United States of Europe* (New York: Coward-Mc Cann).

Bruinsma, Jelle (Ed.), 2003: *World Agriculture. Towards 2015/2030. An FAO perspective* (London: Earthscan).

Buzan, Barry; Wæver, Ole; Wilde, Jaap de, 1998: *Security. A New Framework for Analysis* (Boulder-London: Lynne Rienner).

Checkel, Jeffrey T., 1997: *Ideas and International Political Change. Soviet/Russian Behavior and the End of the Cold War* (New Haven – London: Yale Univ. Press).

Chourou, Bechir, 2005: *Promoting Human Security: Ethical, Normative and Educational Frameworks in the Arab States*, paper commissioned for United Nations Educational, Scientific and Cultural Organization (Paris: UNESCO).

Chourou, Bechir, 2007: "Human Security in the Arab world: A perspective from the Maghreb", in: Brauch, Hans Günter; Grin, John; Mesjasz, Czeslaw; Krummenacher, Heinz; Chadha Behera, Navnita; Chourou, Béchir; Oswald Spring, Ursula; Kameri-Mbote, Patricia (Eds.): *Facing Global Envionmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts* (Berlin – Heidelberg – New York – Hong Kong – London – Milan – Paris – Tokyo: Springer-Verlag).

CHS [Commission on Human Security], 2003*: Human Security Now* (New York: Commission on Human Security).

Dajani, Mohammad, 2004: "Big Dreams and Small Hope", oral presentation in the last session during the Third AFES-PRESS GMOSS Workshop on: Reconceptualising Security at the: 5th Pan-European Conference, The Hague, 9-11 September, see at: <http://www.bigdreamsmallhope.com>.

Donovan, Robert J., 1987: *The Second Victory: The Marshall Plan and the Postwar Revival of Europe*. Foreword by Clark M. Clifford (New York: Madison Books).

Duchêne, François, 1994: *Jean Monnet. The First Statesman of Interdependence* (New York – London: W.W. Norton Durham 1992).

Esposito, Chiarella, 1994: *America's Feeble Weapon: Funding the Marshall Plan in France and Italy, 1948- 1950* (Westport, Conn.: Greenwood Press).

FAO, 2000: *Agriculture: Towards 2015/30. Technical Interim Report* (Rome: FAO, Global Perspective Studies Unit).

Garthoff, Raymond L., 1994: *The Great Transition. American-Soviet Relations and the End of the Cold War* (Washington, D.C.: Brookings).

Gimbel, John, 1976: *The Origins of the Marshall Plan* (/ Stanford: Stanford University Press).

Groom, A.J.R., 1975: "Functionalism and World Society", in: Groom, Taylor, Paul (Eds.): *Functionalism. Theory and Practice in International Relations* (New York: Crane & Russak): 93–111.

Groom, A.J.R.; Taylor, Paul (Eds.), 1975: *Functionalism. Theory and Practice in International Relations* (New York: Crane, Russak & Co.).

Grunberg, Isabelle; Risse-Kappen, Thomas, 1992: "A Time for Reckoning? Theories of International Relations and the End of the Cold War", in: Allan, Pierre; Goldmann, Kjell (Eds.): *The End of the Cold War* (Dordrecht: Martinus Nijhoff Publishers): 104–46.

Haas, E.B., 1970: "The Study of regional Integration: reflections on the Joys and Agonies of Pre-theorising", in: *International Organisation*, 24,4: 607–646.

Haas, Ernst B., 1958; ^{2}1968:. *The Uniting of Europe: Political, Economic and Social Forces, 1950 – 1957* (London: Stevens & Sons – Stanford, CA: Stanford University Press).

Haas, Ernst B., 1964: *Beyond the Nation State. Functionalism and International Organizations* (Stanford, CA: Stanford University Press).

Hayek, Bassam, 2004: "Water Resources in Jordan and the Arab World", Third AFES-PRESS GMOSS Workshop on: Reconceptualising Security in an Era of Globalisation at the: 5th Pan-European Conference, The Hague, 9-11 Sept. (at: htp://www.afes-press.de/pdf/Hague/Bassam_Hayek_Water_resources.pdf).

Herrmann, Richard K.; Ned Lebow; Richard (Eds.), 2004: *Ending the Cold War: Interpretations, Causation, and the Study of International Relations* (London-New York: Palgrave Macmillan).

Herz, John H., 1959: *International Politics in the Atomic Age* (New York: Columbia University Press).

Hoffmann, Stanley, 1966: "Obstinate or obsolete? The fate of the nation state and the case of Western Europe2, in: *Daedalus*, 95.

Hogan, Michael J., 1987: *The Marshall Plan: America, Britain, and the Reconstruction of Western Europe, 1947-1952.* (New York: Cambridge University Press).

IOM, 2005: "Regional and Country Figures", at: <http://www.iom.int>.

IPCC, 2001: *Climate Change 2001. Impacts, Adaptation and Vulnerability. Mitigation* (Cambridge – New York: Cambridge University Press).

Israel, State of, Ministry of the Environment, 2002: *The Environment in Israel* 2002 (Jerusalem: Ministry of the Environment).

Issar, Arie S.; Zohar, Mattanyah, 2004, ^{2}2007: *Climate Change – Environment and Civilization ion the Middle East* (Berlin – Heidelberg: Springer-Verlag).

Jonas, Hans, 1979: *Das Prinzip Verantwortung* (Frankfurt: Insel).

Kam, Ephraim, 2003: "Conceptualising Security in Israel", in: Brauch, Hans Günter; Liotta, P.H.; Marquina, Antonio; Rogers, Paul; Selim, Mohammed El-Sayed (Eds.): *Security and Environment in the Mediterranean. Con-*

ceptualising Security and Environmental Conflicts (Berlin – Heidelberg: Springer): 357–366.

L.N. Lindberg, 1963: *The Political Dynamics of Economic Integration* (Oxford: Oxford University Press).

Lindberg, L.; Scheingold, S. (Eds.), 1971: *Regional Integration: Theory and Research* (Cambridge, Mass: Harvard University Press, Harvard).

Lindberg, L.; Scheingold, S., 1970: *Europe's Would-Be Polity: Patterns of Change in the European Community*. (Cambridge, Mass: Harvard University Press, Harvard).

Lipgens, Walter, 1977: *Die Anfänge der Europäischen Einigungspolitik* (Stuttgart: Ernst Klett).

Long, David; Ashworth, Lucian (Eds.) 1998: *New Perspectives on International Functionalism* (London - Basingstoke: Macmillan).

Lüdeke, M.K.B.; Moldenhauer,O.; Petschel-Held, Gerhard, 1999: "Rural poverty driven soil degradation under climate change: the sensitivity of the disposition towards the Sahel Syndrome with respect to climate", in: *Environmental Modeling and Assesment*, 4: 315–326.

Maier, Charles S. (Ed.), 1991: *The Marshall Plan and Germany: West German Development within the Framework of the European Recovery Program* (New York: Berg).

Mee, Charles L., Jr., 1984: *The Marshall Plan. The Launching of the Pax Americana* (New York: Simon & Schuster).

Mitrany, David, 1943: *A Working Peace System: An Argument for the Functional Development of International Organization'* (London: Royal Institute of International Affairs).

Mitrany, David, 1944: "The road to security", in: *Peace News Pamphlets No.* 29 (London: National Press Council).

Mitrany, David, 1966: *A Working Peace System* (Chicago: Quadrangle Books).

Mitrany, David, 1975: The Functional Theory of Politics (London: Macmillan).

Mitrany, David, 1975a: "A Political Theory for a New Society", in: Groom, A.J.R.; Taylor, Paul (Eds.): *Functionalism. Theory and Practice in International Relations* (New York: Crane, Russak & Co.): 25–37.

Mitrany, David, 1975b: "The Prospects of Integration: Federal or Functional?", in: Groom, A.J.R.; Taylor, Paul (Eds.): *Functionalism. Theory and Practice in International Relations* (New York: Crane, Russak & Co., 1975): 53–78.

Møller, Bjørn, 2003: "National, Societal and Human Security: Discussion – A Case Study of the Israeli-Palestine Conflict", in: Brauch, Hans Günter; Liotta, P.H.; Marquina, Antonio; Rogers, Paul; Selim, Mohammed El-Sayed (Eds.): *Security and Environment in the Mediterranean. Conceptualising Security and Environmental Conflicts* (Berlin – Heidelberg: Springer): 277–288.

Navari, C., 1995: "David Mitrany and International Functionalism", in: Long, D.; Wilson, O. (Eds): *Thinkers of the Twenty Years' Crisis: Inter-War Idealism Reassessed* (Oxford: Clarendon Press).

Newman, David, 2004: "'In the Name of Security: In the Name of Peace'- Environmental Schizophrenia and the Security Discourse in Israel – Palestine", Third AFES-PRESS GMOSS Workshop on: Reconceptualising Security in an Era of Globalisation at the: 5th Pan-European Conference, The Hague, 9-11 September.

Newman, David, 2007: "'In the Name of Security: In the Name of Peace'. Environmental Schizophrenia and the Scurity Discourse in Israel and Palestine", in: Brauch, Hans Günter; Grin, John; Mesjasz, Czeslaw; Behera, Navnita; Chourou, Bechir; Oswald Spring, Ursula; Kameri-Mbote. Patricia (Eds.): *Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts* (Berlin - Heidelberg - New York - Hong Kong - London - Milan - Paris - Tokyo: Springer-Verlag), in prepa-ration.

Oswald Spring, Ursula, 2001: "Sustainable Development with Peace Building and Human security", in: Tolba, M.K. (Ed.): *Our Fragile World. Challenges and Opportunities for Su-stainable Development. Foreunner to the Encyclopedua of Life Support Systems* (Oxford, UK; Eolss Publishers), Vol. 1: 873–916.

Parry, Martin; Rosenzweig, Cynthia; Iglesias, Ana; Fischer, Günther; Livermore, Matthew, 1999: "Climate change and world food security: a new assessment", in: *Global Environmental Change*, Part A, Vol. 9 (Suppl. 1): S51–S67.

Petschel-Held, Gerhard; Lüdeke, Matthias K.B.; Reusswig, Fritz, 1999: "Actors, Structures and Environments. A Comparative and Transdisciplinary View on Regional Case Studies of Global Environmental Change", in: Lohnert, B.; Geist, H.: *Coping with changing environments* (Ashgate: London): 255–291.

Pisani, Sallie, 1991: *The CIA and the Marshall Plan* (Lawrence, Ks: University of Kansas),

Population Reference Bureau, 2004: 2004 *World Population Data Sheet of the Population Reference Bureau. Demographic Data and Estimates for the Countries and Regions of the World* (Washington, D.C.: Population Reference Bureau).

Price, Harry Bayard, 1955: *The Marshall Plan and Its Meaning* (Ithaca, N.Y.: Cornell University Press).

Rosamond, B., 2000: *Theories of European Integration* (London: Macmillan Press)

Schellnhuber, Hans-Joachim; Block, Arthur; Cassel-Gintz, Martin; Kropp, Jürgen; Lammel, Gerhard; Lass, Wiebke; Lienenkamp, Roger; Loose, Carsten; Lüdeke, Matthias K.B.; Moldenhauer, Oliver; Petschel-Held, Gerhard; Plöchl, Matthias; Reusswig, Fritz, 1997: "Syndromes of Global Change", in: *Gaia*, 6.1: 19–34.

Selim, Mohamed El-Sayed, 2003: "Conceptualising Security by Arab Maghreb Countries", in: Brauch, Hans Günter; Liotta, P.H.; Marquina, Antonio; Rogers, Paul; Selim, Moham-med El-Sayed (Eds.): *Security and Environment in the Mediterranean. Conceptualising Security and En-*

vironmental Conflicts (Berlin-Heidelberg: Springer): 333–344.

Selim, Mohamed El-Sayed, 2007: “Environmental Security in the Arab World”, in: Brauch, Hans Günter; Grin, John; Mesjasz, Czeslaw; Krummenacher, Heinz; Chadha Behera, Navnita; Chourou, Béchir; Oswald Spring, Ursula; Kameri-Mbote, Patricia (Eds.): *Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts*. Hexagon Series on Human and Environmental Security and Peace, vol. 4 (Berlin – Heidelberg – New York – Hong Kong – London – Milan – Paris – Tokyo: Springer-Verlag), i.p.

Siegel, Irene, 2006: *Süd-Nord-Migration als Sicherheitsfrage in der nördlichen Mittelmeerregion. Italien und Spanien im Vergleich. Diploma thesis,* Berlin, Free University of Berlin, Otto-Suhr Institute for Political Science, submitted on 6 October.

Steffen, W.; Sanderson, A.; Tyson, P.D.; Jäger, J.; Matson, P.A.; Moore III, B.; Oldfield, F.; Richardson, K.; Schellnhuber, H.J.; Turner II, B.L.; Wasson, R.J., 2004: *Global Change and the Earth System. A Planet under Pressure. The IGBP Series* (Berlin-Heidelberg-New York: Springer).

Strzepek, Kenneth; Onyeji, S. Chibo; Saleh, Magda; Yates, David N., 1995: “An Assessment of Integrated Climate Change Impacts on Egypt“, in: Strzepek, Kenneth; Smith, Joel B. (Eds.): *As Climate Changes. International Impacts and Implications* (Cambridge - New York: Cambridge University Press): 180–200.

Taylor, P.; Groom, AJR , 1975: “Functionalism and International Relations”, in Groom, AJR; Taylor, P (Eds.): *Functionalism: Theory and Practice in International Relations* (London: University of London Press).

Taylor, Paul; Groom, A.J., 1975: “Introduction: Functionalism and International Relations”, in: Groom, A.J.R.; Taylor, Paul (Eds.): *Functionalism. Theory and Practice in International Relations* (New York: Crane & Russak): 93–111.

Twite, Robin, 2003: “A Question of Priorities – Adverse Effects of the Israeli-Palestinian Conflict on the Environment of the Region over the Last Decade”, in: Brauch, Hans Günter; Liotta, P.H.; Marquina, Antonio; Rogers, Paul; Selim, Mohammed El-Sayed (Eds.): *Security and Environment in the Mediterranean. Conceptualising Security and Environmental Conflicts* (Berlin-Heidelberg: Springer): 563–572.

Twite, Robin, 2007: “Security and Environment – the Israel-Palestine conflict”, in: Brauch, Hans Günter; Grin, John; Mesjasz, Czeslaw; Behera, Navnita; Chourou, Bechir; Oswald Spring, Ursula; Liotta, P.H. ; Kameri-Mbote. Patricia (Eds.): *Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts* (Berlin – Heidelberg – New York – Hong Kong – London – Milan – Paris – Tokyo: Springer-Verlag), in preparation.

UN, 2000: *World Urbanization Prospects. The* 1999 *Revision. Data, Tables and Highlights* (New York: UN Secretariat, Department of Economic and Social Affairs, Population Division, 27 March).

UN, 2001: *World Population Prospects: The* 2000 *Revision*, vol. I, *Comprehensive Tables* (New York: UN Population Division).

UN, 2002: *World Urbanization Prospects. The* 2001 *Revision. Data, Tables and Highlights* (New York: UN Department of Economic and Social Affairs, Population Division).

UN, 2003: *World Population Prospects: The* 2002 *Revision*, vol. I, *Comprehensive Tables* (New York: UN Population Division).

UN, 2003a: *World Population in* 2300*. Highlights*, Draft (New York: UN Population Division, 9 December).

UN, 2005: *World Population Prospects: The* 2005 *Revision*, vol. I, *Comprehensive Tables* (New York: UN Population Division).

UN, 2005: *World Population Prospects: The* 2005 *Revision*, Wall Chart, at: <http://www.un.org/esa/population/publications/WPP2004/World_Population_2004_chart.pdf>.

UNEP, 2003: *Desk Study on the Environment in the Occupied Palestinian Territories* (Nairobi: UNEP).

Wolf, Dieter, 1999: *Integrationstheorien im Vergleich. Funktionalistische und intergouvernementalistische Erklärung für die Europäische Wirtschafts- und Währungsunion im Vertrag von Maastricht [Integration theories in comparison. Functionalistic and intergovernmentalistic explanation for the European Economic and Monetary Union in the Treaty of Maastricht].*

Wolfers, Arnold, 1962: “National Security as an Ambiguous Symbol”, in: Wolfers: *Discord and Collaboration. Essays on International Politics* (Baltimore: John Hopkins University Press): 147–165.

38 Mitigating Negative Impacts of Global Warming on Water Resources of the Middle East

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Abstract

The author's investigation supported by research from Mediterranean countries shows that the present water shortage may worsen, once the globe warms. Thus, a water shortage catastrophe in the Middle East seems imminent. By understanding and evaluating future climatic trends and changes, in which long periods of drought may alternate with periods of abundance and floods, emphasis should be put on enlarging long-term storage capacity, especially that of groundwater resources, this, in some cases, on account of water quality in these reservoirs. The planned, long-term utilization of fossil aquifers, underlying most countries, should also be investigated.

Parallel to the climate change with its impact on the hydrologic cycle there will be increasing urbanization and a consequent rising demand for urban water supply, which may be partly answered by desalination of seawater or brackish groundwater, creating more urban sewage water. This after treatment can be reused and also be recharged into aquifers for the purpose of long-term storage. These two changes as well as pressure from population increase and rising standards of living mandate new plans for water resources management, including the creation of a regional, cooperative, long-term plan for the Middle East aiming at increasing and sharing its scarce water resources by agreements on trans-boundary influence and transport.

Keywords: global warming, hydrological cycle, reuse wastewater, regional cooperation.

38.1 Of Blessed Memory

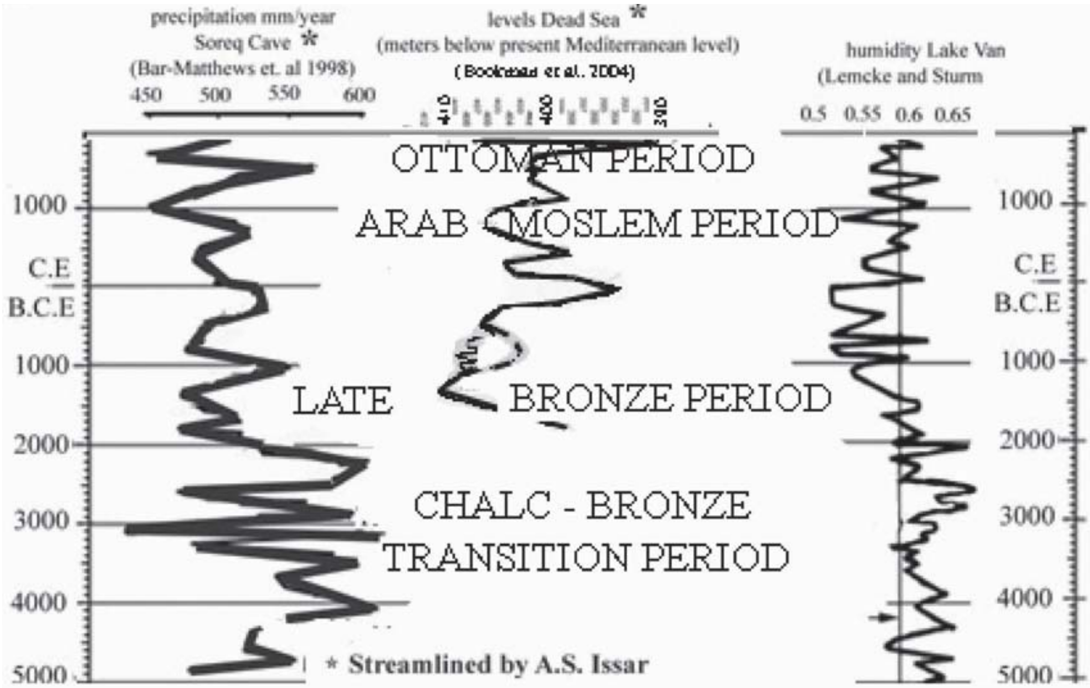
Just before this article was finalized, my former student, later assistant and afterwards colleague Prof. Ronit Nativ passed away. Certain aspects of her work are included in this article as can be seen in the reference list. I have to admit that Ronit did not agree with my suggestion to turn the Coastal Plain aquifer into a long term storage reservoire, which will cause the quality of its water to degrade. She argued that we should do our best to restore and then keep the high quality of the water of this aquifer. We disagreed about this issue and it is a sad task to present her side.

Ronit was a strong believer in the possibility of cooperation between Israelis and Palestinians in general and in the field of water resources in particular and did her best to advance such cooperation. Let us hope that her belief in the possibility of cooperation and peace between the people of this region will become true in the near future.

38.2 Introduction

The impact of past climate change on the hydrology has been investigated by this author in order to foresee what may be the impact of global change on the hydro-geological regime of the Middle East in general, and Israel and Palestine in particular. As measurements are restricted to a little more than a century, the only solution is the reconstruction of past climates and their impact on the environment, by the

Figure 38.1: Main Warm Dry Periods During the Past 7,000 Years. **Source**: Bar-Matthews/Ayalon/Kaufman 1998; Bookman/Enzel/Agnon/Stein 2004; Lemcke/Sturm 1997.



use of proxy-data. These include ancient sea, river and lake levels, chemical and environmental isotope data (^{18}O,^{2}H, ^{13}C and Sr) in cave, lake and sea sediments and in fluid inclusions, tree-rings and pollen assemblages. From these quasi-parameters the components of past hydrological cycles were deduced and were used for projecting the future (Issar 2003, 2006; Issar/Zohar 2004, 2007).

38.3 Past Impacts of Climate Changes

Figure 38.1 represents part of the proxy data which were used in order to decipher the nature of climate changes during the last 7000 years. The first curve refers to the changes in the quantities of precipitation gathered from the changes in the composition of the environmental isotopes (oxygen 18 and carbon 13) in the stalagmites in the Soreq Cave near Jerusalem (Bar-Matthews et. al. 1998) The last research enabled the estimation of the quantity of rains during historical periods. This was done by sampling contemporary rain and investigating the ^{18}O and ^{13}C isotopes' ratios, and then correlating them with the annual quantity of rain. Periods of high precipitation corresponded with periods of low temperatures.

The second curve represents ancient levels of the Dead Sea as deciphered from its exposed sediments (Bookman/Enzel/Agnon/Stein 2004, 2006). As can be seen, allowing for minor differences on the time scale, due to difference in type of sediments and their dating, periods of high values of precipitation correspond with high levels of the Dead Sea and vice versa.

The third curve portrays the ancient levels of humidity at Lake Van in Anatolia as deciphered from the chemistry of its sediments. Taking into account the constraints, mentioned earlier, with regard to the exact correspondence in time, it could be seen that the general sequence of periods of warm dry climate, according to the stalagmites correspond with low levels of the Dead Sea, which correspond with low levels of humidity at Lake Van and vice versa.

The main conclusion is that during cold periods the Middle East became humid, while warm periods were drier. Correlating the major climate changes with historical and archaeological data showed that during cold humid periods the Fertile Crescent flourished, while warm dry periods spelled socio-economic crises, desertion of urban centres especially along the desert margins, as well as processes of desertification. The warmer the climate (as can be seen by the oxygen 18 ratios) the drier it was (as can be seen from the lakes' data) with severe socio-economic crisis (archaeological data). In contrast, Egypt fared better, economically speaking, during most warm periods, and worse during cold climates. This was due to the fact that most probably the Nile gets its water from the tropical and sub tropical rain systems. (Issar/Zohar 2004, 2007).

A study of archaeological data from the various sites in the Fertile Crescent, situated along the margins of the desert, which experienced crisis during periods of dryness, shows that not all places shared the same fate. Urban and rural centres, which got their water supply from non-perennial streams or perched local aquifers, like Arad, Avdat and most of the Decapolis cities in Transjordan did not survive. On the other hand, sites like Jericho and Beit Shean that were lucky to get their supply from rivers or springs fed by regional aquifers, survived although in worst crises they were temporarily deserted. The perennial springs, which mitigated the impact of periods of dryness and also enabled the rapid restoration of these emerged in most cases from the limestone and dolomite aquifers of the Jurassic and Cretaceous i.e. the Mesozoic age and in some cases of the Eocene age. The aquiferous rocks of the Mesozoic age happen to build the backbone of the anticlinorial structures of the Taurides, Zagroids and Syrian arch, thus forming the high mountainous regions, which get high amounts of precipitation, thus recharging the regional aquifers. These emerge as perennial springs feeding the main rivers of the Fertile Crescent. It can be concluded that these geological pre-conditions i.e. deposition of limestone and dolomite rocks during the Mesozoic and the post-Mesozoic folding, generated the hydrogeological conditions, which helped the civilizations of the Fertile Crescent to survive during periods of warm and dry climate.

In addition to natural pre-conditions, cultural adaptations should not be neglected. An important lesson, which can be drawn from investigating the archaeological sites, is that in many cases a crisis resulting from the decline of the flow of a spring was postponed or entirely averted by human resourcefulness and innovation, such as augmenting and lengthening the period of flow by tunneling, or by inventing methods of pumping from wells (Issar/Zohar 2007).

38.4 The Past as a Key to Forecasting the Future

The main forecast based on the above-mentioned observations is that the expected intensifycation of the greenhouse effect will spell a dryer period in the Middle East, i.e. longer droughts and declining yearly average precipitation. This will cause the drying up of small springs in the areas where rainfall is relatively low. There will also be a decline in the flow of the big springs feeding the main rivers in this region. The average amount of surface runoff will also decline. This being said, it should be taken into consideration that while the multi-annual average of precipitation will decline, there may be years of higher percentages of precipitation, resulting in floods and also partially refilling of the depleted aquifers. This may happen after big volcanic explosions, like after that of the Pinatubo in the early 1990s.

As in the past, the decline of the flow of the big springs and consequently the rivers fed by them will depend on the geography of the area of recharge of the aquifers and on their long term storage capacity. In general terms it can be said that the big springs emerging from the limestone aquifers of the Mesozoic age which feed the rivers of Mesopotamia, Anatolia, Syria and Lebanon (including the Jordan) will decline but still persist. To what degree will this happen is a matter of further research. But it is expected that the tropical and subtropical systems feeding the Nile will become stronger, resulting in higher levels of this river.

38.5 The Present

As was pointed out above the impact of the decline in the average precipitation, on the flow of springs will be mitigated to a certain extent by the enormous storage capacity of the regional aquifers. In many regions the utilization of these aquifers can be enhanced by drilling and lowering of the water table in years of want, taking all precautions not to undertake ireversible steps. The general recommendation should thus be:

1. Develop the tools in which the storage capacity of regional aquifers could be optimally managed;
2. Enlarge artificial storage, when possible;
3. Transfer water from regions of abundance but little use to regions where the opposite conditions exist;
4. Develop new untapped water resources.

To asses the possibility for these steps the present situation has to be taken into account.

38.5.1 Hydrogeologic Status of Major Joint Aquifers

The practical application of these steps will be shown for the water resources of Israel and Palestine. Therefore, a brief survey of the hydrogeology of this part of the Middle East will be given for its regional aquifers.

38.5.1.1 The Jurassic and Cretaceous Limestone Aquifers

These aquifers supply the base flow of the Jordan River, which feeds the Sea of Galilee. A great part of the recharge area of these aquifers is in Syria and Lebanon. To this lake also flow springs and winter floods from the Galilee and the Golan Heights. Due to topographical reasons the groundwater storage of these aquifers can not be tapped and the overflow of these aquifers is stored in the Sea of Galilee. Presently the operational storage capacity of the Sea of Galilee is about 560 MCM (about 25 per cent of Israel's annual consumption) due to evaporation and contribution from saline springs the salinity of the water of this lake is about 220 mg Cl/liter.

38.5.1.2 The Cenomanian Turonian Limestone (Judea Group) Aquifer

This aquifer is built of permeable limestone and dolomite. Its permeability is a function of the dissolution processes. The recharge areas are mainly in the mountainous area, from where as ground water it flows to all directions, north, south, west and east. The western flank of the anticlinorium forms the Yarkon-Taninim aquifer, whose annual recharge is about 350 MCM. The increase in water pumping from the aquifer reduced the western natural discharge in the Taninim springs to about 33 MCM of brackish water. The total quantity pumped annually from this aquifer is about 570 MCM, i.e. twice the recharge, which results in the exploitation of the one time reserve and depletion of the water table. Due to the high permeability of this aquifer the water table rises sharply during wet years and declines quickly during dry years.

The part of the Judean Group aquifer east of the ground water divide is flowing towards the Rift Valley, and part of it to the fresh and mostly brackish springs flowing into the Dead Sea. A part flows to the North East to the Beit Shean Valley, with a quantity of about 250 MCM. The springs along the eastern coast of the Dead Sea get their salts, most probably, from the contact with the interface of the Dead Sea water. Thus fresh water may be tapped more to the west, nearer to the ground water divide. This means deep wells and pumping from great depth, which implies non-conventional methods of drilling and pumping.

38.5.1.3 The Coastal Plain Aquifer of the Quaternary Age

The third aquifer of importance is the Coastal Plain aquifer. It is built of permeable sandstone rocks. With inter-bedding layers of semi-permeable loam to impermeable clay in-between the sandstone layers, dividing them into sub-aquifers. This subdivision is especially developed in the western part of the coastal plain, where one borehole may go through a few separate sub-aquifers, each having a different head and sometimes also different quality. Due to this separation the infiltration from the rain falling on the sandstone layers in the western part, as well as polluting solutes, affects only the upper most sub-aquifer. In this part of the Coastal Plain, all along the coast, there are areas in which; due to overpumping and decline of the groundwater table, there is a penetration of the sea interface. This, however, is differentiated according to the position of the hydraulic head in each sub aquifer. The separating layers disappear a few kilometers away from the shoreline towards the east, and the sub aquifers merge together to form one phreatic system. This causes the water table of the aquifer to be directly fed by the water infiltrating into the subsurface. In general terms one can say that in the central and eastern part of the Coastal Plain the aquifer is one unit, being subdivided only by semi-permeable loams, which retard but do not confine vertical flow. Moreover, these layers, due to their clay content, may act, as filters by absorbing pollutants, like heavy metals.

Generally, the ground water flow in the Coastal Plain aquifer is from east to west (from the recharge area on land toward the outlet which is the sea), except in areas of over-pumping, where the massive lowering of the water table has produced cones of depression. In these areas the flow is directed towards the 'sinks'.

On the whole the thickest part of the aquifer (about 150 m) is along the seashore. Towards the east the aquifer thins out to a few tens of meters. As mentioned already, the Coastal Plain aquifer is recharged by rain falling on its surface and to some extent by floods coming from the mountains. It is also fed by return flow from irrigation and leakage from the sewage systems. The annual average natural recharge including the flow from the east, calculated by the Hydrological Service of Israel for the year 1998/9 reached 155 MCM, about 60 MCM is recharged annually due to infiltration from irrigation and about 110 MCM was recharged artificially. In total about 505 MCM, were pumped out annually. About 27 MCM flowed to the sea (Hydrological Survey of Israel 1999).

The average salinity of the water in this aquifer in Israel has risen from 100 mg/l Cl during the thirties to 200 at present and is rising 2.4 mg/l annually. This is mainly due to backflow from irrigation and recharge by reclaimed sewage. Nitrates increased from an average of 10 mg/liter in the 1930's to about 60 mg/liter at present. It is rising at the annual rate of 0.5 mg/liter. In the part of the Coastal Plain underlying Gaza, the situation is even worse, and approximately 44 per cent of the wells show nitrate concentrations higher than 90 mg/liter (Melloul/Collin 1994).

38.5.1.4 The Aquifers under the Negev

Three main aquifers containing fresh to brackish water underlie the Negev Desert.

a.) The Nubian Sandstone (N.S) aquifer, belonging to the Kurnub Group, of the Lower Cretaceous Age. The average thickness is about 250 meters. The salinity varies between 800 to 2000 mg/liter Cl. The water is fossil; age range is around 20,000 years
b.) The limestone-dolomite aquifer belonging to the Judean Group of Cenomanian-Turonian age. Its average thickness about 500 m. Salinities range from 500 to 2,000 mg/l Cl. The water is mainly fossil; its age range is around 10,000 years.
c.) The alluvial aquifer of the Rift Valley. Its thickness varies from a few tens to a few hundred m. Recharge is contemporary. Salinities are mostly low. This aquifer is not within the scope of the current research.

In general it can be said that the first two aquifers are part of a regional aquifer extending below the Sinai Desert. The general direction of the flow is from the outcrops bordering the igneous block of southern Sinai towards the Suez Gulf in the west and the Rift Valley and Dead Sea in the east. Recharge takes place on the outcrops extending along the crests of the anticlines and the erosion sinks exposing these rocks. In the areas surrounding these anticlines local groundwater mounds are formed in which water is younger and less saline. However, the quantities of contemporary recharge are negligible in comparison with the general quantity of fossil water stored in the aquifers.

Research carried out by the author and his colleagues has shown that the fossil water aquifers under the Negev can be regarded as a regional resource, containing a volume of water able to last for centuries, even when quantities in the order of magnitude of 300 million m^3 are planned to be pumped annually.

38.6 Future Plans for Water Development

It is obvious to all the authorities concerned with the future development and management of the water resources of Israel that the potential for the development of new natural water resources is negligible and the answer for future demand for household consumption will come from desalination of brackish and seawater, while the supply to answer part of the demand for agriculture will come from reclaimed sewage. In the Negev the development of the fossil water aquifers, as well as reclaimed sewage will gurantee future supply. In 1994 about 365 MCM of sewage water was produced in Israel, of which about 309 MCM was treated. From this about 254 MCM have been used. About 136 MCM have been treated to the level allowed for irrigation and was used directly (Klein 1999). The rest was partly recharged into the Coastal Plain aquifer and part flowed into the sea. According to the Hydrological Survey (1999) the quantity of reclaimed sewage recharged into the Coastal Plain aquifer in 1997/8, was 110 MCM. Needless to say that this has affected the quality of water in this aquifer. The plan for future development of reclaimed sewage prepared by Tahal in 1997 for the Water Commissioner, forecasts that in the year 2020 about 593 MCM will be available, from which 494 MCM will be directly used to answer part of the agricultural demand. The rest will be recharged or used for recreation sites, such as keeping the flow of rivers etc. According to the estimates of the former Water Commissioner of Israel, Eng. Shimon Tal, the quantity of sewage, which has to be reclaimed by the year 2020 must reach 830 MCM. The rest of the yearly demand by agriculture amounting to 530 MCM will come from natural resources (Tal 2001).

Below additional solutions for the water problems of Israel and Palestine will be offered. Needless to say, the execution of these ideas will have to be done stage by stage, parallel to progress in the peace process. Yet, it is important to proceed with the preparation of a master plan based on new ideas and concepts in the first place in order to eliminate unnecessary obstacles to the peace talks, and in the second place to give negotiators new ways of thought.

This optimistic attitude is supported, in some way, by a survey of the history of the development of the water resources of Israel. This survey shows that from time to time experts expressed the opinion that the limited water resources of this area will not be sufficient to supply a new modern agricultural and industrial society. The innovations in all that concerns methods of water development and use, introduced by water engineers, hydro-geologists and agronomists have already falsified this prophecy.

38.6.1 Development of a New Long-term Storage Reservoir for Israel and Palestine in the Coastal Plain Aquifer

According to Tal (2001) annual agricultural water demand by the year 2020, in Israel will reach 1350 MCM (Tal op. cit.). The future agricultural demand by the Palestinians may reach 415 MCM (Alatout 2000). Thus in the year 2020 the total Palestinian and Israeli demand for agriculture may reach 1,770 MCM. Taking into account that part of it will come from reclaimed sewage water, which when fully exploited in both countries may reach 830 MCM/Y, and that an annual amount of about 530 MCM can be supplied from natural resources (Tal 2001), there will still remain an unsatisfied annual demand of about 400 million MCM for agriculture. All this is said when no major deterioration of the climate is projected. Once a pessimistic forecast is adopted, the fall in the natural supply may amount to 25 per cent of the present average amount. This will bring the deficit for agricultural demand to 500 MCM/year.

Taking this figure into consideration, it seems to be obvious that water supply from natural resources for irrigation will have to be reduced drastically by the year 2020 (and even totally cut during spells of dry years) and a major part of the urban demand of the Israeli and Palestinian population will have to be met by the desalination of brackish and of seawater. At the same time the increased demand for agriculture will be mainly by the Palestinian population, and for this purpose the use of reclaimed sewage will increase. Considering these general assumptions, the two main problems to be dealt with are:

1. The storage of surplus of water during years when precipitation will be above the average.
2. The storage of reclaimed sewage in general and in particular during the winter months, when supply exceeds the seasonal demand for irrigation.

Examining the various aquifers from the point of view of storage, it seems clear that the greatest potential for further augmentation of storage is in the Coastal Plain. This is due to the fact that the sandstone layers from which this aquifer is built have a high storativity coefficient (average 10 %), due to their high porosity. At the same time the velocity of flow in the sandstones is relatively low due to low permeability coefficient (K = 1 m/d). On the other hand the high permeability of the limestone aquifer (K=100 m/d) causes water recharged to flow to the outlets in a rather short time. Another fact, which has to be taken into consideration is that in the eastern part of the Coastal Plain a large volume of the aquiferous layers is unsaturated, and can be recharged artificially providing additional storage.

The shifting of the recharge and storage areas to the east is a prerequisite in order to meet the future requirements for storage, which should reach about five times more than that of the present. Today this is carried out in a region densely populated and as the demand and cost of land is increasing. Moreover the location of the present subsurface storage field of the treated sewage of the central Coastal Plain (the Shafdan) is at a rather small distance from the sea. This is an area underlain by confining layers, which limits the inflow of the recharged water to the deeper aquifer and thus causes water to flow to the sea. If the proximity to the sea remains, these losses will become even more pronounced once the quantity stored is increased.

These are the basic assumptions, concerning desalination and agricultural use. They, as well as the hydrogeological characteristics of the Coastal Plain, must be taken into account in planning for the storage of reclaimed sewage and floodwater. Once Israel and the Palestinian Authorities collaborate, they will jointly be able to close the gap between supply and demand.

In the first place the Coastal Plain aquifer will have to become the joint storage for Israel and the Palestinian Authority. Once the recharge of reclaimed sewage and storage areas have shifted from the western part of the region to its eastern part it will also be possible to recharge and store the floodwater coming from the Palestinian territory. At the same time Israel will have to plan anew its recharge areas for its reclaimed sewage and floodwater. Due to paleo-environmental conditions, which existed during the Quaternary period, all the riverbeds, which cross the Coastal Plain are underlain by thick layers of clay. Moreover, adequate natural sites for storage dams are very rare in the central and western parts of the Coastal Plain. These conditions dictate that the best places for storage and later gradual recharge of the floods are in the eastern parts of this region, close to the foothills.

As part of the new cooperative planning, storage in the part of the Coastal Plain underlying the Gaza Strip should follow a similar policy. This will enable the recovery of the over-pumped aquifer below the Gaza Strip. This can only be done once the gap between supply and demand in this region will be supplied from Israel and local desalination projects. On the whole the total quantity of water recharged annually to the Coastal Plain aquifer would be of the order of magnitude of 600 MCM. The quality of this water supply would be as follows:

1. One-third recharged from precipitation, infiltration from urban runoff and returning irrigation water would contain about 300 mg/liter Cl.
2. Another third, coming from the winter flow of the Jordan River, diverted above the Sea of Galilee to the Israeli National Carrier would contain about 100 mg/liter Cl.
3. One-third will come from reclaimed wastewater, would contain an average of 400 mg/liter Cl.
4. An additional quantity, not yet estimated, will be from the desalination plants during periods of low demand.

All this would eventually combine to give an average water quality of about 250–270 mg/liter Cl. This conceptual model of the coastal aquifer as the main long-term storage aquifer is an example of a new way of thought on a regional plan for Israel and the Palestinian Authority.

38.6.2 Diversion Projects of the Jordan and Yarmouk Rivers

As mentioned this plan takes into consideration the diverting of part of the flow of the Jordan River above the Sea of Galilee, at about 100 meters above sea level (the original plan for the National Water Carrier). This will enable the use the Sea of Galilee as a storage for the Yarmouk River floodwater instead. This would also help Jordan store water for its Jordan Valley agriculture without the need of a big dam on the Yarmouk River. Currently, the Jordan flow is stored in the Sea of Galilee, 200 meters below sea level, from which it is later lifted and distributed through the National Water Carrier to areas extending mainly over regions averaging an altitude of 150 meters above sea level. Pumping thus requires about 12 per cent of total Israel's electricity production and raises the average cost of water in Israel to 0.30 US $ per cubic meter (Lonergan/Brooks 1994).

38.6.3 Changing the Regime of Flow of the Mountain Aquifer

Once the role of the Coastal Plain aquifer is recognized as a storage reservoir for a regional water supply of low-grade water the limestone aquifer of central Israel will remain the main supply of water of drinking quality. This will require close cooperation between Israel and Palestine. Cooperative efforts will enable the two parties to capture the water from the eastern subsurface drainage basin of the mountain aquifer about 100 million cubic meters per year, which flows to the Rift Valley to emerge as brackish or saline springs.

38.6.4 Development of New Recharge Techniques

A series of problems related to the more technical aspects of recharge calls for interdisciplinary brainstorming, where geologists, environmentalists, water engineers, and economists try to devise solutions for inventing new recharge methods, and locating new recharge areas in a region with a very high population density. A special emphasis must be put on the reclamation and storage of water from built up and paved urban areas. This can be achieved either by the development of porous concrete and asphalt or by devices of collection of urban runoff and its recharge.

38.6.5 Utilization of one Time Reserve from Fossil Aquifers

Several studies by this author (Issar/Bein/Michaeli 1972; Nativ/Bachmat/Issar 1988, Tzur/Park/Issar 1989, Issar 1994) have shown that a few hundred million cubic meters per year may be pumped out from the Nubian Sandstone aquifers underlying the Negev and Sinai. This pumping is guaranteed for at least the coming century. The actual quantity and duration would be a function of the management policies and various economic factors. In principal, however, such a project is technically feasible, and the water is of adequate quality. Although this water source is not replenishable, it may be regarded as any other non-replenishable resource (e.g. oil, coal, and iron ore). In other words, the evaluation of whether or not to use it should be based on economic considerations.

38.6.6 Importing Water from Turkey

Turkey has proposed a mega-project of transporting water from the eastern Mediterranean coastal area of Turkey to Syria, Jordan, Saudi Arabia, and the Gulf Emirates in the past. The Turkish plan includes two pipelines. The western line would extend 2,800 kilometers and pump 1,300 million cubic meters per year to Syria, Jordan, and Western Saudi Arabia. The eastern line would cover 4,000 kilometers en route to the Persian Gulf, through Kuwait, Eastern Saudi Arabia, Bahrain, and Qatar. An alternative pipeline has also been proposed (unofficially) to supply water to Syria, Jordan and the West Bank, its capacity being 730 million cubic meters per year (Lonergan/Brooks 1994).

While the problem of water scarcity of Syria is more that of transport from one part to the other, the problems of Jordan, Palestine, Israel and especially Egypt are much more crucial than that of the Arabian Peninsula. The most crucial problem is that of the fast growing population of Egypt where the demand for food supply may pose a severe economic crisis in this country if no special measures are taken to boost its available water supply. Thus an alternative plan to that mentioned above should aim to avoid this catastrophe and at the same time solve the long-term problems of water shortage in Israel, Palestine and Jordan. This plan, in view of the forecasts of global climate change, is a 'win or win' project. This because the warming of the oceans may bring a strengthening of the monsoons, which would in turn cause during some years a surplus of water in the Nile River exceeding the capacity of the Aswan dam. Yet, this is still only a hypothesis. Thus, when the likely water shortage develops in Egypt, a Turkish project may bring water from north (Turkey) to south (Egypt), but if there is an abundance of water in the south, a Nile-based project may work in the opposite direction.

References

Alatout, S., 2000: "Water Balances in Palestine: Numbers and Political Culture in the Middle East", in: Brooks, D. B.; Mehmet, O. (Eds.): *Water Balances in the Eastern Mediterranean* (Ottawa, Canada: IDRC): 59–84.

Bar-Matthews, M.: Ayalon, A..; Kaufman, A., 1998: "Middle to Late Holocene (6,500 yr. period) paleoclimate in the Eastern Mediterranean region from stable isotopic composition of speleothems from Soreq Cave, Israel", in: Issar, A.S.; Brown, N. (Eds.): *Water, Environment and Society in Times of Climate Change* (Dordrecht: Kluwer Academic Publishers): 203–214.

Bookman (Ken-Tor), R.; Enzel, Y.; Agnon, A,; Stein, M,, 2004: "Late Holocene lake levels of the Dead Sea", in: *Geological Society of America Bulletin*, 116,5/6: 561.

Bookman (Ken-Tor), R.; Enzel, Y.; Agnon, A.; Stein, M.; 2006: "Quaternary lake levels in the Dead Sea basin: Two centuries of research", in: *Geological Society of America*, Special Paper 401: 155–170.

Hydrological Survey of Israel, Ministry of Infrastructures, Government of Israel, 1999: *The Development of utilization and the state of the water resources of Israel to Autunn* 1998 [in Hebrew] (Jerusalem: Hydrological Survey of Israel,.

Issar A.S.; Zohar, M., 2004: *Climate Change, Environment and Civilization in the Middle East* (Heidelberg; Springer-Verlag,).

Issar A.S.; Zohar, M., ^{2}2007: *Climate Change, Environment and Civilization in the Middle East* (Heidelberg; Springer-Verlag,).

Issar S. A., 1994: "Fossil water under the deserts of the Middle East: A safeguard against strife", in: Isaac, J.; Shuval, H. (Eds.): *Water and Peace in the Middle East*. Proceedings of the first Israeli-Palestinian International Academic Conference on Water. Zürich, Switzerland, 10–13 December 1992.

Issar, A., S.; Nativ, R., 1988: "Water Beneath Deserts: Keys to the Past, A Resource for the Present", in: *Episodes*, 11,4: 256–262.

Issar, A.; Bein, A.; Michaeli A., 1972: "On the ancient water of the Upper Nubian Sandstone aquifer in central Sinai and southern Israel", in: *Journal of Hydrology*, 17: 353–374.

Issar, A.S., 2003: *Climate Changes during the Holocene and their Impact on Hydrological Systems* (Cambridge University Press: Cambridge).

Issar, S. A., 2006: "Water turning the wheels of history", in: Gavaghan, Helen (Ed.): *Science, People and Politics*, Vol. 1, at: <http://www.gavaghancommunications.com/middleeastwater.html>.

Klein H., 1999: "The technology of reclamation in the Israeli water system" [in Hebrew], in: *Maim Vehaskaya*, Issue 394: 22–27.

Lemcke, G.; Sturm, M., 1997: "d^{18}O and Trace Element as Proxy for the Reconstruction of Climate Changes at Lake Van (Turkey): Preliminary Results", in: Dalfes, G.; Kukla, G.; Weiss, H. (Eds.): *Third Millennium B.C. Climatic Change and Old World Collapse*. NATO ASI Series I: Global Environmental Change, Vol. 49. (Berlin: Springer Verlag): 654–678.

Lonergan, S.; Brooks, D.B. 1994: "The economics of water in the Middle East". Annual Meeting of the American Association of Geographers, San Francisco, CA, USA (Washington, DC: American Association of Geographers).

Melloul, A.; Collin, M., 1994: "The Hydrological Malaise of the Gaza Strip", in: *Israel Journal of Earth Science*, 43: 105–116.

Nativ, R., 2004: "Can the Desert Bloom? Lesson Learned from the Israeli case", in: *Ground Water*, 42, 5: 651–657.

Nativ, R. ; Bachmat, Y.; Issar, A. : 1987: "Potential use of the deep aquifers in the Negev desert, Israel – A conceptual model", in: *Journal of Hydrology*, 94: 237–265.

Tal, S., 2001: "The crisis of the water economy", [in Hebrew] in: Tal, A. (Ed.): *Water Economy Crisis – Research and ideas* (Tel Aviv: Tel Aviv University – The Interdisciplinary Center for Technological Analysis and Forecasting): 4–9

Tzur, Y.; Park, H.; Issar, A., 1989: "Fossil Groundwater Resources as a Basic for Arid Zone Development. An Economic Inquiry", in: *International Journal of Water Resources Development*. 5,3: 191–201.

39 The Past as a Key for the Future: Mutual Dependencies of Land Use, Soil Development, Climate and Settlement

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Abstract

It is of high actual importance to clarify historic climate variations and their impact, because it is not possible to predict future developments and their drivers, unless those of the past are understood. The Decapolis area in northern Jordan provides excellent opportunities to analyze this question. Environmental change as a result either or of human activities or of climate variation could have been responsible for the abandonment of the area by Arab farmers in medieval times. Recent studies let the climatic changes are the more likely reason. There are several arguments for this conclusion: Climatic models match very well to the historical development. The Arab farmers were also highly skilled. Our investigations revealed a very heterogeneous land use and soil development pattern, and found no evidence for a sudden, widespread general erosion event. In contrast, relic surfaces and the soil's genesis point to moister conditions in the past and differences in the soil's development point to diverse land use intensities. Though it is evident that land use changed the character of the landscape and can be tracked according to soil development, it did not lead to advancement of the desert. It therefore seems that desertification is related to climate change.

Keywords: Climate change, historic land use, impact of global warming, settlement history, soil erosion, soil properties.

39.1 Introduction

Global warming is feared to lead to climate change, water shortage and advancing desertification. However, it is still discussed whether global warming really takes place, whether it is caused by CO_2 emissions, destruction of rainforests or natural factors which are not related to human activities, and it is not yet determined how the exact consequences of global warming may look like (Berner/Streif 2000).

Ways to a better understanding of climate are investigations of past changes. Human influence is supposed to be minimal before industrialization, while the global atmospheric air circulation is believed to be stable since the last Ice Age (Hare 1961). Nevertheless, investigations in past climates found fluctuations during the Holocene (Butzer 1961; Nützel 1975, 1976). As the methodical approaches were greatly improved in recent years, research increasingly focused on shorter time intervals and historic periods (Bar-Matthews/Ayalon/Kaufmann 1998; Issar 1992, 1998, 2003; Frumkin/Stein, 2003; Bookman/Enzel/Agnon/Stein 2004). But it was so far not possible to evaluate the exact impact of the discovered variations or to understand their reasons.

The settlement history of the Near East shows periods of abandonment, which seem to be related to these climate fluctuations. A rainfall calculation from Soreq Cave (Bar-Matthews/Ayalon/Kaufmann 1998) found decreasing precipitation to about 50 mm during short periods (100 years) which matches the desertion of sites (Lucke/Schmidt/al-Saad/Bens/Hüttl 2005). However, it neither proves causality nor implies the reasons or the exact impact of lowered precipitation. It is possible that the rainfall reductions led to an advance of the desert, reducing agricultural potentials and forcing the abandonment of sites. But it has to be clarified whether a reduction of 50 mm is enough to let the desert advance. It is connected with the question of whether the rainfall pattern changed as well. The latter is most important for agriculture (Seth 1978; Lanzendörfer 1985). Additionally, it is also possible that land use was too intensive and caused desertification. Land use has an effect on climate, too, and the activities of early man may have contributed to the rainfall variations (Claussen 2003; Claussen/Claussen/Brovkin/Ganopolski/Kubatzki/Pethoukov 2003).

To cope with possible negative developments caused by global warming, it is important to better understand the past. To achieve this goal, contributions can be made by soil science, archaeology and evaluation of land use. Soils are like a memory which stores changes of the environment and allows for a reconstruction of past landscapes and climate conditions (Bäumler 2001a, 2001b; Bäumler/Bäumler/Ni/Petrov/Lemzin/Zech 2002). In combination with archaeology, soil examinations can describe this (Lucke/Schmidt/al-Saad/Bens/Hüttl 2005). If the historic land use is evaluated, impacts of climate variations and a possible effect of land use change on local climate can be assessed.

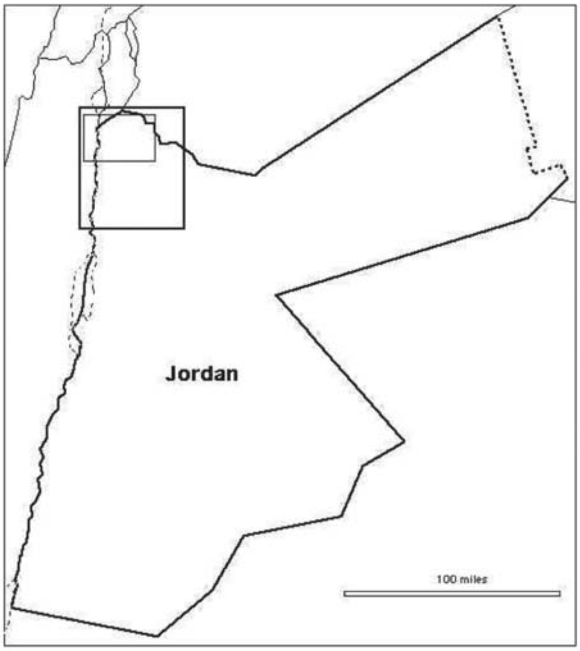
39.1.1 The Decapolis Region

The Decapolis region in Northern Jordan and Israel is an excellent place for research on the relationship of settlement history, land use and climate (figure 39.1). It is situated close to the desert, which causes strong variations of rainfalls; while the settlement history is fairly well known and past climate data are available as well for the Near East. In antiquity, numerous cities flourished in the Decapolis region. Most sites were settled in the Early Bronze Age. During the Roman, Byzantine and Umayyad periods, the cities grew considerably and many monumental buildings were constructed, demonstrating great wealth of the inhabitants – but during the Abbasid period, the region suffered a sharp decline and the cities were abandoned (Hoffmann/Kerner 2002). Apart from a minor resettlement during the Ayyubid-Mamluk time, no cities were present in the Decapolis region after that and the area was characterized by villages and nomadic tribes until the end of World War II (Walmsley 1992, 1997).

The region includes several landscapes: The Jordan valley is characterized by hot and dry climate, but numerous springs and the Jordan River make intensive irrigation possible. The heavily dissected highlands further east allow for limited irrigation, as perennial streams are scarce and many valleys deep and narrow. The plateau, however, receives sufficient rainfall for intensive agriculture. Further east, the highlands merge with the desert and precipitation variations increase. Despite the heterogeneous landscape, the region was a political unit and the sites experienced a similar historic development.

Several authors have suggested climate changes to be responsible for the abandonment of the region (Huntington 1911, 1915; Issar 1990, 1998; al-Shorman, 2002). Other authors believe that land use became too intensive inducing desertification and desertion (Lowdermilk 1944; Butzer 1961), or that political and economic power shifted away from the area and

Figure 39.1: Location of the Decapolis region (big box) investigation area (small box).



caused decay (Walmsley 1992, 1997). Moreover, an earthquake in 747/748 A. D. was also considered to have been responsible for the abandonment of the region (Hoffmann/Kerner 2002).

39.1.2 The Investigation Area

Our goal is to achieve a better understanding of historic land use, to clarify whether abandonment happened after an over-exploitation of resources, because of climate change. To include different landscape types, research was carried out at the site of Abila, ca. 16 km north of the modern city of Irbid, and in the Wadi el-Arab, close to the modern town of Umm Queis (figure 39.1).

The Abila site is situated 16 km north of the city of Irbid and 5 km south of the Yarmouk River which marks the border to Syria. The site was chosen because it is situated on the level eastern plateaus and because of a low rate of disturbances from building activities. The highland around Abila gives the impression of a vast, gently undulating plain of red soils, dissected by several wadis with steep slopes. The wadis were cut deeply into the soft rock, predominantly dry during the summer and to deep and narrow to be used by agriculture to a significant extent. Many wadi slopes are steep with angles of 40–80 degrees and nearly bare of vegetation, while a grey and white substratum, mixed with gravel and stone, is present in the valley's bed. Essentially all wadis are very narrow, allowing cultivation only at limited places where the valley floors widen. There, usually unirrigated orchards are grown. These are supplied with abundant water during floods after winter rains. The spring water of a once-perennial stream in one of the wadis at the site of Abila is pumped for the supply of nearby villages, leaving the wadi dry in summer. In contrast, the plateaus are under intense cultivation. Due to gentle slope degrees, there are no terraces. Except for large olive tree plantations, no other trees or forests are present. On the fields, rain-fed cereals and vegetables are grown.

The Wadis el-Arab and Umm Queis lie further west where the plateaus are more heavily dissected and start to descend to the Jordan Valley. In the Wadi el-Arab, the perennial stream dried out as pumping of the springs started approximately 20 years ago for the supply of the modern city of Irbid. The Wadi was dammed and is now partially covered by a lake, which also provides drinking water for Irbid. The valley's southern slopes are quite gentle and intensively used for agriculture. In comparison, the northern slopes are very steep and do not allow for agricultural land use, but the plateau north of the wadi, close to the ancient city of Gadara (today Umm Queis), provides one of the most fertile soils of Jordan (Lucke/Schmidt/al-Saad, Bäumler/Lorenz/Udluft/Heusser/Walker 2007).

39.2 Methods

Soil samples were collected both from the vicinity and from the debris in the ruined sites of Abila and Tell Zera'a. In the vicinity, profiles were opened up in the bedrock to clarify the development process of soils and to get the in situ parent material. To assess the influence of cultivation, culture material was collected with the soil samples which gave clues to the intensity and periods of historic land use. To evaluate the land use, air photos and maps were examined for relict structures and land use changes. The present agriculture was investigated using data from the Ministry of Agriculture of Jordan and by interviewing farmers.

For collection of the soil samples, small plastic containers were filled with soil material from a 5 cm thick stripe in the middle of a defined layer/horizon. On the plateaus and in the wadis, pits were dug and the samples collected from freshly opened profiles. In existing excavation trenches, the top 5 cm of substrate were removed to exclude influence from material washed down from above. As it was occasionally impossible to determine the exact depth in the excavation trenches, the sampling layers were numbered and their thickness was measured. Determining the correct depth of an excavation trench is sometimes difficult due to the excavation practice of not digging one hole, but rather several with different depths. The samples were analyzed for texture, pH value, as well as for nitrogen, calcium, carbonate, sulphur and phosphorus content. The phosphorus content was analyzed in those soil samples for which an agricultural land use seemed likely. The agricultural test areas were examined after heavy rains, the water content was also analyzed by weighing the samples before and after 72 hours of drying at 105 °C. The pH value was measured potentiometrically with a glass electrode in distilled water at a soil: solution ratio of 1:2.5. The calcium content was determined using a Scheibler-Apparatus according to Schlichting and Stahr (1995), while the content of carbon (C), nitrogen (N) and sulphur (S) was measured with the elemental analysis apparatus Vario El. For analysis of the phosphorus (P) content, the samples experienced pressure decomposition according to Loftfield (Bock 1972), allowing photometric measurement with the molybden-blue method according to Murphey and Riley (Schlichting/Stahr 1995). The texture was determined using wet sieving according to DIN 19683, while the smaller particles were measured with a laser diffraction device (HRLD Mode Sympatec) according to ISO 13320. Before sieving, the samples were treated with abundant hydrochloric acid (HCl) to eliminate carbonates. The hydrochloric acid was evaporated again and the samples were dispersed with natriumpyrophosphate solution ($Na_4P_2O_4$) to eliminate binding matter. Before measuring with the laser diffraction device, the samples were additionally pretreated by 60 seconds of ultrasonic to destroy any agglomerations.

39.3 Results and Discussion

39.3.1 Land Use

As Lucke/Schmidt/al-Saad/Bäumler/Lorenz/Udluft/Heusser/Walker (2007) found, present land use in Jordan is quite similar to historic land use and has similar problems. Crops are highly dependent on rainfall patterns. Therefore, farmers usually decide after the first rainfalls which crops to sow (Lanzendörfer 1985). If there are no well-distributed rains at the beginning of the rainy season a hard drought crust is likely to form in the summer heat, impeding germination of most crop seeds. Additionally, the harvest is endangered if the growing season has no late rains. As well, excessive rains are reported to be a disadvantage, since the soils get elastic and hence make the field work difficult (Lucke/Schmidt/al-Saad/Bens/Hüttl 2005). Agriculture on the plateaus is fully dependent on rainfall, as there are no other water sources than cisterns, and irrigation is very difficult even today. While on the one hand the dependency on winter rains prevents salinization, on the other hand shallow soils rich in calcium carbonate are very vulnerable to drought.

39.3.2 Soils

Our research at Abila revealed strong variations of soil depth in the area, although the highland looks like a vast, homogeneous plain. While the evaluation of air photos gave no clues for it, soil and rock openings along streets and our own diggings on the fields revealed a strong variation of the soil's depth. It varied between 30 cm to 3 m. These differences seem partially to be related to the relief, but could also be observed on the same terrain units. Reifenberg (1947) assumed that these differences are caused by different weathering behavior of the source rocks. Although chemical analyses of the bedrock have not yet been carried out, this explanation seems not very probable, as the observed differences in soil development are too big to be solely explained by different weathering behavior of the parent material. At Abila, soils are derived from the B.1 unit of the Belqua limestone group (Bender 1974). Yaalon and Ganor (1973) postulated that soil development in Israel and neighboring countries is influenced by aeolian deposited during rainstorms. Although the extent of aeolian deposits is still discussed, it can be concluded that the differences in soil development at Abila would be even more distinct, if part of the parent material is derived from aeolian input, as the level highland around the site should have received the same amount of aeolian deposits. Thus, the observed differences in soil development may largely come from land use.

Walking over the fields close to Abila, the soil color varies slightly at many places according to field borders. To examine this observation, samples were collected from two neighboring pits which were dug in a distance of approximately 200 m (fields 1A and 2A). The sampling plot on field 2A was characterized by enrichment of nutrients, very high calcium content and stronger weathering of bedrock (table 39.2). Differences due to the parent rock or relief can be ex-

Table 39.1: Soil Properties of Sampling Place 1A. The sand- and silt-fractions are shown in total and divided in coarse, medium and fine material. The carbon content represents the total carbon (Ct). **Source**: Based on: Lucke, Schmidt, al-Saad, Bens, and Hüttl (2005).

Sample depth	No.	H_2O [%]	pH	Ca [%]	Ct [%]	N [%]	S [%]	P [mg/g]	Gravel [%]	Comment
5cm	A1	14,4	7,7	22,5	1,7	0,06	0,03	0,94	1,2	ploughed
15cm	A2	8,5	7,9	20	3,5	0,11	0,04	0,92	17,2	crust
25cm	A3	8,1	7,8	25	4	0,10	0,03	0,73	57,4	
40cm	A4	29,2	7,9	21	3,6	0,11	0,03	0,75	15,9	

Sample depth	No.	Sand [%]	Silt [%]	Clay [%]	Coarse Sand [%]	Medium Sand [%]	Fine Sand [%]	Coarse Silt [%]	Medium Silt [%]	Fine Silt [%]
5cm	A1	4	89	7	0,4	0,5	3,1	38	32	19
15cm	A2	4	90	6	0,3	0,2	3,5	48	28	14
25cm	A3	10	84	6	0	0,7	9,3	43	27	14
40cm	A4	5	90	5	0,3	0,2	4,5	40	33	17

Table 39.2: Soil properties of sampling place 2A. **Source**: Modified and based on: Lucke, Schmidt, al-Saad, Bens and Hüttl (2005).

Sample depth	No.	H_2O [%]	pH	Ca [%]	Ct [%]	N [%]	S [%]	P [mg/g]	Gravel [%]	Comment
5cm	A5	9,2	7,9	45,9	6,6	0,16	0,04	1,35	21,4	ploughed
15cm	A6	5,3	7,9	40,3	6,3	0,13	0,04	1,18	46,6	crust
25cm	A7	6,6	7,9	47,3	6,4	0,13	0,04	1,29	4,5	
40cm	A8	7,5	7,9	47,4	6,3	0,10	0,03	1,29	3,2	

Sample depth	No.	Sand [%]	Silt [%]	Clay [%]	Coarse Sand [%]	Medium Sand [%]	Fine Sand [%]	Coarse Silt [%]	Medium Silt [%]	Fine Silt [%]
5cm	A5	2	91	7	0,5	0,4	1,1	30	40	21
15cm	A6	2	91	7	0	1	1	37	37	17
25cm	A7	2	93	5	0	0,4	1,6	41	36	16
40cm	A8	2	92	6	0	0,8	1,2	48	31	13

cluded for both sampling plots. Both field 1A and 2A revealed many ancient sherds, mostly from the Late Roman and Byzantine-Umayyad period. On field 2A a cistern was constructed in antiquitiy. Ayyubid-Mamluk herds are reported from there by Fuller (1985), indicating a medieval farmstead which fits well to the more intensive weathering and nutrient enrichment of the soil of field 2A.

The soil in the debris of the ruins of Abila was investigated for comparison with the relict soils (plot 11R, table 39.3). Here, we found a relict surface developed out of Early Bronze Age debris and remains of mudbrick stones which were preserved in a burrow. They were quickly covered with sediments and thus conserved while remains of the city walls prevented erosion.

The red soils on the plateaus can be described as degraded Terrae rossae (Rhodochromic Cambisols). As the weathering of calcareous rocks produces minimal residuals, the development of a Terra Rossa (Rhodochromic Cambisol) occurs very slowly. The red color usually arises due to the clay mineral of haematite, which emerges after long and intensive weathering processes of the silicates (Horowitz 1979). Therefore Terrae Rossae are in general counted as old soils, dating from the Tertiary or the Pluvials of the Ice Ages (Horowitz 1979; Scheffer/Schachtschabel, 1998). A relic surface under Basalt, close to the village of Amrawah, indicated that the soils reached depths up

Figure 39.2: Soil Properties of Sampling Location 11R. The samples were numbered and their thickness added, because it was not possible to measure their exact depth. The trench is in total 7,50 m deep. The samples are listed as they are positioned in the trench. **Source**: Modified and based on: Lucke (2002).

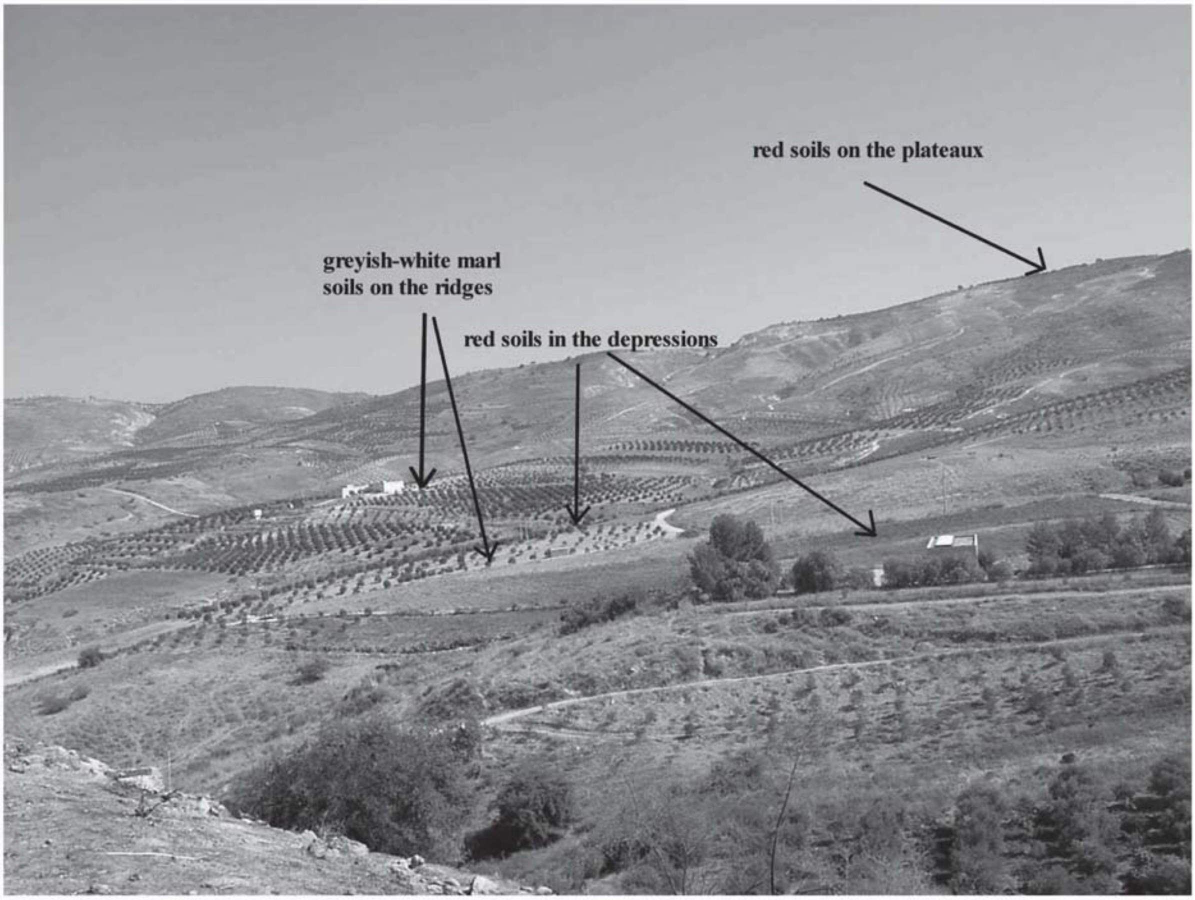
Sample/ Thickness	No.	PH	Ca [%]	Ct [%]	N [%]	S [%]	P [mg/g]	Gravel [%]	Comment
11R 8 / 60 cm	A46	8,5	64,4	7,8	0,08	0,04	5,86	12,4	surface today
11R 7 / 25 cm	A47	8,3	39	5,1	0,08	0,03	5,59	4,9	brownish substr.
11R 6 / 1,75 m	A48	8,4	39	5	0,07	0,06	5,13	6	grey debris
11R 3 / 15 cm	A51	9,1	24	1,9	0,04	0,03	2,69	4,5	mudbrick stone
11R 2 / 5 cm	A52	8,6	20	1,9	0,05	0,04	1,30	15,7	burrow
11R 1 / 2 m	A53	8,6	53	7	0,08	0,06	6,38	13	grey debris
11R 0 / 30 cm	A54	8,4	48,8	6	0,08	0,8	5,56	11	soil over bedrock

Sample/ Thickness	No.	Sand [%]	Silt [%]	Clay [%]	Coarse Sand [%]	Medium Sand [%]	Fine Sand [%]	Coarse Silt [%]	Medium Silt [%]	Fine Silt [%]
11R 8 - 60 cm	A46	3	87	10	0,2	1	1,8	12	42	33
11R 7 - 25 cm	A47	8	83	9	0,5	2	5,5	29	31	23
11R 6 - 1,75cm	A48	7	86	7	0,5	2,1	4,4	23	40	23
11R 3 - 15 cm	A51	12	82	6	0,2	0,2	11,6	39	27	16
11R 2 - 5 cm	A52	15	79	6	6,7	0,3	8	40	26	13
11R 1 - 2 cm	A53	6	86	8	0,5	1,8	3,7	25	38	23
11R 0 - 30 cm	A54	8	84	8	0,6	1,6	5,8	23	38	23

to 3 m before cultivation started (Lucke/Schmidt/al-Saad/Bäumler/Lorenz/Udluft/Heusser/Walker 2007). It can be concluded that a considerable amount of soil has been lost since cultivation of the fields which are now around 60 cm deep, as most soils at Abila. No tracks of intensive mismanagement forcing the abandonment of the site could be detected. Today agriculture is applied on this ancient land surface (Horowitz 1979; Lanzendörfer 1985). This matches the natural reforestation observed by travelers in the 19th century (Seetzen 1854; Schumacher 1890) and is in disagreement with Lowdermilk's (1944) theory of insufficient land use. He assumed that Arab mismanagement produced barren lands and malaria-infested swamps in the wadis. Newer historical investigations also mediate against the theory of insufficient land use, because they could show that Islamic Conquerors were not uncultivated Bedouins, destroying the agricultural systems, but highly developed agriculturists (Waston 1981). The similarity of the relict substrates of Tell Abil to the present agricultural surfaces indicates that soils were probably already eroded in the Bronze Age, as the inhabitants usually used local mudbrick for the construction of their houses. Re-weathering of source rock or aeolian deposition prevented the landscape from changing into barren rock. The relict surface in the animal's cave on the other hand points to more intensive weathering in the Bronze Age, as present debris surfaces did not develop the red colors (Lucke/Schmidt/al-Saad/Bäumler/Lorenz/Udluft/Heusser/Walker 2007) which matches the climate reconstructions of Butzer (1961) and Bar-Matthews (1998).

Investigation of the soil in the Wadi el-Arab around the Tell Zera'a revealed a different picture (Lucke/Schmidt/al-Saad/Bäumler/Lorenz/Udluft/Heussner/Walker 2007). In the wadi, on the one hand deep red soils are present, which are dissected by many erosion gullies. On the other hand, a uniform greyish-white substrate could be observed which extended down on ridges from the top of surrounding slopes. These greyish-white soils seem to be the typical marl soils which Reifenberg (1947) described. Both the ridges and the red soils in the depressions in-between are intensively cultivated (figure 39.2). Construction of a farm on one of the ridges revealed that the marl substrate is deeper than 4 m, but it is difficult to draw a distinction between the very soft parent material and the soil. It is possible that these ridges are products of weathering and land slides of the exposed rocks at the wadi slopes. Although the soils on the depressions of the wadi were crossed by many deep erosion gullies, we assume that these material losses are replaced

Figure 39.3: The Southern Slopes and Soil Characteristics of the Wadi el-Arab



by sediments carried down from the ridges and plateaus. Otherwise, they could not have maintained depths of 2 m and more, while the level plateaus around Abila carry soils of a depth of only 60 cm. As the greyish wadi substratum has similar characteristics as the greyish debris soil (table 39.3), we assume that it represents slightly weathered products of the soft limestones. In comparison, the red soils of the plateaus and wadi depresssions must have experienced a much longer and more intensive weathering process to develop their color.

Comparing the soils on the plateaus, it is remarkable that we found a depth of approximately 2 m on the plateau close to Gadara/Umm Queis, while a very dense coverage with material culture (mainly from the Roman and Byzantine-Umayyad periods) indicated that land use was not less intensive than close to Abila (Lucke/Schmidt/al-Saad/Bäumler/Lorenz/Udluft/Heussner/Walker 2007). Because of its depth, the soil close to Gadara/Umm Queis is today one of the best in Jordan. The difference in depth in comparison to Abila may come from different bedrock, as basalt is present at Gadara/Umm Queis, or from higher aeolian deposition. This has to be investigated further, but speaks also against the theory of catastrophic erosion as proposed by Lowdermilk (1944).

39.4 Conclusions

Agriculture in Jordan today strongly depends on rainfall, as the greater part of the cultivated area lies on plateaus, where only rain-fed agriculture is possible. The shallowness of soils and the high content of calciumcarbonate cause a high vulnerability to drought. On the one hand, relict mudbrick stones preserved in the debris at Tell Abil indicate that ancient soils looked not much different from the present ones. On the other hand, differences in soil development on the same source rock within an identical relief position, point to a strong impact of land use on soil genesis. It is evident that land use changed the landscape, as the observed differences of soil development can only come into being after long periods of land use.

It further indicates that the theory of catastrophic erosion after the Arab conquest has to be rejected. It merely seems that the present character of the landscape does not differ much from the landscape present during the abandonment of the Decapolis cities. A relict soil developed out of Early Bronze Age debris points to increased precipitation during the Bronze Age, which matches climate reconstructions.

According to Khresat and Rawajfh (1998) and Khresat (2001), the soils of Jordan developed in a humid climate that shifted gradually towards more arid conditions. According to Cordova (2000), the red soils extended further east in antiquity than today. Our results match these findings and indicate that there was no sudden catastrophic erosion due to overexploitation of the land. According to Frumkin and Stein (2003), periods of increasing aridity as during the drying of lake Lisan at the end of the last glacial period led to quick and strong soil erosion and degradation. In this context, it seems possible that soil degradation is more related to climate than to the activities of man, because the latter transformed the landscape but did not produce barren lands.

If this proves true and if global warming leads to increasing aridity in the Near East, it can be expected that soil degradation will increase, even if countermeasures are undertaken to combat desertification and to promote a sustainable land use. Further losses of soil will have a negative impact on groundwater and vegetation, too. In this context, it seems most important to investigate the relationship of local climate and land use. It might be possible that the intensive historic land use, cutting down the forest, contributed to the intensity and negative effect of climate variations (Seth 1978). To cope with the effects of global warming, it might be more promising to focus on the land use's influence in local climate than on soil preservation measures. The latter may be doomed to fail if soil degradation is inevitable due to changing climate conditions.

References

Al-Shorman, A., 2002: "Archaeological Site Distribution in Jordan since the Paleolithic and the Role of Climate Change", in: *Adumatu*, no. 5: 7–26.

Bar-Matthews, M.; Ayalon, A.; Kaufmann, A., 1998: "Middle to Late Holocene (6,500 Yr. Period) Paleoclimate in the Eastern Mediterranean Region from Stable Isotopic Composition of Speleothems from Soreq Cave, Israel", in: Issar, A.; Brown, N. (Eds.): *Water, environment and society in times of climatic change* (Dordrecht: Kluwer Academic Publishers): 203–215.

Bäumler, R., 2001a: "Pedogenic studies in aeolian deposits in the high mountain area of eastern Nepal", in: *Quaternary International*, 76/77: 93–102.

Bäumler, R., Ni, A., Petrov, M., Lemzin, I., Zech,W., 2002: Pedogeochemical studies and palaeo environmenttal implications in Kichik Alay Mountain soils (Kyrgystan), *Z. Geomorph. N.F.* 46, 461–474.

Bäumler, R., 2001b: *Vergleichende bodenkundliche Untersuchungen in Hochasien und Kamtschatka.* Habilitation thesis, Relief, Boden, Paläoklima 16 (Berlin: Gebrüder Bornträger).

Bender, F., 1974: *Geology of Jordan* (Berlin: Gebrüder Bornträger).

Berner, U.; Streif, H.J., [2]2000: *Klimafakten. Der Rückblick – ein Schlüssel für die Zukunft* (Stuttgart: E. Schweitzerbart).

Bock, R., 1972: *Aufschlussmethoden der anorganischen und organischen Chemie* (Weinheim: Wiley VCH).

Bookman (Ken-Tor), R.; Enzel, Y.; Agnon, A.; Stein, M., 2004: "Late Holocene Lake Levels of the Dead Sea", in: *Geological Society of America Bulletin*, Vol. 116, No. 5/6: 555–571.

Butzer, K., 1961: "Climatic change in arid regions since the Pliocene", in: Stamp, D. (Ed.): *A History of Land Use in Arid Regions* (Paris: UNESCO): 31–56.

Claussen, M., 2003: "Klimaänderungen: Mögliche Ursachen in Vergangenheit und Zukunft", in: *UWSF* 15, no. 1: 21–30.

Claussen, M.; Brovkin, V.; Ganopolski, A.; Kubatzki, C.; Pethoukov, V., 2003: "Climate Change in Northern Africa: The Past is Not the Future", in: *Climatic Change*, 57, no. 1: 99–118.

Cordova, C., 2000: "Geomorphological Evidence of Intense Prehistoric Soil Erosion in the Highlands of Central Jordan", in: *Physical Geography*, 21,6: 538–567.

DIN 19683, Deutsches Institut für Normung, 1973: Blatt 1–3, *Physikalische Laboruntersuchungen, Bestimmung der Korngrößenzusammensetzung nach Vorbehandlung mit Natriumpyrophosphat.*

Frumkin, A.; Stein, M., 2003: "The Sahara-East Mediterranean Dust and Climate Connection Revealed by Strontium and Uranium Isotopes in a Jerusalem Speleothem", in: *Earth and Planetary Science Letters*, 6890: 1–14.

Fuller, N., 1985: "Analysis of Ethnoarchaeological Studies", in: *Near East Archaeological Society Bulletin*, no. 25: 73–90.

Hare, K., 1961: "The causation of the arid zone", in: Stamp, D. (Ed.): *A History of Land Use in Arid Regions* (Paris: UNESCO): 25–31.

Hoffmann, A.; Kerner, S. (Eds.), 2002: *Gadara-Gerasa und die Dekapolis* (Mainz: Phillip von Zabern).

Horowitz, A., 1979: *The Quaternary of Israel* (New York: Academic Press).

Huntington, E., 1911: *Palestine and its Transformation* (Boston & New York: Houghton Mifflin Company).

Huntington, E., 1915: *Civilisation and climate* (New Haven: Yale University Press).

ISO 13320-1, International Organisation for Standardisation, 1999: *Particle Size Analysis – Laser Diffraction Methods – Part 1: General Principles*.

Issar, A., 1990: *Water shall flow from the Rock. Hydrogeology and Climate in the Lands of the Bible*. (Heidelberg: Springer).

Issar, A., 1998: "Climate Change and History during the Holocene in the Eastern Mediterranean Region", in: Issar, A; Brown, N. (Eds.): *Water, Environment and Society in Times of Climatic Change* (Dordrecht: Kluwer Academic Publishers): 113–128.

Issar, A., 2003: *Climate Changes during the Holocene and their Impact on Hydrological Systems*. International Hydrology Series (Cambridge: Cambridge University Press).

Issar, A.; Govern, V.; Geyh, M.; Wakshal, E.; Wolf, M., 1992: "Climate Changes During the Upper Holocene in Israel", in: *Israel Journal of Earth Sciences*, no. 40: 219–223.

Khresat, K., 2001: "Calcic Horizon Distribution and Soil Classification in Selected Soils of North-West Jordan", in: *Journal of Arid Environments,* 47, no. 2: 145–152.

Khresat, S.; Rawajfh, Z.; Mohammad, M., 1998: "Morphological, Physical and Chemical Properties of Selected Soils in the Arid and Semi-Arid Region in North-West Jordan", in: *Journal of Arid Environments*, 40, no. 1: 15–25.

Lanzendörfer, M., 1985: *Agricultural Mechanisation in Jordan. A study of its Processes in a Socioeconomic Context*. PhD thesis, Sozioökonomische Schriften zur ruralen Entwicklung 62 (Göttingen: University of Göttingen).

Lowdermilk, W., 1944: *Palestine – land of promise* (London: Victor Gollancz).

Lucke, B., 2002: *Abila's Abandonment*. Diplom thesis, Anthology of Scientific Publications & Research Papers, RPR 14 (Cottbus: Chair of Environmental Planning, BTU Cottbus).

Lucke, B.; Schmidt, M.; al-Saad, Z.; Bens, O.; Hüttl, R., 2005: "The Abandonment of the Decapolis Region in Northern Jordan –Forced by Environmental Change?", in: *Quaternary International,* no. 135, Special issue: Geochronology and Environmental Reconstruction: a Tribute to Glenn A. Goodfriend, 65–81.

Lucke, B., Schmidt, M., al-Saad, Z., Bäumler, R., Lorenz, S., Udluft, P., Heussner, U, Walker, B., 2007: "Soils and Land Use around Tell Zera'a and Abila of the Decapolis", in: *ZDPV*, accepted.

Nützel, W., 1975: "Das Mesopotamien der Frühkulturen in Abhängigkeit der nacheiszeitlichen Klimaschwankungen und Meeresspiegeländerungen", in: *Mitteilungen der Deutschen Orientgesellschaft zu Berlin*, no. 107: 27–38.

Nützel, W., 1976: "The Climate Changes of Mesopotamia and Bordering Areas 14.000 to 2.000 B. C.", in: *Sumer*, no. 32: 11–24.

Reifenberg, A., 1947: *The soils of Palestine* (London: T. Murby).

Scheffer, F.; Schachtschabel, P., 1998: *Lehrbuch der Bodenkunde. 14th edition* (Stuttgart: Enke).

Schlichting, E.; Blume, H.; Stahr, K., 1995: *Bodenkundliches Praktikum*. Pareys Studientexte 81 (Berlin: Blackwell Verlag).

Schumacher, G., 1890: *Northern Ajlun: Within the Decapolis* (London: Palestine Exploration Fund).

Seetzen, U., 1854: *Reisen durch Syrien, Palestina, Phönicien, die Transjordan-Länder und Unter-Ägypten*. Edited by F. Kruse (Berlin).

Seth, S. K., 1978: "Climatic Change in the Indian Desert and North-West India during the Late Pleistocene and Early Holocene", in: Brice, W. (Ed.): *The Environmental History of the Near and Middle East Since the Last Ice Age* (London: Academic Press).

Walmsley, A., 1992: "Vestiges of the Decapolis in North Jordan During the Late Antique and Early Islamic Periods", in: *ARAM*, 4, no. 1–2: 346–371.

Walmsley, A., 1997: "Land, Resources and Industry in Early Islamic Jordan (Seventh - Eleventh century: Current research and future directions", in: Bisheh, G.; Zaghloul, M.; Kehrberg, I. (Eds.): *Studies in the History and Archaeology of Jordan. Volume 6: Landscape Resources and Human Occupation in Jordan throughout the Ages* (Amman: Department of Antiquities of Jordan): 345–351.

Watson, A., 1981: "A medieval green revolution – New crops and farming techniques in the early Islamic world", in: Udovitch, A. L. (Ed.): *The Islamic Middle East,* 700 – 1900*: Studies in economic and social History* (Princeton. , The Darwin Press Inc.): 29–58.

Yaalon, D.; Ganor, E., 1973: "The Influence of Dust on Soils during the Quaternary", in: Soil Science. 116, no. 3: 146–155.

Part IX Water and Wastewater Technology in the Middle East

40 Waste Water Management and Reuse in Jordan

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Abstract

Jordan is an arid to semi-arid country. Its population has has risen over the past few decades, which places an enormous pressure on water resources. Water resources in Jordan consist primarily of surface and groundwater, while treated wastewater is being used on an increasing scale for irrigation , mostly in the JordanValley. Over the past decades, the government has developed surface water resource management schemes that included the construction of dams and irrigation projects in the Jordan Valley. The future of the agricultural sector in Jordan heavily depends on future plans for water resource management to meet irrigation requirements.

Due to Jordan's increasing population and the social and economic development, the amount of treated wastewater is increasing, which is considered an essential element in its water strategy. By the year 2020, the volume of treated wastewater is estimated at 227 MCM/year and will constitute a significant portion of the total irrigation demand. Demand management measures are important because they often have short payback periods and lead to reduced capital and operational costs for water supply and wastewater treatment facilities.

Keywords: Wastewater reuse/management, Jordan, water resources, treatment

40.1 Introduction

Jordan is a small country of about 89.4 km^2 with a coastline of 30 km along the Gulf of Aqaba. Towards the end of 2001, Jordan's population reached 5.18 million with an official unemployment rate of 14 per cent and unofficial estimate between 22 and 24 per cent. According to government statistics, one third of the population lives below the poverty line. According to UNDP (2001), Jordan ranks 88th in the human development index among 174 countries. The adult literacy rate is 90 per cent, the human development index is 0.741 compared to 0.677 in 1990.

40.2 Water Resources

Water resources in Jordan are characterized by scarcity, variability and uncertainity. The high population growth during the last twenty years has pushed its per capita water availability below 198 m^3/capita/ year. This is far below the benchmark level of 1000 m^3/capita/year often used as an indicator of water scarcity. Below this level a country is experiences chronic water scarcity on a scale sufficient to impede development and harm human health.

Fresh water resources in Jordan are limited. The government has identified three priorities for using this limited resource: for municipal use, tourism and industry. This means that agriculture must rely increasingly on treated wastewater. These priorities are estimated to increase Jordan's total water supply from 898 MCM in 1998 to 1,287 MCM in 2020 (table 40.1). This increase in the total actual water supply would be for *municipal and industrial* (M&I) use, which is expected to more than double from 275 MCM in 1998 to 660 MCM in 2020.

Table 40.1: Estimated Water Supply in Jordan (MCM/Year). **Source:** World Bank

Year	Municipal and industrial supply	Agriculture supply	Total estimated supply
1998	275	623	898
2005	363	679	1042
2010	486	764	1250
2015	589	693	1283
2020	660	627	1287

The deficit between supply and demand is estimated to range between 186 and 360 MCM during the period 1998–2020 (table 40.2). The deficit becomes more crucial when considering that the estimated supply is based upon the assumption that all resources are being developed and all water projects are being implemented as planned, which may be unrealistic. Thus, water availability for agriculture will face major constraints.

Table 40.2: Estimated Water Supply and Requirements (MCM/Year). **Source:** World Bank

Year	Total requirements	Total estimated supply	Deficit
1998	1205	898	-307
2005	1321	1042	-279
2010	1436	1250	-186
2015	1536	1283	-254
2020	1647	1287	-360

Wastewater is being reused in irrigation. It is expected to increase from 67 MCM in 1998 to 227 MCM in 2020. Re-use occurs mainly in the Jordan Valley for exclusive irrigation purposes, with some reuse as supplemental irrigation in the highland industry, landscaping and agriculture as well (table 40.3).

The re-use of treated wastewater in agriculture is associated with three environmental aspects: pollution of products, pollution of soil and ground water resources. In addition, there is a concern about its social acceptance. However, using treated wastewater in agriculture will provide these benefits:

Table 40.3: Project Treated Wastewater Re-use in Jordan (MCM/Year). **Source:** World Bank.

Year	In the Jordan Rift Valley	In the highlands	Total
1998	56	11	67
2005	65	41	106
2010	110	45	155
2015	123	74	197
2020	137	90	227

1. Increasing crop production;
2. Saving scarce fresh water resources for other high-value uses; and
3. Minimizing fertilizers due to the high nutrient contents of treated wastewater

Due to sanitary restrictions and social acceptance the number of crops grown under irrigation using treated wastewater could be limited.

40.2.1 Surface Water

Surface water resources vary considerably from year to year. The long-term average surface water flow is estimated at 707 MCM/year, comprised of 451 MCM/year base flow, and 256 MCM/year flood flow. Thereof only an estimated 473 MCM/year is usable or can be economically developed.

40.2.2 Groundwater

Groundwater resources amount to 54 per cent of the water resources of Jordan. Twelve groundwater basins have been identified, including two fossil aquifers: Al-Disi and Al-Jafar. Some basins have more than one aquifer. The annual safe yield of renewable groundwater supply is estimated at 277 MCM. An additional 143 MCM per year is available from non-renewable fossil aquifers that are sustainable for between 40 and 100 years.

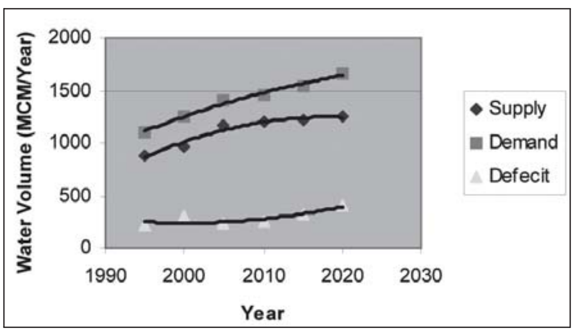
40.2.3 Wastewater

In Jordan wastewater is an important water resource. Due to the topography and the concentration of urban population above the Jordan Valley escarpment, the majority of treated wastewater is discharged into various watercourses and flows downstream to the Jordan Valley where it is used for irrigation. At present about 52 per cent of the population, 75 per cent of the urban population are served by sewage systems. By the year 2020, it is expected that the volume of treated wastewater available will amount to 227 MCM/Yr and will constitute a significant portion of the total irrigation demand and hence supplement the demand for renewable groundwater resources. Thus, treated wastewater is an essential element in Jordan's water strategy. Brackish aquifers are not yet fully explored but at least 50 MCM/year is expected to be accessible for urban use after desalination. The uneven water distribution has resulted in three demand areas with regard to water availability:

1. Available local water resources meet the demand;
2. Available local water resources exceed the demand;
3. Available local water resources are insufficient to meet the demand, and requires the transportation of water from more than 100 km distance.

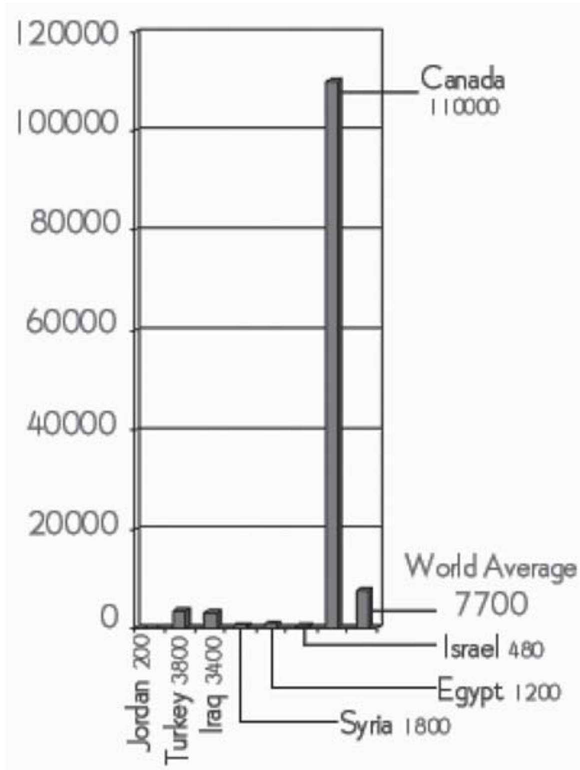
The nationwide demand has continuously exceeded the nationwide supply of fresh water over the past few years. This water deficit has been continuously on the rise, and is anticipated to have the same trend in the projected future, as shown in figure 40.1.

Figure 40.1: Water Supply and Demand Trends in Jordan (1990-2020).



There has been a continuous increase in the annual water demand, while the increase in the supply has been much lower. Unless serious measures are taken, the supply is anticipated to level out by the year 2020, resulting in a continuous increase ing the water deficit. The daily per capita share of water in Jordan is one of the lowest, both according to world averages, and the averages in neighboring countries (figure 40.2). Jordan shares some of its most important water resources with its neighbors. These resources form a large percentage of the presently exploited water resources, on which the country depends. One of the most important shared surface water resources is the Jordan River system. Other important shared water resources include the groundwater resources of north Jordan (Azraq, Yarmouk and Amman Zarqa Basins), where a large percentage of the natural recharge occurs in Syria.

Figure 40.2: Annual Water Daily Demand per Capita.



About 69 per cent of the water is used in agriculture (for irrigation and livestock) while domestic and industrial use account for 27 per cent and 4 per cent, respectively. Table 40.4 summarizes the annual 'irrigation water' demand, in relation to Jordan's the various water resources. The annual water demand for irrigation purposes accounts for 45 per cent of the surface water consumption, 45 per cent of the groundwater consumption, and 10 per cent of the wastewater consumption. Almost half of the surface and the groundwater are allocated for meeting the irrigation demand. Nearly 74 per cent of the surface water resources are available from the Jordan Valley that are primarily used for irrigation in the Valley. They account for 32 per cent of the total irrigation water demand, and nearly 22 per cent of the total national water demand. Given the agriculturally rich nature of the Jordan Valley and keeping the rising water deficits in mind, water management measures and practices must be developed that will preserve water as a limited resource and the Jordan Valley area as a main agricultural area.

Table 40.4: Annual Irrigation Water Demand (Volume and Percentage).

Source of irrigation water	Total consumption (MCM/Year
1. *Surface water*	
– Jordan Rift Valley	194.486 (73.5%)
– Springs	30 (11.34%)
– Base & flood	40 (15.12%)
Total surface water	264.486 (100%)
Percent of total irrigation consumption	44.70%
2. *Groundwater*	
– Renewable	207.119 (77.80%)
– Nonrenewable	59.07 (22.2%)
Total Ground Water	266.189 (100%)
Percent of Total Irrigation Consumption	44.98%
3. *Treated Waste Water*	
– Registered	57.3 (93.9%)
– Not registered	3.7 (6.1%)
Total treated wastewater	61 (100%)
Percent of total irrigation consumption	10.31%
Total	**591.675 (100.00%)**

Because of its limited resources, water has become the center of development targets and of government efforts to utilize it in the most efficient and productive way. Measures were also taken to mitigate the problems related to the permanent water shortages. These include public awareness campaigns, rehabilitation of existing networks and rationing of water supplied for domestic and irrigation purposes. Careful water use planning is required and should address various water rights. In line with government policy, priority must be given for reasonable domestic use, followed by socio-economic development. Industry and tourism. Water planning for agriculture needs to be addresse separately. Despite the huge investment in the water sector, a considerable water deficit will still be facing Jordan. The water deficit for all uses is projected at 408 MCM/year in the year 2020.

40.2.4 Irrigation Water Policy

The *Irrigation Water Policy* (MWI 1998b) was approved by the Council of Ministers in 1998 that addresses irrigation water including agricultural use, resource management, technology transfer, water quality, and efficiency. But it does not deal with irrigated agriculture. Many provisions of this policy are already implemented. Specific policy statements address:

1. *Sustainability of Irrigated Agriculture*. Existing areas shall be accorded the chances for sustainability; protection of groundwater resources takes priority over sustainability of agriculture; coordination with Ministry of Agriculture;
2. *Resource Development and Use* (e.g., use of wastewater; use of rainfall for crop production);
3. *Technology Transfer*, e.g. higher agricultural yields; modern advanced irrigation technologies; pressure pipelines; genetically engineered plant varieties;
4. *Farm Water Management*, e.g., night application of irrigation water; automation of farm irrigation networks; monitoring of soil moisture; crop water requirements for micro-climatic zones;
5. *Irrigation Water Quality*, e.g. monitoring of sources, conveyances, and distribution network; improving wastewater quality to allow unrestricted irrigation; testing of soil Salinity;
6. *Management and Administration*, e.g. JVA (Jordan Valley Authority) is responsible for operation and maintenance of irrigation facilities from source (e.g., reservoir, river, spring) to farm gate; use of piped irrigation networks; metering of water at the farm turn-out; participatory irrigation management;
7. *Water Pricing*, e.g., irrigation water managed as an economic commodity; water price to cover at least operation and maintenance costs and as possible capital costs; differential prices for different water quality;
8. *Regulation and Controls*, e.g., discourage crops with high water needs through economic and market forces.

Other policy aspects address legislation and institutional arrangements, irrigation efficiency, research and development, energy and environment, shared groundwater resources, and public awareness.

40.3 Water Resource Management

During the past decades, the government has extensively developed surface water resources management schemes, most notably the construction of dams and irrigation projects in the Jordan Valley. Such practices promoted the effective utilization of surface water before its drainage to the Dead Sea. The future of the agricultural sector in Jordan heavily depends on future plans for water resource management to meet irrigation requirements. Aquifers in the Disi-Mudwara, Jafer and Hamad areas are prime fresh water sources, able to supply an additional 80 million m^3/year of water for 100 years. Optimum utilization of these resources would require adequate management practices to avoid salination and should be accompanied by reducing extraction from over-utilized aquifers.

Jordan, Israel and the West Bank are presently over-exploiting their water resources. Water levels are dropping, groundwater resources are being mined, salinization and salt water intrusion are observed and the domestic water supply does not reach adequate standards. One of the prime actions recommended to remedy this crisis is the reduction of water demand for irrigation, also known as 'Water Demand Management' (WDM).

Although the potential for irrigation development in the highlands is great, a very small increase in irrigated agriculture is anticipated due to the lack of water resources. The average water consumption for irrigation in the Jordan Valley and southern Ghor is less than 10,000 m^3/ha per year, which is much less than in the highlands where it reaches on average 16,000 m^3/ha per year. This may be due to the fact that in the highlands, irrigation water is mostly groundwater pumped individually by farmers with less supervision than in the Jordan Valley where the Jordan Valley Authority controls the delivery of water. The Jordan Valley is the prime agricultural area in the Kingdom. Agriculturalists need to be encouraged to use water efficiently and educated 'Water Demand Management' strategies.

Until recently, the preferred approach to satisfying the water needs of growing communities has been to develop untapped supplies. New water supply sources have become less accessible and developing them has become more expensive and less acceptable environmentally. This has increased the importance of managing demand. Demand management could play an important role in coping with climate change, both because it promotes efficiency and because it enables a considerable amount of flexibility in water resource management.

The objective of demand management is to use water more efficiently. Regulatory options can be used to promote it. Demand-management options include such measures as:

1. Modifying rate structures,
2. Reducing landscape water use,
3. Modifying plumbing and irrigation systems, and
4. Conducting educational programs.

Temporary measures can provide great flexibility in relieving stress during droughts. In addition to preserving water resources, efficiency gains from water demand management schemes could offset or postpone the building of large and costly structures that might otherwise be needed. Demand management measures are also important because they often have short payback periods and lead to reduced capital and operating costs for water supply and wastewater treatment facilities. Water saved through demand management can solve problems of water deficits. Reduced wastewater and drainage flows can yield additional environmental advantages.

For demand management to be implemented, the governmental must take leadership. Suggested policies include increased funding for the development and use of water saving technologies, and reforming tax provisions to promote conservation investments. Future development of water resources in order to meet the increasing demand for water for agriculture will require the implementation of expensive projects for the development and conveyance of water to the land. These projects could place a heavy burden on the national budget and could seriously affect the national economy. Future projects include the construction of storage facilities on major rivers and side wadis to alleviate part of the water shortages for agricultural activities.

40.3.1 Wastewater in the Water Strategy

40.3.1.1 On Resource Development

Wastewater shall not be managed as 'waste'. It shall be collected and treated to standards that allow its re-use in unrestricted agriculture and other non-domestic purposes, including groundwater recharge. Appropriate wastewater treatment technologies shall be adopted with consideration for economy in energy consumption and quality assurance of the effluent for use in unrestricted agricultre. Consideration shall be given to blending of the treated effluent with fresh water for appropriate reuse.

40.3.1.2 On Resource Management

Management of wastewater shall receive attention with due regard to public health standards. Industrial wastewater shall be carefully monitored to avoid degrading the quality of the effluent that is destined for reuse.

40.3.1.3 Wastewater Management Policy

Wastewater collection has been practiced in Jordan in a limited way since 1930 in the town of Salt. Mostly septic tanks and cesspits were used with gray water often discharged to gardens. This practice resulted in major environmental problems, especially groundwater pollution. Modern technology to collect and treat wastewater was introduced in the late 1960s when the first collection system and treatment plant was built in Ain Ghazal.

Since 1980 and during the following decade (1980–1990), the government of Jordan carried out significat plans with regard to the different issues of wastewater management primarily related to the improvement of sanitation, whose chracteristics are somewhat different. The average salinity of municipal water supply is 580 ppm and the average domestic water consumption is low (around 70L/c/d country wide). This results in very high organic loads and in a higher than normal salinity in wastewater. Given the low level of industrial discharges (10 per cent) to sewage treatment plants, wastewater in Jordan is comparatively low in toxic pollutants such as heavy metals and toxic organic compounds.

Principal concerns in the use of wastewater for irrigation include its salinity, chloride concentrations, and the presence of fecal coliforms and nematode eggs. The Jordanian standards and regulations which specify the quality of the treated effluent allowed to be discharged into wadis or destined for reuse in agriculture, require a secondary level of treatment. Quality specifications follow the WHO guidelines for the safe use of treated effluent in irrigation.

In order to develop a *Wastewater Management Policy*, the following represents the key issues under consideration:

1. Provision of adequate wastewater collection and treatment facilities for all major cities and towns in Jordan;
2. Protection of the environment and public health in the areas affected by the proposed systems, especially, surface and groundwater;
3. Consideration of treated effluents as a source for irrigation use: and
4. Improvement of the socio-economic conditions in the areas to be served by the proposed systems.

This policy that has been adopted by the Jordanian government is described below.

40.4 The Policy

40.4.1 On Resources Development

1. Wastewater is a perennial water source and shall form an integral part of renewable water resources and of the national water budget.
2. The collection and treatment of wastewater is a necessity to circumvent hazard to the public health and the environment. It becomes imperative when contamination of freshwater resources with wastewater is immminent.
3. Collection and treatment of wastewater becomes mandatory to protect public health against water borne diseases and threats of epidemics.
4. Existing levels of wastewater services shall be maintained and upgraded where necessary to enhance public health and the environment.
5. Treatment of wastewater shall be targeted toward producing an effluent fit for reuse in irrigation in accordance with WHO and FAO guidelines as a minimum. Reuse of treated wastewater in other purposes shall be subject to appropriate specification.
6. Co-ordination shall be maintained with the official bodies in charge of urban development to account for the treatment and disposal of their liquid wastes. Central treatment plants shall be built to serve semi urban and rural communities, and collection of wastewater can be made initially through trucking until collection systems are in place.
7. Specifications and minimum standards shall be issued by the competent authorities for the use of

septic tanks in rural areas. Particular attention shall be paid to the protection of underlying aquifers.

40.4.2 On Resource Management

8. It is imperative that a section in the water authority be responsible for the development and management of wastewater systems as well as the treatment and reuse of the effluent.
9. A basin management approach shall be adopted where possible. The use of treated wastewater in irrigation shall be given the highest priority and shall be persued with care.
10. Effluent quality standards shall be defined based on the best obtainable treatment technologies, and calibrated to support or improve ambient receiving conditions, and to meet public health standards for end users. Key factors will include the location of the discharge, its proximity to wells, the type of receiving water, and the nature and extent of end uses. Wastewater intended for irrigated agriculture will be regulated based on the soil characteristics of the irrigated land, the type of crops grown, the irrigation schedule and methods, and whether other water is mixed with the treated wastewater .
11. Industries shall be encouraged to recycle part of their wastewater and to treat the remainder to t standards set for its disposal through the collection systems and or into the receiving environment.
12. Wastewater from industries with significant pollution should be treated separately to standards allowing its reuse for purposes other than irrigation or for safe disposal.
13. Consideration shall be given to isolating treated wastewater from surface and groundwater used for drinking purposes, and to the blending of treated effluent with relatively fresher water for suitable reuse.

40.4.3 On Wastewater Collection and Treatment

14. The existing level of services shall be sustained and promoted. Where it is necessary to meet public health and environmental objectives, treatment shall be improved. Wastewater shall be collected and treated in accordance with WHO and FAO Guidelines as the basic for effluent quality requirements for reuse in irrigation. However, final reuse options, type of crops to be irrigated, location of reuse and treatment (effluent parameters) and the treatment technology yet to be adopted.
15. Priority shall be given to protecting public health and water resources from chemical and microbiologic pollutants.
16. Where possible, gravity flow shall command the collection and conveyance lines.
17. Treatment plants shall be located away from any potential population growth. Location selection shall be coordinated and approved with the concerned governmental agencies. Plans shall be made to interact with landowners and adjacent communities.
18. The transfer of advanced wastewater treatment technologies shall be endorsed and encouraged. However, appropriate wastewater treatment technologies shall be selected with due consideration to operation and maintenance costs and energy savings, in addition to their efficiency in attaining and sustaining quality standards.
19. Innovative approaches to wastewater treatment, particularly for the small municipal systems have to be considered. Design criteria, performance specifications and guidelines for such systems shall be adopted and generalized.
20. Design and performance specifications of wastewater treatment plants shall be studied and standardized. Sufficient room in tendering for the construction of new plants shall be provided for competition to take place in both technologies and costs. However, deviations from standard designs shall be minimized and justified.
21. Septage from unserved areas shall be treated either in municipal or in well monitored and maintained facilities specifically designed for it.

40.4.4 On Reuse of Treated Effluent and Sludge

22. Treated wastewater effluent is considered a water resource and is added to the water stock for reuse. This is warranted and deemed feasible in light of the semi arid climate, the modest per capita share of freshwater resources, the high demand for municipal water, the per capita share of the deficit in the trade of food commodities, and of the marginal cost of resource development.
23. Priority shall be given to agricultural reuse of treated effluent for unrestricted irrigation. Blending of treated wastewater with fresh water shall be made to improve quality where possible. Crops to be irrigated by the treated effluent or blend

thereof with freshwater resources shall be selected to suit the irrigation water, soil type and chemistry, and the economics of the reuse operations.

24. Crop nutrient requirements shall be taking into consideration the prevailing effluent quality. Overuse of nutrients shall be avoided.
25. Accumulation of heavy metals and salinity shall be monitored, managed and mitigated. Leaching of soils shall be advocated by the irrigation authorities.
26. Farmers shall be encouraged to determine the rate of water application needed for different crops, taking into consideration the value of nutrients in the treated water and other parameters.
27. Farmers shall be encouraged to use modern and efficient irrigation technologies. Protection of farm workers and of crops against pollution with wastewater shall be ensured.
28. Treated effluent quality should be monitored and users be alerted to any emergency causing deterioration of the quality so that they will not use such water unless corrective measures are taken.
29. Studies should be conducted and projects designed and implemented to store the excess treated wastewater in surface reservoirs or in groundwater reservoirs through artificial recharge techniques. Due attention shall be given to the quality of treated and groundwater and the characteristics of the strata.
30. Plans and studies for power generation from sludge, if proven technically, economically and financially feasible, shall be made with due attention to environment impacts.
31. Sludge produced from the treatment process will be processed so it may be used as fertilizer and soil conditioner. Care shall be taken to conform to the regulations of public health and environment protection norms.
32. Whenever possible, other end uses of treated effluent; such as cycling, cooling, power generation, etc. shall be considered.

40.4.5 On Pricing

33. Wastewater charges, connection fees, sewage taxes and treatment fees shall be set to cover at least the operation and maintenance cost of the services. The ultimate aim is for a full cost recovery.
34. Appropriate criteria to apply the ‘polluter pays’ principle shall be established.
35. Different charges for different areas may be applied. This shall be assessed for each geographical area as a function of end uses and effluent quality and will be subjected to economic and social considerations.
36. Treated effluent shall be priced and sold to end users at a price covering at least the operation and maintenance costs of its delivery.

40.4.6 On Selected Priority Issues

37. To the extent that design capacities of wastewater treatment plants permit, priority of collection and house connections shall be accorded to urban areas. Users willing to contribute to the cost of the services in addition to fees and charges set by laws and regulations shall also be given priority.
38. Where design capacities of treatment facilities and of conveyance system are approached or exceeded, priority shall be given to the expansion of such capacities.
39. Priority shall be accorded to situations and locations where wastewater disposal practices threaten the environmental integrity of freshwater resources, and where performance of cesspools and percolation pits pollute underground water aquifers.

40.4.7 On Standards, Regulations and Quality Assurance

40. Jordanian Standards JS893/95, JS 1145/96, regulations of the Water Authority of Jordan (WAJ) for the quality of industrial wastewater to be connected to the collection system and WAJ’s specifications for sewage works, have been, thus far, the benchmarks against which plans and specifications of treatment plants and wastewater reuse were evaluated. They were established to bring about relative uniformity throughout the country. Periodically, these standards and regulations should be reviewed and modified to reflect special ambient conditions or end uses. Other aspects shall also be considered, e.g. economic socio-cultural, environmental and regional aspects.
41. Particular attention shall be focused on adopting and enforcing effluent and sludge standards for municipal and industrial wastewater treatment plants and for discharges from industries, laboratories, hospitals, slaughterhouses and other businesses.
42. Extensive and comprehensive monitoring programs shall be developed. Influent to and effluent from the plants and throughout watercourses shall

be measured and monitored against all appropriate parameters to insure that public health objectives and treatment efficiency goals are attained.

43. All crops irrigated with treated or mixed waters shall be analyzed and monitored periodically.
44. Observation wells shall be installed near the treatment plants to monitor groundwater quality where necessary, and to mitigate adverse impacts where and when needed.
45. Data collected from the monitoring process shall be entered and stored, processed and analyzed through computer software, and results published periodically.
46. Roof and storm water connections to public sewers shall be prohibited. Collection of storm water shall be done separately and will be the subject of water harvesting.
47. Effluent and sludge standards for the disposal of hazardous liquid wastes shall be defined to ensure the safe disposal of such wastes.
48. Laboratories shall be maintained and properly equipped to provide services and reliable data needed to ensure enforcement of and adherence to standards and regulations.

40.4.8 On Legislation and Institutional Arrangements

49. Legislation and institutional arrangement for the development and managements of wastewater shall be periodically reviewed. Gaps shall be filled, and updating of institutional arrangements with parallel legislation shall be made periodically to cope with changing circumstances.
50. The role of the government shall be fine-tuned and its involvement reduced with time to be regulatory and supervisory. Involvement of the stakeholders in wastewater management and support shall be introduced and expanded.

40.4.9 On Financing and Investment

51. Because of the limited financial resources available to Jordan, setting investment priorities in wastewater will be compatible with government investment plans.
52. Criteria for prioritizing investments in the wastewater sector shall take into account the current and future needs of the country, needs to expand wastewater systems in urban areas and to provide wastewater systems to smaller towns and villages that are not yet served.
53. Priorities of wastewater projects shall be made in conjunction with water supply projects and urbanization in general. Decisions will be made concerning them to attain optimum solutions to the need for services, availability of finance and availability of trained manpower.

40.4.10 On Public Awareness

54. The public shall be educated through various means about the risks associated with exposure to untreated wastewater and the suitability of treated effluents for different end uses.
55. Awareness programs for farmers and for the general public shall be designed and conducted to promote the reuse of treated wastewater, methods of irrigation and handling of produce. Such programs shall concentrate on methods of protection of the health of farmers, animal, birds and the environment.
56. Public awareness campaigns shall also be waged to educate the public on the importance of domestic hygiene, wastewater collection, treatment and disposal.

40.4.11 On the Role of the Private Sector

57. It is the intention of the government, through private sector participation, to transfer the management of infrastructure and services from the public to the private sector, in order to improve performance and upgrade the level of service.
58. The role of the private sector will expand with management contracts, concessions and other forms of private sector participation in wastewater management.
59. The concepts of BOO/BOT shall be entertained, and the impact of such concepts on consumers shall be continually addressed and negative impacts mitigated.
60. The private sector's role in reuse of treated effluent shall be encouraged and expanded.

40.4.12 On Human Resources Development

61. Capabilities of human resources in the management of wastewater shall be enhanced through training and continuous education. Work environments shall be improved and incentives provided.
62. The existing National Water Training Center shall be enhanced. It will be accorded adequate attention and provided with space, furniture and the

necessary support to identify needs, promote and conduct human resources development activities and training.

63. Human resources performance will be continually appraised in order to upgrade capabilities, sustain excellence and provide job security and incentives to qualified individuals with excellence performance.

40.4.13 On Research and Development

64. Applied research on relevant wastewater management topics shall be adopted and pro-moted. Topics such as the transfer of wastewater treatment technologies, low cost wastewater treatment technologies, reduction of energy consumption and others will receive adequate support.
65. Cooperation with specialized centers in the country and abroad shall be advanced, and raising of funds for this purpose shall be supported.
66. Transfer of appropriate technology suited for local conditions will be a primary target for the development activities and for adaptive research.
67. Emphasis will be placed on liaison with international institutions to keep abreast of modern technological advances and to facilitate their transfer and adaptation.

40.5 Conclusions

To protect human health and the environment and to provide additional water supply that meets the approved standards for its use, the Ministry of Water & Irrigation developed a wastewater management policy through which, the Ministry will ensure that appropriate wastewater collecting systems and treatment facilities are provided for all sources of wastewater, wherever feasible. It will also ensure that wastewater is not managed as 'waste' but is collected, treated, managed, and used in an efficient and optimized manner. The management policy illustrates that treated effluent complies with recently established national standards (JS893–2002) and that all treatment is to a quality appropriate for use in agricultural activities and other non-domestic purposes, including groundwater recharge. Appropriate wastewater treatment technologies shall be adopted with due consideration to sustainability, economy in energy consumption, and quality assurance of the effluent. Consideration shall also be given to the blending of the treated effluent with fresh water for suitable reuse.

41 Reducing the Environmental Impact of Olive Mill Wastewater in Jordan, Palestine and Israel

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Abstract[1]

Olive mill wastewater (OMW) generated by the olive oil extraction process is the main waste product of this industry. Approximately 5.4×10^6 m^3 of olive mill wastewater are produced annually worldwide. The majority of it is being produced in the Mediterranean Basin. The uncontrolled disposal of OMW is becoming a serious environmental problem, due to its high organic COD concentration, and because of its high content of microbial growth-inhibiting compounds, such as phenolic compounds and tannins. The improper disposal of OMW to the environment or to domestic wastewater treatment plants is prohibited due to its toxicity to microorganisms, and because of its potential threat to surface and groundwater, due to the current lack of appropriate alternative technologies to properly treat OMW. In the Mediterranean area it is most often discharged directly into sewer systems and water streams or concentrated in cesspools, despite the fact that such disposal methods are prohibited in many Mediterranean countries.

The Research and Development Center of the *Galilee Society* (GS) in Israel is coordinating a joint USAID funded project with partners from Hebron University, Palestine, *The Royal Scientific Society* (RSS) in Jordan, and the Technion - Haifa, Israel. The project aims to investigate industrially feasible physico-chemical and biological treatment systems in order to reduce the environmental impact of OMW. During the last three years, the partners conducted an inclusive survey on location, type of olive mills, production capacity, OMW generation, current practiced methods for the disposal of OMW and data related to the socio-economic situation of the farmers in the region. Furthermore, laboratory and pilot-scale experiments have been conducted in the GS, RSS and the Technion to examine the most effective physico-chemical and biological treatment systems to treat OMW.

The experimental work was conducted to identify the most efficient anaerobic treatment for OMW. It was demonstrated that in the *up-flow anaerobic sludge blanket reactor* (UASB) reactor, COD removal efficiency of 75–85 per cent was reached at a *Hydraulic Retention Time* (HRT) of 5 days with an influent COD concentration of about 40 gL^{-1} and *Organic Loading Rate* (OLR) = 7–8 g CODL-1.d^{-1}. Based on the results obtained in

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bench scale experiments, a demonstration pilot scale system was designed and constructed in Hebron district to continuously treat OMW.

Keywords: Anaerobic treatment, biomass, olive mill wastewater, GIS database, upflow anaerobic sludge blanket reactor.

41.1 Introduction

Olive mill wastewater (OMW) generated by the olive oil extraction process is the main waste product of this industry. Approximately, 1.8x106 tons of olive oil are produced annually worldwide, the majority (98 per cent) of it is produced in the Mediterranean basin (Benitez/Beltran-Heredia/Torregrosa/Acero 1997a). It is reported that OMW resulting from the production process surpasses 30 million m^3 per year (Baccari/Bonemazzi/Majone/Riccardi 1996) in the Mediterranean region. Treatment of OMW is becoming a serious environmental problem, due to its high organic COD concentration, and because of its resistance to biodegradation due to its high content of biomass-inhibiting growth, mainly phenolic compounds (Ramos-Comenzana/Monteolica-Sanchez/Lopez 1995). In addition, OMW typically contains polysaccharides, lipids, proteins, a number of monocyclic and polymeric aromatic molecules (Ethaliotis/Papadopoulou/Kotsou/Mari/Balis 1999), which might exhibit inhibition effects towards some specific anaerobic microorganism populations. All chemicals of analytical grade were purchased from Sigma.

The OMW is a significant source of environmental pollution in the Mediterranean countries (Basheer/Sabbah/Marzook 1999; Basheer/Sabbah/Marzook 2004). In general and for economic reasons, OMW is often concentrated in evaporation ponds and left to dry throughout the summer season (Borja/Martin/Maestro/Alba/Fiestas 1992; Benitez/Beltran-Heredia/Torregrosa/Acero/Cercas 1997b). OMW, negatively impacts the regional environment due to its toxicity to microorganisms in domestic wastewater treatment plants, its strong and unpleasant odor after anaerobic digestion, and also due to its potential threat to surface and groundwater sources. The seasonal production and high organic load of OMW make anaerobic treatment a very reasonable treatment option for this type of aqueous waste (Boari/Brunett/Passino/Rozzi 1974).

Within the different anaerobic treatment systems studied so far, up-flow anaerobic sludge blanket reactor (UASB) is considered as one of the most popular bioreactors to treat agro-industrial wastewaters characterized with high organic load. Previous research works show that a very high efficiency of COD removal has been achieved using UASB reactors with an influent organic loading rate of 8 g COD-1d-1 (Erguder/Guven/Demirer 2000). Most research studies in this field report that the major problems of UASB system are the long-term start-up period in addition to the instability of the biological activity as a result of washing out a significant part of the biomass from the reactor. Also, other problems are accounted such as the high toxicity of phenolic compounds, tannins, and adjusting the pH in the medium of the reactor (Sabbah/Marzook/Basheer 2004) when dealing with wastewater generated from the agro-industry.

Suitable sludge source is highly important for both start-up period and overcoming the low biodegradability of toxic compounds typically present in OMW. Therefore, the main goal of this study is to examine the most suitable sludge to be used for OMW in anaerobic treatment systems, mainly UASB reactors. Also, a *geographic information system* (GIS) database to allocate olive mills mainly in Jordan, Palestine and Israel and document their characteristics was prepared in this study.

41.1.1 Geographic Information System (GIS)

In order to successfully manage the OMW generated in Jordan, Palestine and Israel it was necessary to identify the locations most in need of facilities. In particular, analysis of the following was carried out:

- Location of the olive mills
- Availability of wastewater treatment facilities
- Characteristics and quantity of wastewater

A GIS database currently exists mapping many details about olive oil production in Jordan, Palestine and Israel. The database has been divided into three areas. Area 1 covers the Kingdom of Jordan and has been accumulated by the Royal Scientific Society. Area 2 was compiled by the Hebron University team and is subdivided into area 2(a) (West Bank) and area 2(b) (Gaza Strip). The Regional R&D Center at the Galilee Society collected the data for area 3 (Israel). The following information has been brought together for the database:

- Towns and villages
- Districts
- Main Roads
- Regional Roads
- Local Roads.

There are two comprehensive maps on the database. Each map contains several different layers for Jordan, Palestine and Israel. Layers detailing rivers, districts, roads, towns and villages, and olive mills have been added to a base map. A second map was compiled specifically for area 3. A questionnaire for olive mill owners was produced and the information gathered has been added to the database. This includes tables with the following information:

- General information about the mill, including name, location, type and manufacturing country.
- Numerator – contains information about the data entry.
- Olive mill owner information, including level of education.
- Production capacity of the mill.
- Water consumption and use of other resources.
- Generation of wastewater and solid waste.
- Infrastructure of the mill.
- Characteristics for area 1 – results of tests (quality of waste) carried out for some of the olive mills in Jordan.
- Characteristics for area 2 – results of tests carried out for some of the olive mills in Palestine.

The information in the database allows the relevant stakeholders to assess the requirement for the treatment in different areas, as well as practical considerations such as how to collect the OMW from the olive mills concerned. Any change in local circumstances, such as increase in mill's production capacity or modernization of milling Techniques, can be easily added to the database.

41.2 Materials and Methods

41.2.1 OMW Characterization

OMW for this study was obtained from different olive mills in the Galilee area and was refrigerated at 4 °C. The parameters COD, BOD, TSS, VSS, pH, and alkalinity of the collected OMW samples were determined according to the "Standard Methods for the Examination of Water and Wastewater, 20th Edition 1998". The total polyphenols in OMW were determined according to the Folin-Cioacalteau method (see Hamdi 1995; Kachouri/Hamdi 2004). Table 41.1 shows the typical characteristic parameters of OMW from the region. All chemicals of analytical grade were purchased from Sigma.

41.2.2 Biomass Characterization

The main characteristics of five different types of biomass collected from different sources in Israel are given in table 41.2. The differences in concentrations of *mixed liquor suspended solids* (MLSS) and *mixed liquor volatile suspended solids* (MLVSS) for the tested OMW samples were due to the solid contents of the original biomass collected from the specific source.

Table 41.1: Characteristics of Olive Mill Wastewater Used for the Biomass Selection Study (Batch Systems). **Source**: Basheer/Sabbah/Marzook 2004.

Parameter	Value
pH	5.0
Total alkalinity as CaCO3	1.172 g l^{-1}
Total polyphenols	6.8 g l^{-1}
COD(total)	163.5 g l^{-1}
COD (soluable)	131.5 g l^{-1}
BOD	27.5 g l^{-1}
TSS	86.84 g l^{-1}
VSS	0.503 g l^{-1}
$N\_NH^{+}_{4}$	0.11 g l-1

Biomass dry weight for the OMW samples was checked by taking an amount of mixed liquor suspended biomass, which was centrifuged at 5000 rpm for 10 minutes. The two phases obtained after centrifugation, were separated by decantation and then a fixed amount of the accumulated biomass was weighted and considered as wet base biomass. The obtained wet biomass amount was heated in an oven at 110 °C for 24 hours, and the resulting weight was considered as the dry weight of the biomass.

The relatively low MLVSS/MLSS (0.227) of Gadot biomass was due to the presence of an inert carrier material (such as sand and silt), where the high MLVSS/MLSS (0.7260) ratio of the biomass from Pri-Gat was due to the high organic content of the distillery wastewater that was absorbed or mixed with the biomass.

Table 41.2: Characteristics of Five Different Biomass Sources Tested in this Study.

Biomass Type	MLSS (g l^{-1})	MLVSS (g l^{-1})	MLVSS/ MLSS	Wet Weight (g)	Dry Weight (g)	% Dry/Wet weight
Sakhnin UASB	102.4	69.5	0.678	50.0	7.7	15.4
Haifa (HWTP)	23.3	16.25	0.697	43.6	4.2	9.6
Gadot UASB	411.4	93.6	0.227	49.8	20.0	40.2
OMW-evaporation pond	48.7	35.4	0.726	50.0	5.1	10.2
PriGat UASB	74.05	53.4	0.722	50.0	6.5	13

41.2.3 Anaerobic Batch Experiments

Anaerobic batch experiments were carried out in 1 l Erlenmeyer flasks connected with tubing to gas measuring tubes of 500 ml in volume. All gas collection tubes were calibrated daily to determine the volume of gas accumulated. For each biomass source OMW with COD concentrations in the range of 993–35,500 mg l^{-1}, was added.

Similar volumes of standard solutions containing trace elements and yeast extract were added to all of the anaerobic batch experiments in addition to a source of carbon (either sodium acetate or OMW). Sucrose solutions (5 per cent of total COD, 700 ml in each flask) were added to two flasks containing OMW, where the first had a COD of 1 g l^{-1} and the second had a COD of 20 g l^{-1}, in order to examine the effect of easy biodegradable compounds on the total efficiency of biodegradation. Each flask was supplemented with 50 g of biomass from a different source and 0.4 g urea as a source of nitrogen. The medium in each flask was adjusted to pH = 7.0 and kept constant at this value by appropriate addition of NaOH or HCl solutions each of 0.1 M. The flasks were immersed in a shaker bath at temperature 37 °C and shaken at 50 rpm. Samples were taken daily for COD and pH tests. The COD was determined by taking 5 ml of the flask content, centrifuged at 5000 rpm for 10 minutes, then tested according to the "Standard Methods for the Examination of Water and Wastewater, 20th Edition 1998". The gas collection tubes were monitored to determine the volume of the accumulated gas.

41.3 Results and Discussion

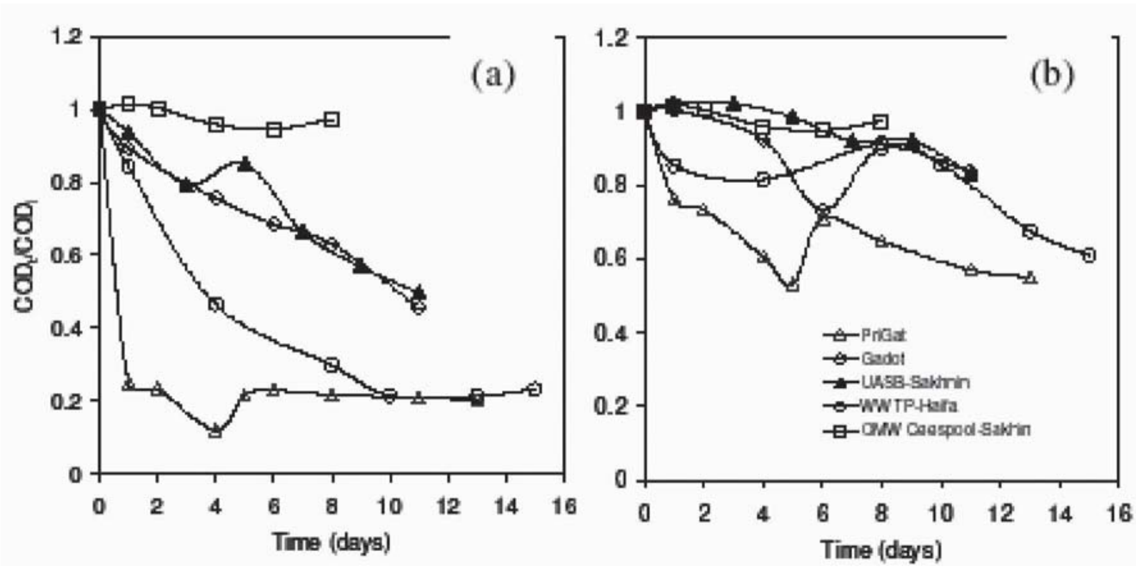
41.3.1 Biomass Activity with OMW

In a preliminary work, the anaerobic activity of the five different sources of biomass was evaluated. Each of the five batch-anaerobic systems containing water-diluted OMW with two various initial COD concentrations, each were inoculated with one of the five different biomass sources. Figure 41.1 shows the rate of the biological activity using the five different sources of biomass with OMW at initial COD concentrations of 1 g l^{-1} (figure 41.1a) and 20 g l^{-1} (Figure 41.1b). Figures 41.1a and 41.1b show obviously that the biomass from PriGat has the highest anaerobic biological activity in the treatment of OMW at both low and high concentration ranges. This result confirms that the PriGat biomass comprised the most appropriate populations of anaerobic microorganisms for the treatment of OMW compared to other sources of biomass used in this study.

41.3.2 Effect of Concentration Range of OMW on the Biomass Activity

The biomass of Gadot and PriGat were selected for our further study in order to test the effect of a broader COD concentration range on the biological activity of OMW biodegradation under anaerobic conditions. Figure 41.2 presents the results for the effect of initial COD concentrations of OMW on the biological activity of biomass from PriGat. It can be seen from the results that the initial COD concentration of 5 g l^{-1} does not affect the rate of biodegradation of OMW as well as having no effect on the extent of the ultimate removal percentage (80 %) obtained after 4 days. However, the (a) (b) results in figure 41.2 show that starting with initial COD concentrations of OMW equal or higher than 20 g l^{-1} caused a major

Figure 41.1: Kinetics of COD (mg/L) Removal of OMW Presented as COD Measured at Different Time Intervals (CODt) per the Initial COD Concentration (CODi). The anaerobic biodegradation conditions: Two sets of five OMW solutions (1l) of CODi 1 g/l (graph a) and of 20 g/l (graph b) were inoculated each with 50 g of sludge from the different sources. The solutions were shaken at 50 rpm, pH 7 and at 35 °C. **Source**: Basheer/Sabbah/Marzook 2004

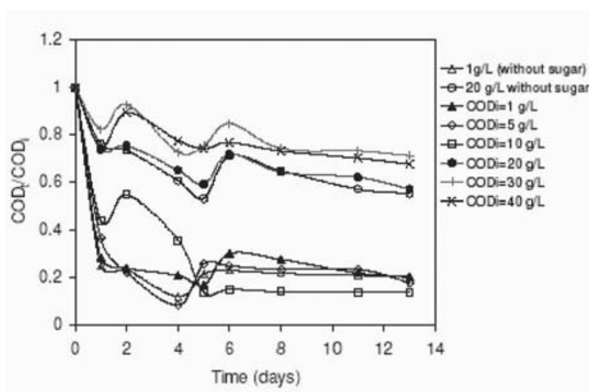


inhibition effect on the anaerobic biodegradation rate of OMW as well as on the final extent of COD removal. It can also be seen in figure 41.2 that the initial COD concentration of 10 $g\ l^{-1}$ was observed to be such an 'intermediate' concentration level, where the biodegradation rate was slow in the first three days, but the ultimate degraded organic materials present in OMW was similar to the extent obtained when using lower initial concentration of COD for OMW. Figure 41.2 also shows that 73–85 % of the COD content in the low range (1–10 $g\ l^{-1}$) was removed within 4–5 days of contact time compared to about 40 % COD removal obtained when the initial COD concentration of 20 $g\ l^{-1}$ was used with the PriGat biomass. The results also show that only 25–28 per cent of the COD concentration was removed when the initial COD concentration was of 40 $g\ l^{-1}$. These results indicate that the equivalent concentration of the refractory compounds (assumed to be polyphenols) in OMW of 20 $g\ l^{-1}$ or more as COD has significantly inhibited the biomass anaerobic activity.

41.3.3 Pilot Plant for the Treatment of OMW

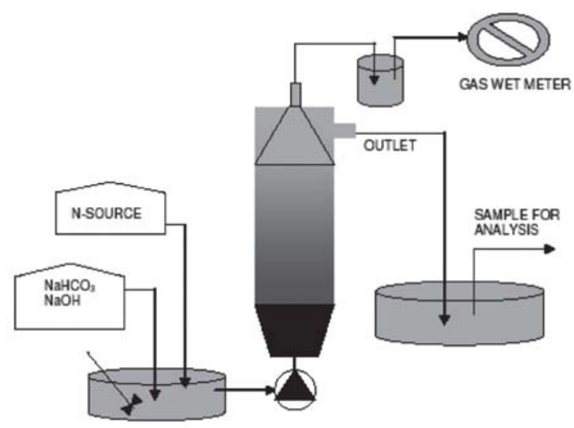
Pilot plant of $4\ m^3$ in volume was designed and constructed for the treatment of OMW in one olive mill in the region of Hebron (figure 41.3). The concentration of COD in the reactor was 5000 mg/L. The

Figure 41.2: The Effect of Initial COD Concentration of OMW on the Kinetic Activity of Biomass from PriGat. The activity profile is presented as COD measured at different time intervals (CODt) per the initial COD concentration (CODi). The anaerobic biodegradation conditions: OMW solutions (1l) of various initial COD concentrations were inoculated each with 50 g of sludge from PriGat. The solutions were shaken at 50 rpm, pH 7 and at 35 °C.



amount of wastewater, which flowed into the reactor was 3m3, and the amount of sludge seeded was 1900L ($1.9m^3$) with the concentration of 53 g VSS/L. The constructed UASB was fed with diluted OMW with COD content in the range of 2000–5000 mg/L

Figure 41.3: Schematic Drawing for the UASB 4 m^3 in Volume Reactor System. **Source**: Basheer/Sabbah/Marzook 2004



during the start-up period of the continuous reactor. The generation of biogas bubbles in top of the reactor could be observed on the 5th day of operation, indicating anaerobic activity. Anti-foaming agent was used to reduce the scum layer that periodically appeared on top of the liquid phase of the UASB reactor. The pH of the influent was adjusted to the range of 6.8–7.00 with alkaline solution while the pH of the effluent was in the range of 7.5–7.75. The COD applied after two weeks after start-up of the continuous reactor was 6250 mg/L, while the CODout was 1710 mg/L using a Hydraulic Retention Time (HRT) of 5 days. The flow rate was increased from around 980L/d to 1200L/d (HRT=4.2 days) within a one-week period. Depending on the reactor performance the HRT has been decreased down to 3.5 days or less. The work on the pilot station is being continued, with the aim of treating OMW in the constructed UASB system so that the effluents of the system can be disposed directly to the municipal wastewater system.

41.4 Conclusions

A GIS database system was compiled in this study. This system is comprised of three levels representing Jordan, Palestine and Israel. The database contains geographic data, which includes maps and locations for the areas and the mills in the three countries. The compiled database also contains information about the characteristic of olive mills in Jordan, Palestine and Israel.

In our study also, two types of biomass, collected from the wastewater treatment systems of a citrus juice producing company "PriGat" and of citric acid manufacturing factory "Gadot" both located in Israel, were found to be the most efficient sources of microorganisms to anaerobically treat both sodium acetate solution and OMW. The results show that 70–85 % of COD removal was reached using Gadot biomass after 8–10 days when the initial COD concentration of OMW was up to 5 g l^{-1}, while similar removal efficiency was achieved using OMW of initial COD concentration of 10 g l^{-1} in 2–4 days of contact time with the PriGat biomass.

The physico-chemical pretreatment of OMW was found to enhance the anaerobic biodegradation rate for OMW with initial concentration of 20 g l^{-1} using PriGat biomass. A removal efficiency of 80 % was observed when OMW was first physicochemically pretreated, while only 40 per cent of removal efficiency was reached using water-diluted OMW with the same initial COD and biomass concentrations. This finding is attributed to the high removal efficiency of polyphenols and other toxicants by the proposed pretreatment process for OMW.

References

Baccari, M.; Bonemazzi, F.; Majone, M.; Riccardi, C., 1996: "Interaction between Acidogenesis and Methanogenesis in the Anaerobic Treatment of Olive Oil Mill Effluents", in: *Wat. Res.*, 30,1: 183–189.

Basheer, S.; Sabbah, I.; Marzook, T., 1999: "Olive mill wastewater treatment in the Galilee Region". *Annual Report, Israeli Ministry of Agriculture* (Jerusalem).

Basheer, S.; Sabbah, I.; Marzook, T., 2004: "The effect of pretreatment on anaerobic activity of olive mill wastewater using batch and continuous systems", in: *Process Biochem*, 39: 1947–1951.

Benitez, F.J.; Beltran-Heredia, J.; Torregrosa, J.; Acero, J.L., 1997[a]: "Aerobic degradation of olive mill wastewater", in: *Appl. Microbiol. Biotechnol*, 47: 185–188.

Boari, G.; Brunetti, A.; Passino, R.; Rozzi, A., 1974: "Anaerobic digestion of olive mill wastewater2, in: *Agri. Wastes*, 10: 161–175.

Borja, R.; Martin, M.; Maestro, R.; Alba, J.; Fiestas, J.A., 1992: "Enhancement of the anaerobic digestion of olive mill wastewater by the removal of phenolic inhibitors", in: *Process Biochem*, 27: 231–237.

Cercas, V., 1997b: "Chemical pretreatment by ozone of wastewater from olive oil mills", in: *Technol. Environ. Chem*, 60: 97–109.

Erguder, T.H.; Guven, E.; Demirer, G.N., 2000: "Anaerobic treatment of olive mill wastes in batch reactors", in: *Process Biochem*, 36: 243–248.

Ethaliotis, C.; Papadopoulou, K.; Kotsou, M.; Mari, I.; Balis, C., 1999: "Adaptation and population dynamics of Aztobacter vinelandii during aerobic biological treatment of olive mill wastewater", in: *FEMS Microbiol. Ecol.*, 30: 301–311.

Hamdi, M., 1995: "Anaerobic digestion of olive mill wastewater", in: *Process Biochem.*, 31: 105–110.

Kachouri, F.; Hamdi, M., 2004: "Enhancement of polyphenols in olive oil by contact with fermented olive mill wastewater by Lactobacillus plantarum", in: *Process Biochem.*, 39: 841–845.

Ramos-Comenzana, A., 1995: "Monteolica-Sanchez M and Lopez MJ, Bioremediation of alpechin", in: *J. Biodeter. Biodegr*, 35: 249–268.

Sabbah I.; Marzook T.; Basheer S., 2004: "The effect of pretreatment on anaerobic activity of olive mill wastewater using batch and continuous systems", in: *Process Biochem*, 39: 1947–1951.

42 A Seeping Timebomb: Pollution of the Mountain Aquifer by Sewage

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Abstract

Untreated sewage of over 2 million people on the recharge area of the Mountain Aquifer threatens to pollute the most significant, shared water source of Israelis and Palestinians. The vast majority of Palestinians in the West Bank, and large parts of the Israeli settlements, have none or inadequate sewage treatment facilities. The international community, led by Germany and the U.S., has committed funding for several sewage projects, however, only one full scale project has been implemented to date (one pre-treatment facility was completed in 2005) This chapter examines the factors preventing projects' implementation, and proposes recommendations to all parties involved.

This article was prepared and presented in 2004, and appears here without change. However, several noteworthy developments took place since its original presentation. These include: launching of a sewage pre-treatment facility in Tul Karem (German funded); the proposed sewage project for Nablus East was cancelled; establishment of a sewage removal project on the Kanah Stream for some Israeli settlements; Enforcement measures were taken by the Israeli Environment Ministry against the settlement of Ariel on the issue of sewage treatment; the USAID froze its Hebron wastewater project, owing to the establishment of the Hamas government in the Palestinian Authority.

Keywords: Development; Middle East; mountain aquifer; transboundary pollution; water

42.1 Introduction

This chapter describes one of the most severe environmental problems threatening Palestinians and Israelis: large-scale pollution of freshwater resources. The Mountain Aquifer is a shared Israeli – Palestinian fresh water resource. Though there has been much debate over the division of the waters of the Mountain Aquifer between the parties, the issue of protecting the aquifer's groundwater from pollution has yet to receive the attention that it deserves. Large quantities of untreated sewage run on the surface of the Mountain Aquifer, percolate into the ground and threaten the continued utilization of vital water resources. Pollution sources are both Palestinian and Israeli, the threat to future water supplies is undisputed and evidence shows that groundwater in some locations has already been polluted. Despite the urgency of the issue, progress on solutions has been slow, and funds committed to build sewage treatment projects may be withheld or withdrawn.

This chapter points at major sources of pollution from sewage, describes the different solutions that have been proposed and attempts to identify factors that prevent the implementation of sewage solutions. In the preparation of this chapter, *Friends of the Earth Middle East* (FoEME) staff met with Israeli and Palestinian representatives as well as those of donor countries. These meetings and the comments gathered on drafts of the chapter, enabled FoEME to draw conclusions and make recommendations to protect the Mountain Aquifer.

42.2 Background

The Mountain Aquifer is one of the most significant sources of water for both Israelis and Palestinians. It consists of three sub-aquifers, which together supply 600–700 million cubic meters of water per year (Gvirtzman 2002: 103; IWC 2003a: v), equivalent to more than one third of the yearly water consumption in Israel. Water of the Mountain Aquifer is shared between Palestine and Israel, whereby nearly the entire Palestinian population in the West Bank is dependent on springs, wells or extracted water from the Mountain Aquifer for drinking and other uses. In Israel, the Mountain Aquifer supplies water to major population centers such as Jerusalem, Tel-Aviv, Be'er Sheva and other cities. Israeli settlements in the West Bank also rely on Mountain Aquifer water.

The Mountain Aquifer is the source of major streams and rivers in Israel's coastal area, including the Yarkon, Taninim, Hadera and other streams. The aquifer consists of a recharge area and a confined area. Rainfall in the recharge area permeates through the rocky foundation and accumulates underground, where it flows west, north-east or east, dividing the Mountain Aquifer into three sub-aquifers. The confined area is located further down the slopes, beneath an impermeable layer of rock. Most wells and water extraction sites are located there.

The greatest part of the recharge area (consisting of 4,700 sq. kilometers) is situated in the West Bank and the Jerusalem corridor. The confined area of the western sub-aquifer lies, for the most part, within Israel. This sub-aquifer is the source of most of the water extracted by Israel from the Mountain Aquifer, and for many wells in the Palestinian cities of Tul Karem and Qalqiliya. Water in the northeastern sub-aquifer flows underground initially to the north, and then continues eastward to the Jordan Valley and the Dead Sea. In the eastern sub-aquifer, water flows underground directly eastwards from Ramallah, Jerusalem and Hebron towards the Jordan Valley and the Dead Sea (Gvirtzman 2002: 102–136; UNEP 2003: 42–57).

Given its karstic geology, most of the Mountain Aquifer's recharge area is vulnerable to groundwater pollution (Gvirtzman 2002: 112; UNEP 2003: 33). The north-western strip of the Mountain Aquifer's recharge area, around the cities of Tul Karem and Qalqiliya, is particularly vulnerable. Groundwater in that area is closer to the surface, requiring a shorter period of time for pollutants to percolate and reach it (Guttman 2000). Some of the most abundant water extractions from the Mountain Aquifer are located in that area (Gvirtzman 2002: 25). Alarmingly, it is also the location of some of the most serious pollution spots (IWC 2003a: 124).

The recharge area of the Mountain Aquifer includes most of the area of the West Bank as well as some parts of Israel. The human population in that area reaches around three million people in 2004. It includes Palestinian cities (except Jericho) and villages in the West Bank (approximately 2,263,931, as of mid-2003; see Palestinian CBS 2003); Israeli settlements in the West Bank (212,900 by the end of 2002; see Israeli CBS 2002); and Israeli cities and villages in the Jerusalem Corridor and Modi'in areas (at least 500,000, including Jerusalem, Modi'in and villages in the Jerusalem Corridor). While sewage of most Israeli localities within Israel is treated adequately, most Palestinians as well as many of the Israeli settlements in the West Bank do not have adequate sewage treatment facilities. The sewage of over two million people flows untreated in the recharge area of the Mountain Aquifer, percolating into the largest and most significant groundwater reservoir in the region.

42.3 Pollution of Groundwater

Sewage flow in the recharge area of the Mountain Aquifer leads directly to pollution of groundwater. Recent reports by the hydrological service of the Israeli Water Commission have shown high levels of nitrate pollution, originating from untreated sewage as well as agricultural sources, in the area near Tul Karem and Qalqiliya, reaching at times concentrations of 100–145 mg/l. A smaller area of pollution was found in the Hebron area, where nitrate concentration reached 60–80 mg/l (IWC 2003a, 2004b). The WHO standard for nitrate concentration in drinking water is 50 mg/l. Other evidence shows water contamination by nitrate and fecal coliforms in many wells and springs in the West Bank, with many sources no longer fit for consumption without prior treatment. Many of the natural springs in the West Bank, mainly the ones located inside the villages, are polluted by fecal coliforms, since most of them are located downstream from some source of pollution, usually unsanitary cesspits of uphill villages (Rabbo/ Scarpa/ Qannan/Abdul-Jaber/Younger 1999; UNEP 2003: 34–35).

Nitrate pollution, was also found in wells in the Jordan valley, Nablus, and Jenin districts. Wells in the Tul Karem district were also found to contain chloride pollution, indicative of industrial and municipal wastewater. Micro-biological pollution, also above WHO levels, was evident in 600 of 2,721 samples examined in 2001 (Kliot 2003: 43–47). In addition, some hotspots of industrial pollution were identified in the vicinity of quarries, olive oil refineries, abattoirs and leather processing industries (UNEP 2003: 56–57).

This evidence suggests that pollution from the surface in the Mountain Aquifer's recharge area has already begun to contaminate water resources. However, the bulk of the pollution has yet to reach groundwater. The 'travel-period' of pollutants to underground reservoirs is difficult to predict, but experts agree that many of the pollutants that have begun to percolate into the ground will undoubtedly reach the reservoirs at some point. According to one study, the first trace of pollution from the Barkan industrial area is expected to reach groundwater within 15 years. Within 30 years, traces of that pollution are expected to reach wells in the Yarkon area and others, which currently provide 37 million cubic meters of water a year. Examining sewage from Ramallah, too, the study estimates that nitrate pollution will take approximately 15 years to reach groundwater. Initially it is expected to cause low concentrations of pollution in groundwater, but those will then rise steadily (Shuval/Isaac 2000).

42.3.1 Sewage from Palestinian Sources

Sewage from Palestinian sources on the Mountain Aquifer's recharge area is estimated at 46 million cubic meters per year.[1] In villages, comprising 61 per cent of the Palestinian population in the West Bank, sewage is commonly disposed of in unlined cesspits, allowing gradual absorption into the ground and requiring periodical emptying of the remaining solid waste. In urban centers, 70 per cent of the population is connected to sewage networks (UNEP 2003: 52). In the vast majority of cases, however, these networks discharge the sewage without treatment into streams in the open environment. Where sewage networks are not in place, sewage runs in open canals or is also disposed of in cesspits.

Currently, only five sewage treatment plants exist for the Palestinian population in the West Bank. Of these, only one is functioning adequately: a new, German-funded plant in El-Bireh, which can treat the sewage of up to 50,000 people. Of the other sewage treatment plants two (in Jenin and Hebron/Al Khalil) do not work at all and the other two (in Tul Karem and Ramallah) have only recently been rehabilitated with German funding. Even the rehabilitated plants, however, are of limited capacity and unable to adequately treat the sewage of today's population.

Several new sewage treatment projects have been planned for West Bank Palestinian cities since the beginning of the peace process. These were supposed to be financed by German and U.S. development agencies, who have committed hundreds of millions of dollars for their implementation. Unfortunately, as of 2004 the sewage treatment plant in El-Bireh is the only one that has been implemented. The result is that sewage in most West Bank cities continues to flow untreated, while large sums of money committed to sewage treatment projects remain unused.

42.3.2 Sewage from Israeli Sources

It is only in recent years that sewage from Israeli cities and villages on the Mountain Aquifer recharge area *within Israel* has undergone adequate treatment. West Jerusalem sewage, for example, is treated at the Soreq treatment plant, which began operation in 1999. Today, therefore, sewage from Israeli sources within Israel poses little threat to the Mountain Aquifer. The treatment of sewage from Israeli settlements in the West Bank, however, is less satisfactory.

Only partial data were provided to the authors on the treatment of sewage from Israeli settlements in the West Bank, amounting to 15 million cubic meters per year. Despite the existence of precise data on the issue, the Israeli Water Commission refused to provide detailed reports. Instead, it claims that 70 per cent of the settlements' sewage is treated satisfactorily, while the remainder is either treated to unsatisfactory levels or is not treated at all (IWC 2004a). Data obtained by the authors show a somewhat different picture. Monitoring results from 1999 suggest that only 6 per cent of the sewage conformed to Israeli treatment standards (Environmental Protection Association Samaria and Jordan Valley 2000), while 48 per cent of the sewage was treated inadequately, or

1 In the absence of hard data, the amount of sewage had to be estimated thus: on a calculation of 2,263,931 Palestinians in the West Bank (excluding Jericho; Palestinian CBS2003), yearly water consumption of 29 cubic meters per capita and sewage proportion of 70 per cent of water (Tahal 1999:. 2–4). There exist a variety of other estimates. Given the relatively low water consumption in Palestinian society and its limited access to water resources, concentration of organic matter is much higher in Palestinian than in Israeli sewage.

Table 42.1: Sewage in the Mountain Aquifer's Recharge Area by Source.

	Palestinian Villages	Palestinian Cities	Israeli Settlements
Population[a]	1,381,000	883,000	213,000
Quantity of sewage[b]	28 MCM/Y	18 MCM/Y	15 MCM/Y
Current treatment	Cesspits (unsatisfactory)	None or unsatisfactory sewage treatment plants. (One exception)	Partial treatment only. Some projects in progress.
Finance for planned infrastructure	None.	Germany and the USA have committed US $ 230 million for projects in the above cities. Very slow implementation.	NIS 65 million (approx. US $ 14.5) financed by settlement municipalities. NIS 400 million (approx. US $ 90 million) required.

a. Palestinian and Israeli Central Bureaus of Statistics, respectively.
b. Quantity of Palestinian sewage was estimated according to population data and assumptions of average water consumption and percentage of wastewater from it according to reports of the Israeli Water Commission. See Endnotes for details. Quantity of Israeli settlement sewage: Israeli Water Commission (IWC 2004a).

not treated at all. Monitoring results for 17 per cent were not available, and the status of 7 per cent was unclear. Several sewage treatment projects for Israeli settlements are currently in various stages of implementation. Once completed, they will treat the remaining 22 per cent of the settlements' sewage. These projects include the Kana Stream carrier line, upgrading of the sewage treatment plant of Barkan Industrial Area, sewage treatment plants in Efrat and Beit-Aryeh, and upgrading as well as building of sewage infrastructure in Modi'in-Illit (IWC 2004a).

42.4 Solutions and Impediments to Their Implementation

Protection of the Mountain Aquifer and the prevention of groundwater contamination by sewage from large urban centers in the West Bank require the building of extensive sewage treatment infrastructure. Since the beginning of the peace process, the international community, led by Germany and the U.S., has committed US $ 230 million for sewage treatment projects in Palestinian cities. This could be the starting point for the protection of vital groundwater resources; however, very little progress has taken place on the ground. Until October 2006, only one full project has been implemented, while several others remain on hold.

The Palestinian Authority, the Israeli Government and German and U.S. aid agencies are all involved in the attempt to build sewage infrastructure in the West Bank. This has proven to be a difficult task even prior to the outbreak of the second Intifada, and certainly throughout the violent conflict. The following is FoEME's attempt to identify the hurdles which have prevented the implementation of sewage projects to date, based on a series of discussions with all parties concerned.

42.4.1 Germany

German agencies operating in the Palestinian Authority have committed more funding than any other donor country to sewage projects, and had plans to construct treatment facilities in all major cities in the northern West Bank. However, they managed to build only one plant before the Second Intifada broke out. Since the Intifada, the Germans have placed all large projects on hold, focusing instead on smaller projects such as rehabilitation of old sewage infrastructure in Tul Karem and Ramallah. These 'pilot projects' are considered test cases, the successful completion of which is required before commencement of larger-scale projects.

The main reason for placing the sewage works on hold, according to German agencies, is the restriction on movement of civilians and vehicles into and out of Palestinian cities, imposed by the Israeli military. Under these conditions, workers, experts and equipment required for the construction of sewage infrastructure often cannot access the sites, although work has been delayed, workers and experts have had to be paid. In addition, imported materials and equipment have been held in Customs for long periods, pending security clearance by military authorities. Such delays occurred even in cases when work was coordinated with Israeli authorities. Instructions to facilitate works often failed to reach the checkpoint level, leading to soldiers not allowing workers through to the site. In one

Table 42.2: Planned Palestinian Sewage Projects in the West Bank as of 2004.

City	Donor	Cost[a]	Project Status
Hebron/Al Khalil	USA	$45 M	The project is in the planning stages. Agreement over the level of treatment and direction of sewage discharge was reached recently. Project was frozen due to the security situation, expected to commence next year.
Tul Karem	Germany	$50 M	Currently work is taking place on the rehabilitation of the municipal sewage network and the old sewage treatment plant. Plans to build a new sewage treatment plant exist, and Germany has committed to finance it. However, no work has taken place to date. Sewage flows across the Green Line, and is treated in an emergency treatment plant in Israel.
Jenin	Germany	$50 M	An old, non-functioning sewage treatment plant exists. Plans include its rehabilitation, a new industrial sewage facility and a new regional sewage treatment plant. No work has taken place at this stage.
Nablus East	Germany	$20-25 M	Plans to build a new sewage treatment plant were cancelled and funds committed shifted to other projects.
Nablus West	Germany	$25 M	A new sewage treatment plant has received final approval from the Joint Water Committee. No work has taken place to date.
El-Bireh	Germany	$12 M	Germany has built a new sewage treatment plant. Still to be built is a pipeline to remove treated effluent.
Ramallah	Germany	$10 M	There are plans to build a new sewage treatment plant. Rehabilitation of the old sewage treatment plant completed, providing a very partial solution.
Salfit	Germany	$13 M	Following approval of the JWC, German agencies began to build a carrier line to a planned sewage treatment plant. After work had begun, it was decided by Israel that the planned location, earlier approved, was too proximate to a planned new neighborhood in the Ariel settlement. Israel compensated Germany and work was supposed to continue at a new location. Plans and tender documents for this project are currently reevaluated in preparation for implementation.

a. Information obtained from interviews with representatives of KFW (German development funding agency) and USAID.

incident, workers were reportedly shot at.[2] These complications have led to a significant increase in the costs of sewage projects, which German agencies are not prepared to absorb. The German taxpayer, it has been said, is prepared to pay for infrastructure projects in Palestinian cities, but not for the 'costs of Israel's occupation'.

When confronted with this argument, officials from the Israeli military have stated that German representatives have rarely approached them with requests to facilitate access for workers and equipment. According to the Israeli side, permits for workers can be issued for speedy passage through checkpoints, and equipment can be quickly released from Customs once the military is assured that it cannot be used for hostile purposes. The Israeli side claims that delays are unavoidable, but their extent depends on the level of coordination between the foreign aid agency and the military.

Clearly, the conflict situation and the policies employed by Israel impose severe constraints on the operation of aid agencies. If projects are to be implemented, a significant investment in daily coordination must be made. German agencies, however, do not consider themselves as responsible for such coordination, and are short of staff for this purpose in any event. FoEME was told that given that Germany's development cooperation is with the Palestinian Authority, official representatives rarely communicate directly with Israeli ones.[3]

2 At the beginning of 2003, the military began to operate a new division in charge of international organizations and external relations. It is hoped that this will improve the military's internal coordination.

3 Stated to FoEME staff in meetings held with KfW officials in Jerusalem and in Frankfurt.

42.4.2 United States of America

The United States Agency for International Development (USAID) committed to build a sewage project in Hebron/Al Khalil. Though plans have been drawn up and negotiations held with all sides, no physical work has yet taken place, and sewage from the city continues to flow down the Hebron River. USAID reports that it also suffers from additional, conflict-related costs, estimated at about 25 per cent of project total costs. USAID reports to have direct and frequent contact with the Israeli military's District Coordination Office (DCO).

The Hebron/Al Khalil Project has been delayed for other reasons, related to the disagreement between Israel, the Palestinian Authority and USAID on aspects of the project's plans. For a long time, the parties were in disagreement about the required location as well as levels of treatment of the treatment plant. Israel insisted that the plant be located on the western slopes of the mountain, so that wastewater flows westward down the Hebron stream, eventually entering Israel across the green line. If the plant was to be located on the eastern side in Banei Naim, as requested by the Palestinian Authority, Israel insisted that far reaching and costly measures be taken to prevent pollution of the Hever stream which it claimed would lead to polluting the springs at Ein Gedi nature reserve. In addition, locating the project in Banei Naim encountered objections from local residents. Recently, agreement has been reached between the parties, and the plant will probably be located in the western side of Hebron.

It appears that these complications and the resultant delays in work could have been prevented by USAID if both the Palestinian and the Israeli authorities were more involved in the planning process from the outset. The Israeli side noted that had they been asked to comment on the project's terms of reference, for example, before completion of plans, much of the subsequent dispute could have been avoided.

42.4.3 Israel

The Israeli Water Commission holds the Palestinian Water Authority responsible for the stalemate in implementing sewage projects in the West Bank. The Palestinian side is blamed for its indifference, deceitful conduct and mal intent, which result in no progress on sewage issues despite the availability of donor funding (IWC 2002). According to FoEME's findings, however, many of the problems concerning sewage projects are the result of insufficient coordination between Israel and the donor countries, and Israel could do better in promoting them.

By pointing at the Palestinians as the sole party at fault in implementing sewage projects, the Israeli Water Commission is ignoring major impediments which the Palestinian Authority is not able to address, for example restrictions on movement resultant from Israel's military policies. If Israeli authorities were to closely follow up the implementation of sewage projects, support donor country efforts and remove the bureaucratic obstacles that they face, it is likely that many of the projects would have been implemented by now. As it stands, however, Israel's liaison with donor countries on this matter has been left in the hands of relatively low-level officials, rather than the diplomatically trained staff that the situation necessitates. This is despite the fact that investment of such magnitude in Palestinian sewage treatment is in Israel's direct interest.

In addition, sewage from many Israeli settlements in the West Bank continues to flow untreated, contributing to pollution of the Mountain Aquifer. Israeli settlements do not suffer from restrictions of movement on West Bank roads, and there are no impediments to building infrastructure there. Nonetheless, it appears that different requirements apply to settlements and to localities within Israel: most settlements have highly inadequate sewage treatment, yet their municipalities do little to address the issue and the Israeli Government fails to enforce its own environmental laws on them.

42.4.4 Palestinian Authority

The issue of sewage treatment appears to be relatively low on the Palestinian agenda. In a recent summit of international donors, the Palestinian Authority detailed its aid requirements, reaching US $ 1.2 billion. Of these, only US $ 60 million was requested for sewage infrastructure (USAID).[4] It appears that other issues (for example, humanitarian assistance and water supply), are treated with greater urgency by the Palestinian Authority, which expresses its preferences to the donor community.

4 Statement by Lawrence J. Gumbiner, (First Secretary, Environment, Science and Technology Affairs, US Embassy in Tel-Aviv) at a symposium: "Protecting the Mountain Aquifer", Tel Aviv University, 17 December 2003.

In a letter dated September 2003, high level officials of the Palestinian Water Authority requested USAID to reallocate funds committed to a sewage treatment plant in Hebron/Al Khalil to water supply projects. Such expressions of Palestinian priorities have led some donor countries to rethink their allocation of aid funds, potentially withdrawing their support for sewage treatment infrastructure.

Israeli officials have claimed that the Palestinian side takes a long time to submit plans for sewage treatment projects in the Joint Water Committee, thereby demonstrating little interest in promoting sewage solutions. While FoEME cannot determine the exact validity of these allegations, correspondence between the parties does suggest that Israel has had to urge the Palestinian side to submit such plans. Another example is the long period of time required for the Palestinian side to agree to a *Memorandum of Understanding* (MoU) on an acceptable level of sewage treatment. Initially, the Palestinian side rejected the treatment criteria as too costly, They later agreed to sign the document, however the signing of the MoU was not brought to the attention of the *German development agency* (KfW), which continued to regard the non-agreement over standards as a major obstacle to project implementation.

42.5 FOEME'S Findings

The building of sewage infrastructure in a conflict zone such as the West Bank is not a simple undertaking. All sides have blamed the conflict conditions, and sometimes one another, for their inability to move forward on sewage treatment facilities. The following is a summary of FoEME's findings:

42.5.1 General

The vast majority of West Bank Palestinian localities have no sewage treatment at all. All relevant stakeholders recognize the importance of protecting groundwater from pollution. Project implementation requires intensive investment in coordination between all parties. Restrictions of movement through military checkpoints is the main factor causing additional costs and delays to projects. Should Israel and the Palestinian Authority fail to support donor countries' sewage treatment projects, an investment in protecting shared water resources to the total value of US $ 230 million may be lost.

42.5.2 Israel

The present coordination of the issue on behalf of Israel is not handled at an appropriately senior level. There has been inadequate follow-up and support of donor country efforts on sewage projects by Israel. Though Israel blames the Palestinians for failing to implement sewage projects, significant difficulties between Israel and donor countries could be addressed irrespective of the Palestinians. The Israeli security forces are bureaucratic and unorganized. In the past, Israel conditioned its approval of sewage treatment projects by insisting that they be connected to settlements. This issue slowed progress on sewage projects until 1999. Since then, Israel demanded particularly high standards of sewage treatment in Palestinian sewage treatment plants. A mutually acceptable compromise on sewage treatment standards was agreed upon only very recently. Israeli settlements produce an estimated 25 per cent of the sewage in the Mountain Aquifer. The majority of the settlements do not have adequate sewage treatment. The Israeli Environment Ministry fails to sufficiently enforce sewage treatment in settlements.

42.5.3 The Palestinian Authority

The present coordination of the issue on behalf of the Palestinian Authority is not handled at an appropriately senior level. The Palestinian Authority has openly stated that water supply projects should take precedence over sewage projects. While sewage treatment projects are largely on hold, many infrastructure projects (particularly on water supply) have continued to move forward in the West Bank. The Palestinian Authority has, until very recently, refused to accept the standards of sewage treatment upon which Israel has insisted.

42.5.4 Donor Countries

Donor countries prefer to postpone the implementation of sewage treatment projects, so as to avoid additional conflict-related costs (25–40 per cent) resultant from restrictions on movement and imports. Insisting on peacetime conditions in a conflict zone is not a realistic expectation. Additional, conflict-related costs should be included in the planning of projects in the West Bank. Conflict-related costs can be significantly minimized by improved coordination between donor country agencies and Israeli authorities. The working relationship of German development agencies with

Israeli authorities is limited and cumbersome. Some project had to be seriously altered following objections of the Palestinian and/or Israeli authorities. This could have been prevented through consultations prior to detailed planning.

42.6 Recommendations

FoEME believes that solutions to groundwater contamination cannot wait for the end of the Israeli-Palestinian conflict, and all parties must do their utmost to achieve such solutions even under the conflict conditions. In order to protect the Mountain Aquifer from sewage pollution, FoEME believes that urgent, constructive and pro-active steps need to be taken by all parties:

42.6.1 Israel

1. It is recommended that the Minister of National Infrastructures appoint a senior staff member to advance the issue at the diplomatic and political levels. This person should invest maximum efforts to assist donor countries in implementing sewage projects in the West Bank through, inter alia:
   a.) Removing obstacles and administrative barriers to their operations;
   b.) Coordinating between them and the Israeli authorities on work permits and import of materials
2. The Ministry of the Environment should take immediate legal action against settlement municipalities that fail to implement Israeli sewage treatment standards.

42.6.2 The Palestinian Authority

In order to protect the Mountain Aquifer from sewage pollution, FoEME believes that urgent and key constructive and pro-active steps need to be taken by the Palestinian Authority, as follows:

1. Sewage treatment projects should be promoted with a similar level of urgency as water provision projects, applying medium- and long-term foresight. The treatment of sewage in the recharge area of the Mountain Aquifer is necessary for the protection of shared Palestinian-Israeli water resources. The aquifer's pollution will cause massive humanitarian problems and will be a great burden on the Palestinian economy.
2. The involvement of the Palestinian Authority and local municipalities in the planning stages of donor-funded sewage infrastructure can prevent delays at a later stage. For example through examining and submitting comments on projects' *terms of reference* (ToR), the Palestinian Authority and local municipalities can voice their concerns on important issues before completion of detailed plans. This could prevent disputes at a later stage, reduce costs and accelerate project implementation.

42.6.3 Donor Countries

FoEME believes that there are several key steps that donor agencies urgently need to adopt in order to better facilitate the implementation of sewage projects in the West Bank.

1. In the planning, building and budgeting of projects in the West Bank, it is necessary to factor in additional, conflict-related costs rather than await the end of the conflict before project advancement.
2. Investment in intensive, daily coordination with Israeli authorities can significantly reduce conflict-related costs. Such cooperation requires:
   a.) Designating staff whose primary task would include coordination of activities with Israeli authorities.
   b.) Submitting lists of the registration numbers of vehicles and names of workers employed in the construction of sewage treatment projects, as well as detailed lists of imported equipment in advance to the relevant Israeli authorities in order to expedite the necessary permits.
   c.) During the past year, the *Israeli Defense Force* (IDF) has created a special division for external relations and international organizations. Its services should be used to the greatest extent possible for the coordination of ongoing activities.
3. Comprehensive consultation with the Palestinian Authority and Israel during the planning stages of projects could prevent later objections. Certain projects have had to be relocated, and the parties insisted on significant alterations to the plans, which could possibly have been prevented had the parties been informed and allowed to comment on the plans at an earlier stage.

42.6.4 Recommendations to all Parties

1. The use of the Mountain Aquifer's pollution for propaganda by either Israel or the Palestinian Authority is damaging. Pollution of the aquifer's recharge area originates from both Palestinian and Israeli sources, and can only be solved through maximum cooperation between all sides, keeping in mind the shared interest to protect scarce water resources.
2. The involvement of Israeli authorities in the planning stages of donor-funded sewage infrastructure can prevent delays at a later stage. For example, through examining projects' *terms of reference* (ToR) and then submitting comments, Israel can voice its concerns on important issues before the completion of detailed plans. This could prevent disputes at a later stage, reduce costs and accelerate implementation of projects.
3. Palestinian villages continue to discharge the largest volume of untreated sewage in the Mountain Aquifer's recharge area. Most of their sewage percolates into the aquifer through cesspits. Similarly, several Palestinian cities have no plans or financing for the treatment of their sewage. Solutions to these problems should be urgently sought.
4. Joint research on the threat of pollution of shared groundwater is of vital importance. Several joint studies were carried out in the past, but most experts agree that the issue requires further research. A joint fact-finding committee, supported by donor countries and consisting of the Israeli Water Commission and the Palestinian Water Authority, would advance better understanding as to the impact of untreated sewage already released and identify priority areas for funding of additional sewage treatment solutions.
5. Appropriate training of staff for sewage treatment plants in the recharge area of the Mountain Aquifer should be supported by donor agencies, including the possibility of joint Palestinian – Israeli training activities.
6. The work of civil society NGOs in community education on transboundary water and sewage issues and their link to peace-building is of vital importance. All parties should cooperate with, and donor agencies support, such efforts in Palestinian and Israeli communities.

References

Civil Administration of Judea, Samaria and Gaza, Environment Officer, 2001: *Sewage Treatment Systems in Judea and Samaria, June* 2001 (Beit El: Civil Administration of Judea, Samaria and Gaza).

Environmental Protection Association, Samaria and Jordan Valley, 2000: *Annual Report* 1999–2000 (Ariel: Environmental Protection Association, Samaria and Jordan Valley).

Guttman, Y., 2000: *Risks of pollution and interruption of the hydrological regime in the case of non-agreement with the Palestinians* [in Hebrew] (Tel-Aviv: Mekorot - Israeli Water Commission, June).

Gvirtzman, H. 2002: *Israel Water Resources – Chapters in Hydrology and Environmental Science* [in Hebrew], (Jerusalem: Yad Ben Zvi Press).

Israeli Bureau of Statistics, 2003: "Population in settlements in wide geographic distributions, final data December 2002, table 1: population by region and district, end of 2002", in: *CBS online publication*, http://www.cbs.gov.il/population/popul.htm (Jerusalem: Israeli Central Bureau of Statistics).

Israeli Ministry of the Environment, 2002: *Water and Streams Division, Preventing pollution of the Mountain Aquifer, draft for a government decision,* 10.11.2002 (Jerusalem: Israeli Ministry of the Environment).

IWC [Israeli Water Commission], 2002: *Palestinian Sewage: Facts, Conclusions, Recommendations* [in Hebrew]. Report by the Water and Sewage Administration in Judea, Samaria and Gaza (Tel Aviv: Israeli Water Commission).

IWC [Israeli Water Commission], 2003a, *Development, exploitation and state of water resources in Israel until Autumn* 2002 [in Hebrew] (Jerusalem: The Hydrological Service, Israeli Water Commission, July).

IWC [Israeli Water Commission], 2003b: *Annual Report Water Consumption Data in Local Authorities* [in Hebrew] (Tel-Aviv: Water Consumption Division, October).

IWC [Israeli Water Commission], 2004a: *Sewage in Judea and Samaria – current state of affairs* [in Hebrew]. A letter by the Judea and Samaria Water and Sewage Administration in response to question by the Knesset Sub-Committee on Environmental Nuisance (Tel Aviv: Israeli Water Commission, 6 January).

IWC [Israeli Water Commission], 2004b: D*evelopment, exploitation and state of water resources in Israel until Autumn* 2003 [in Hebrew] Jerusalem: The Hydrological Service, Israeli Water Commission, July).

Kliot, N., 2003: *Transboundary Pollution: Israel, Arab Countries and the Palestinian Authority* [in Hebrew]. A report submitted to the National Environment Council, Committee on Regional Cooperation (Jerusalem: The Jerusalem Institute for Israeli Studies). .

Naot, Y. [Minister of the Environment], 2004: *A letter to the Member of Knesset Dr. Leah Ness, chair of the Knesset Sub-Committee of Environmental Nuisance* (Jerusalem: Minister of the Environment, 6 January).

Palestinian Central Bureau of Statistics, 2003: *Mid-Year Projected Population in the Palestinian Territory by Region and Governorate (*1997–2003*)*, updated 2nd July 2003 (Ramallah: Palestinian Central Bureau of Statistics).

Rabbo, A. A.: Scarpa, D.; Qannan, Z.; Abdul-Jaber, Q.; Younger, P., 1999: *Springs in the West Bank: Water Quality and Chemistry* (Bethlehem: Report by Palestinian Hydrology Group).

Shuval, H.; Isaac, J., 2000: *Environmental Protection of the shared Israeli-Palestinian Mountain Aquifer* (Michigan: University of Michigan, School of Public Health, Department of Environmental and Industrial Health – Jerusalem: Hebrew University of Jerusalem – Bethlehem: The Palestine Consultancy Group).

Tahal Group, Water Division, 1999: *Memorandum: Master Plan for Judea and Samaria Sewage – Phase I* (Tel-Aviv: Tahal Group).

UNEP, 2003: *Desk Study on the Environment in the Occupied Palestinian Territories* (Nairobi: UNEP).

USAID, 2003: *Palestinian Authority Requests $1.2 Billion from Donors at Ad Hoc Liaison Committee Meeting in Rome*, Cabled Text.

Zohar, A., 1999: *Cooperation in the fields of natural resources and infrastructure between Israel and the Palestinian Authority* (Tel Aviv: Jaffee Center for Strategic Studies).

43 Potential Use of New Geological Findings for Water Exploitation in the Lower Jordan Valley

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Abstract

The Lower Jordan River Valley is part of the Dead Sea Transform. From a geological point of view it comprises a plate boundary between the western African Plate and the southern Arabian Plate. From a political point of view the area acts as a 'triple junction' of three nations: Jordanian, Israeli and Palestinian.

Along the mountainous belts the average precipitation is 500–600 mm/y, where 30–50 per cent of the water penetrates the subsurface to the local aquifers. At the Jordan Valley it drops down to less then 100 mm/y. The subsurface groundwater flow regime direction

1 The authors would like to express their thanks to the German Ministry of Education and Research (BMBF) and to the Israeli Ministry of Science (MOS) for supporting and funding the project: Water Resources Evaluation for a Sustainable Development in the Jordan Rift Basin, German – Israeli – Palestinian Joint Research Program. Project Number 2WT 9179/1773.

is from the mountainous belts calcareous karstic aquifer layers (The Judea Group) towards the Valley.

The Judea Group aquifer at the Valley itself was considered deeply-seated and covered by a thick basin fill young formations and therefore unsuitable for groundwater exploitation. Newly seismic interpretation reveals several conspicuous structural features, which are of considerable hydrological importance for this arid zone: The Judea Group water bearing aquifer layers within the Valley is probably encountered at relatively shallow depth. This structure could encourage new ideas for water exploitation. Furthermore, the results of the integrated study suggest that several salt bodies are buried within the basin and are probably the source of local salination of fresh water.

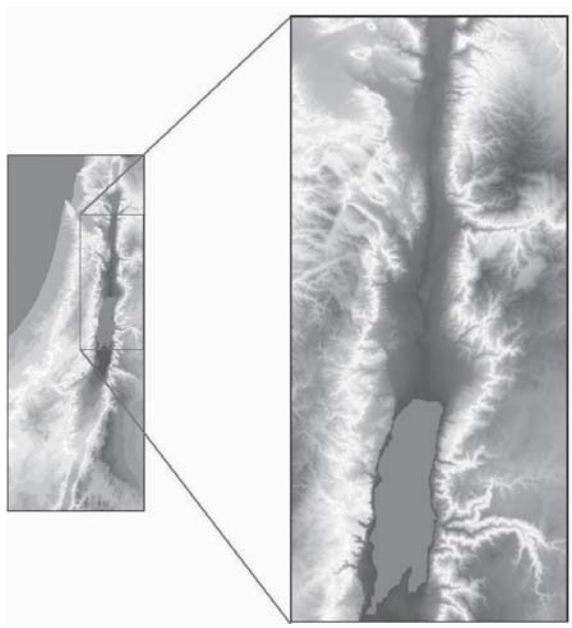
Keywords: : Groundwater, geophysical methods, geochemical methods, Dead Sea Rift

43.1 Introduction

The Lower Jordan Valley between the Dead Sea in the south to Lake Kinneret in the north (figure 43.1) is part of a NS long dislocation line – The Jordan - Dead Sea Rift Valley also known as the Dead-Sea Transform (a segment of the East Africa Rift System, figure 43.2). Geologically the Rift comprises a plate boundary between a northern dent of the African Plate to the west (the Sinai-Israel sub-plate) and the Arabian plate to the east. Politically speaking the study area is a 'triple junction' or a meeting area of three nations – Jordan, Israel and the Palestinian Authority.

The investigation area is subdivided longitudinally into three N-S belts: the Jordan Valley depression in the center and two mountainous belts on both-sides, the Jordanian east side and the Israeli-Palestinian west side. The mountainous belts get an average annual precipitation of about 500–600 mm, where 30–50 per cent penetrates down as groundwater. The topographic altitude of the remarkable NS deep central depression – the Jordan Rift Valley varies between –200 m B.S.L. in the north (Lake Kinneret) to –415 m B.S.L. to the south (The Dead Sea). The average annual precipitation is 100 mm and less.

Figure 43.1: Location Map of the Study Area, the Lower Jordan Valley. **Source:** Hall 2000



43.2 Geology and Hydrology

The groundwater flow is from the two mountainous belts towards the Jordan Valley in the center. The hide and seek game between geological factors and groundwater flow in the area is still under study. Two factors affect the groundwater regime, the lithostratigraphy and the structure. Table 43.1 presents the general stratigraphic column relevant to the study area and its hydrogeological characteristics. The most important aquifers are the Kurnub, Judea (Ajlun), Tiberias and the Dead Sea (Jordan Valley) Groups.

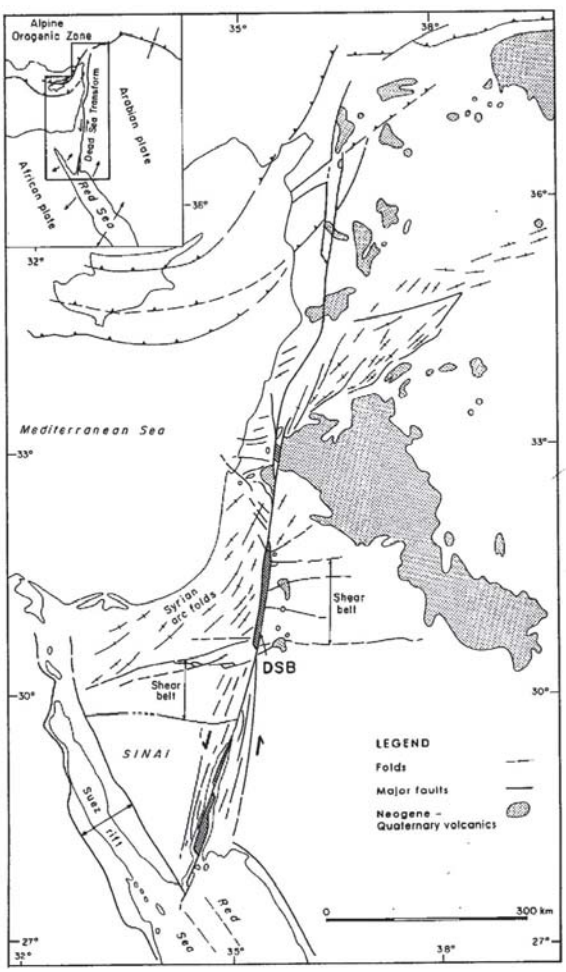
The main structural element in the mountainous area is the Syrian Arc fold belts (figure 43.2), a compressional response to the closure of the Tethys and the collision of the African and Arabian Plates with the the Euroasian (the Anatolian) plates. This fold system has a wide geographic distribution all over the area.

The geology of the Jordan Valley in the study area is ambiguous. First because of the complexity of Rift system itself and associated faults and second because the entire rock mass is covered by young sedimentary fill. Interpretation of available seismic sections reveals several conspicuous structural and stratigraphic features, which are of considerable hydrological importance. The Judea Group aquifer is encountered at relatively shallow depth, which varies from a few hun-

Table 43.1: Hydrostratigraphic Chart of the Lower Jordan Valley and its Margins. The second name in the Group column is the group name prevailing in Jordan. **Source**: Anker 2007

AGE	GROUP	LITHOLOGY	THICKNESS	HYDROLOGY
Quaternary	Dead Sea Jordan Valley	Fine and coarse clastics inter-fingering with chalk, marls, gypsum	0 – 200	Local Aquifer
Neogene	Tiberias	Clastics, volcanics and evaporites	Nil on the shoulders to a few thousand meters in the Rift Valley	Aquifer
Eocene	Avdat, Belqa	Coarse karstic limestone and chalk	Up to 500m	Aquifer
Early Tertiary Late Cretaceous	Mt. Scopus Belqa	Chalk and marls	200 – 400m	Aquiclude
Mid Cretaceous	Judea, Ajlun	Karstic limestone and dolomite	800m	Main aquifer
Early Cretaceous	Kurnub	Mainly sandstone, volcanics	400-500	Aquifer

Figure 43.2: A location Map of the Jordan-Dead Sea Rift Valley also Known as the Dead-Sea Transform, a Segment of the East Africa Rift System. **Source:** Garfunkel 1988.



dred meters in the west (east of the Cretaceous outcrops) to more then 1000 m in the east close to the Jordan River (figure 43.3).

The analysis of seismic evidence suggest that this 10 km long and 700 m thick body is probably composed of interbedded evaporates and clays and thickens eastwards (figure 43.5). The results of this study are in agreement with the study of Kashai and Crocker (1987) as well as preliminary seismic interpretation done in Jordan (El Zoubi, personal communication). The inferred existence of the salt body matches the occurrence of Zaarat Qurein salt diapir (Belitzky/Mimran 1996). The interpreted structural and stratigraphic features enable better evaluation of the hydrological regime and salinization processes.

Figure 43.3: A Seismic Interpretation Presenting the Judea Group Aquifer Encountered at Relatively Shallow Depth in the East Close to the Jordan River. **Source**: Anker 2007

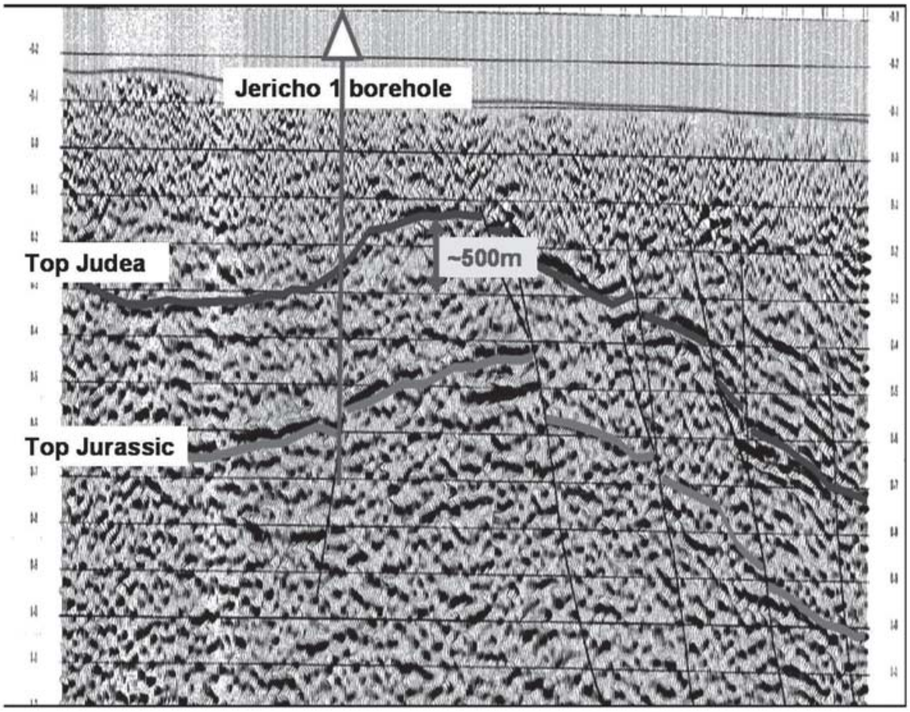
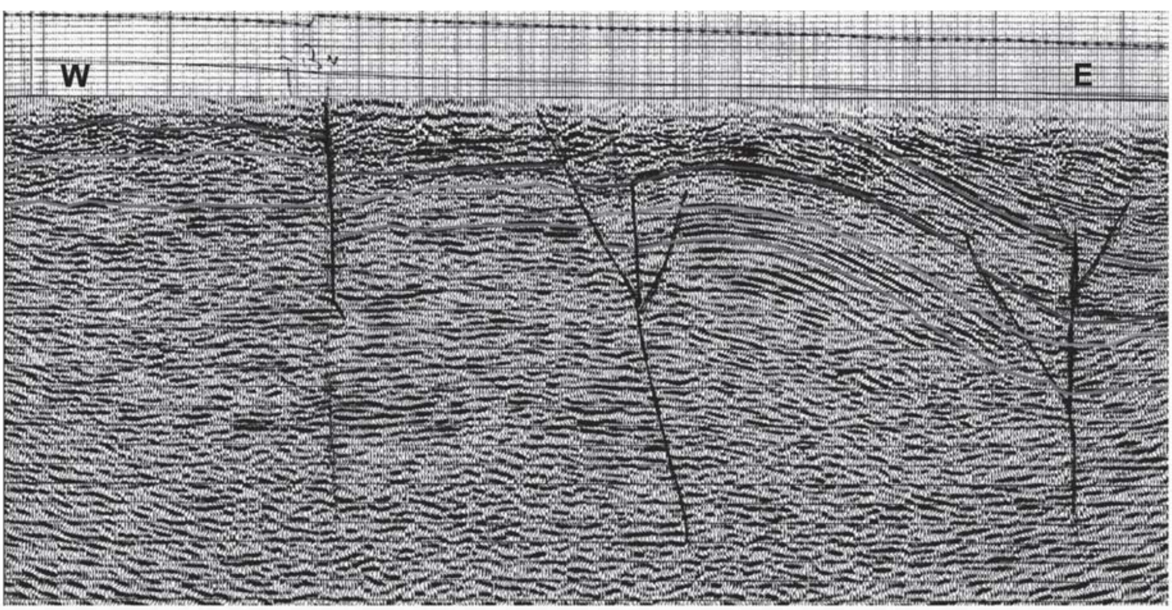


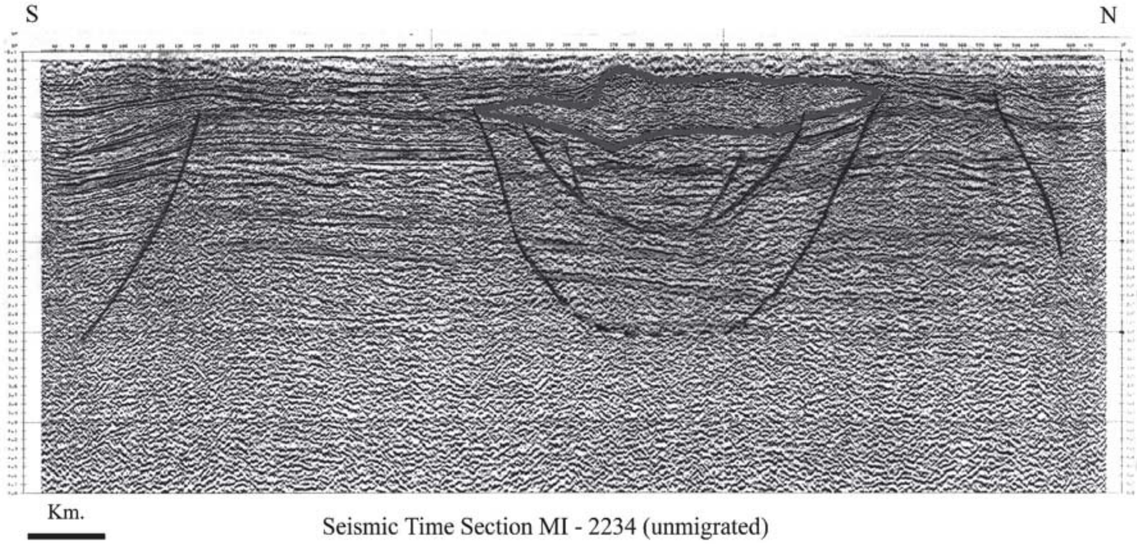
Figure 43.4: An Interpretation of a Seismic Data Presenting Elements of 'Flower Structure' Fault System at the Judea Group Level, Suggesting Lateral Displacement. **Source**: Anker 2007



43.3 Flow Mechanism

This chapter is focused mainly on the west side of the Jordan Valley. This mountainous belt is built of a series of asymmetric folds (figures 43.2 and 43.3) and small undulations forming secondary structures. The area is characterized by intensive fault systems in E-W to SE-NW directions. These fault systems form

Figure 43.5: An interpreted seismic line presenting a lenticular shaped sedimentary body located east of Auja. The analysis of seismic evidence suggest that the body is probably composed of interbedded evaporates and clays and thickens eastwards. **Source**: Shulman/Flexer/Guttman/Yellin-Dror/Rosenthal/Anker 2003



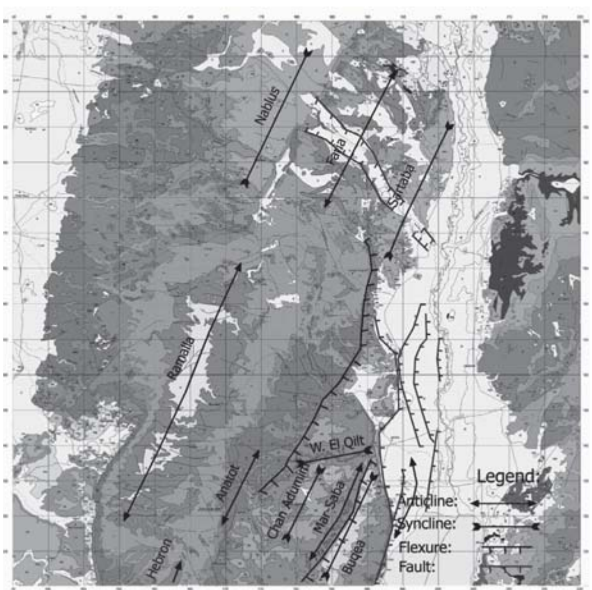
grabens, horsts and step structures. The faults are associated with the creation of the Jordan Rift valley. The faults allow hydraulic connections between sub aquifers (Upper and Lower Judea Group aquifer) and groundwater can flow from one sub aquifer to the other.

In some places, the fault system raises the base of the aquifer above the regional water table and create local barriers to the groundwater that naturally flows downstream towards the Rift Valley. The Judea Group aquifer, with a thickness of about 800 to 850 m, comprises two sub-aquifers. Groundwater flow is also governed by the geological structure of the area, i.e. uplifting of the secondary anticlinal axes, as well as flexures and fault systems (figure 43.6).

The water level near the anticline axis is around +300 m^3. The water levels descend eastwards in the direction of the Jordan Valley and the Dead Sea and close to the foothills the water levels between the recharge area and the foothills area is around 600 m^3 on a distance of about 8 km. This means a very steep gradient (about 7 per cent in an average). In order to account for such high flow gradient, a huge amount of rainfall and recharged areas are needed. Data available about the average rainfall and study of the recharged areas shows that such volume of the water does not exist in the area. In this case the volume of the groundwater within the aquifers cannot account for a high and constant flow gradient.

A series of hydrological barriers is needed to account for the high water levels in the higher areas of the aquifer and the low water levels in the lowermost

Figure 43.6: Geological Map of the Study Area Showing the Main Structural Elements. **Source**: Sneh/Brtov/ Rosensaft 1998 and Anker 2007



area. These structural elements (figure 43.6) are cascades and locations where the base of the aquifer is above the regional water level (hydraulic barriers). The groundwater flow from west to east probably follows these geological cascades and the hydraulic barriers. The Cascades like structure is the result of the asymmetric geological structures crossing the area. In these asymmetric anticlines the eastern flank has a steep dip creating a flexure. The flexure (cascade) area is of low permeability, which causes a water level drop in the eastern lowermost areas of the flexure. The flow gradient in the uppermost areas of the flexure is relatively moderate. Another structural element that influences the flow regime is the hydraulic barrier that coerces the groundwater to bypass them and to flow in individual paths into the Rift Valley.

43.4 Summary and Conclusions

The geology and the hydrology of the Lower Jordan Valley is ambiguous. The combination and synthesis of three research approaches (surface geology, drill holes and geophysics) enable an educated hypothesis of how and where water exploitation can be done. The results of this chapter reveal that the Judea Group aquifer is encountered at relatively shallow depth within the rift itself, an area that was never considered appropriate for water exploitation. This new discovery enables drilling for new potential water resources in this arid zone.

Furthermore, two salt bodies occurred in the study area (Auja and Zaharat Qurrin), probably acting as the source for fresh water salination. It should be pointed out that the occurrence of salt bodies along the Rift Valley is well established (figure 43.7).

The geographical distribution and the geohydrological location of the salt bodies as well as their geometry and dimensions are essential for conducting an efficient water management.

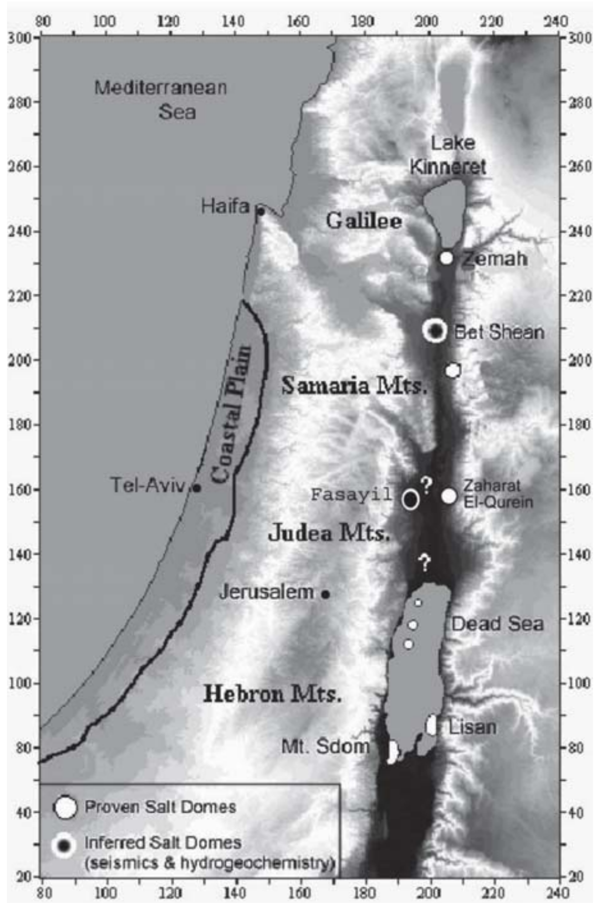


Figure 43.7: Salt Bodies Distribution Along the Rift Valley. **Source:** Flexer/Yellin-Dror/Kronfeld/Rosenta/ Ben-Avraham/Artsztein/Davidson 2000.

References

Anker, Y., 2007: The hydrogeology of the Lower Jordan Valley. Ph.D. Thesis, Under revision, Tel Aviv University.

Belitzky, S.; Mimran, Y., 1996: "Active salt diapirism at the Zaharat El-Qurein dome, Lower Jordan Valley (Jordan)"., in: *Israel Journal of Earth Scinces*, 45: 11–18.

Flexer, A., 2001: "The Pre-Neogene Geology of the Near East", in: Horowitz, A. (Ed.): *The Jordan Rift Valley*, Lisse/ Abingdon/ Exton (PA)/ Tokyo: Balkema Pub.: 123–171.

Flexer, A.; Yellin-Dror, A.; Kronfeld, Y.; Rosental, E.; Ben-Avraham, Z.; Artsztein, P.P.; Davidson, L., 2000: "A Neogene salt body as the primary source of the salinity in Lake Kinneret", in: *Arch.Hydrobiol. Spec. Issue Advanc. Limnol*, 55: 69–85.

Garfunkel, Z., 1988: "The Pre-Quaternary Geology of Israel", in: Yom-Tov, Y.; Tchernov, E. (Eds): *The Zoogeography of Israel,* Dordrecht: Junk: 7–58.

Guttman, J., 1998: "Hydrogeology of the Eastern Aquifer in the Judea Hills and the Jordan Valley". Tel Aviv: Tahal Annual Report 1998, No. 6440-R98

Hall, J. K., 2000: Satellite map of the northern Levant. Jerusalem: Geological survey of Israel, Report GSU 19/ 2000.

Hirsch, F.; Flexer, A.; Rosenfeld, A.; Yellin-Dror, A., 1995: "Palinspatic and crustal setting of the eastern Mediterranean", in: *Journal of Petroleum Geology*, 18: 149–170.

Horowitz, A., 2001: *The Jordan Rift Valley.* Lisse/ Abingdon/ Exton (PA)/ Tokyo: Balkema Pub.: 730 p.

Kashai E.L.; Crocker P.F., 1987: "Structural geometry and evolution of the Dead Sea – Jordan Rift system as deduced from new subsurface data", in: *Tectonophysics*, 141: 33–60.

Shulman, H.; Flexer, A.; Guttman, Y.; Yellin-Dror, A.; Rosenthal, E.; Anker, Y., 2003: "The hide and seek game between geological factors and groundwater flow in the Jericho Fazael region", in: *Israel Geological Society Annual Meeting* (abstract).

Sneh, A.; Bartov, Y.; Rosensaft, M., 1998: Geological Map of Israel/ Sheet 2/ 1:200,000. Jerusalem: Geological survey of Israel.

44 From 'Emergency Response Coordination' to 'Humanitarian Protection': The Role and Activities of the Emergency Water And Sanitation-Health (EWASH) Committee

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Abstract

International agencies, international non-government organizations (NGOs) and local NGOs all play a significant role in providing water and public health services in Palestine. Some also do much more, but this is infrequently recognized. Some agencies complement the activities of the governmental Palestinian Authority (PA) agencies in response, advocate for policy change or implementation, and serve in a civil society role: One example of the inter-relation of these various roles is the Emergency Water and Sanitation- Health (EWASH) Committee.

The EWASH Committee brings together the resources and representation from the *Palestinian Water Authority* (PWA), UN Agencies, Palestinian and international NGOS. Initially, the EWASH Committee enhanced NGO response capacities through coordinating activities and information flows between geographically and organizationally disparate players. However, as the needs of the situation have changed it has also engaged as a 'humanitarian protection' agency – i.e. an agency challenging the Palestinian ministries to take up their responsibilities, and, when the need is beyond the state's resources or scope, providing an opportunity for other (non PA) agencies to fill the gaps. In taking up this role as a 'protection agency' the EWASH Committee has developed beyond its original role as an information-clearing house to a position within civil society where it both represented social interests and facilitates the work of Palestinian government agencies

Keywords: Civil society, humanitarian protection, international NGOs, Israel, Palestine, water

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1 The opinions in this article are the opinions of the author alone and do not represent the opinions, values, policies or current practices of Oxfam GB, Oxfam International nor the current or past members of the EWASH Committee.

2 This paper was delivered before the election of Hamas to the Palestinian government and the subsequent collapse of relations between the Government of Israel and Palestinian representative structures. It is therefore historic, rather than current, reflecting also the departure of the Author from the role, region, and field.

44.1 Introduction

The *Emergency Water and Sanitation- Health* (EWASH) Committee is a loose coalition of actors providing an open forum for all interested stakeholders to share information on the *water and sanitation* (watsan) *sector* in the Occupied Palestinian Territories. It is not a decision-making body but it does serve an interesting role mediating between the PWA and the NGO community. As such it takes on, perhaps unwittingly, a role as a 'protection agency' within the Palestinian civil society. This presentation is intended to present: the history and development of EWASH (44.2); EWASH as a humanitarian protection agency (44.3); EWASH within civil society (44.4); EWASH in practice (44.5); and a few thoughts on the possible future development of the EWASH Committee in the future (44.6).

44.2 History and Development of the Emergency Water and Sanitation/ Health (EWASH) Committee

Israeli damage to civil infrastructure peaked in May 2002. A lot of water and sanitation infrastructure was damaged by Israeli Military and Para Military action; entire communities were under strict curfews and civilians were unable to leave their homes, buy food, or collect water, etc. In particular, local NGOs, the Palestinian Water Authority (PWA) and municipal workers were unable to get out and survey and repair the pipes that had been deliberately ripped up. There was an acute humanitarian crisis. The EWASH committee was formed in response to that crisis.

44.2.1 The Problem

In the immediate aftermath of the violent cycle inspired by the Intifada, several NGOs sought to respond to the needs of the population. There were, however, many problems.

- Information – accurate and timely- was hard to come by and so hampered an effective and efficient response.

When NGOs responded to municipalities and locations that called for their assistance, they ended up by traveling all over the country. At a time when there were most checkpoints and travel restrictions, NGOs trying to respond found themselves trying to cover the most distances.

Many village councils, in their desperation, called more than one NGO for assistance: Consequently multiple NGOs found themselves responding to the same emergency in the same location with the same sort of resources, resulting in a traffic jam of NGO trucks.

- Some NGOs were called to assist in situations outside their expertise or experience- but did not know where to turn to find the appropriate assistance.
- NGOs found themselves being traded off, one against the other: Agencies are often torn between wanting to help community members, and their universal experience that, if support is not met with a meaningful contribution from the beneficiary, it is undervalued. NGOs are also under significant external pressure to distribute aid, so canny village councils and municipal leaders found themselves in a 'sellers market' and able to trade off NGOs to reduce the community contribution. This was to the overall detriment of the country as a whole and the projects' long-term effectiveness in particular.
- NGOs (including International NGOs) were meeting the needs of the population, but were not informing the PWA of their activities. Accordingly, when the PWA went to the Joint Water Committee, the Israeli party knew more about the NGO activities than the nominal Palestinian Regulator. This led to problems in the negotiations, to the long-term detriment of the people the NGOs were trying to help. This is dealt with in more detail below.

44.2.2 The Solution

In the summer of 2002, the 'watsan' agencies formed the Emergency Water and Sanitation/ Health (EWASH) Committee with the intention of: a) sharing information on the damage and needs; b) improving programming through sharing information on projects, problems, innovations, etc.; c) sharing information on a geographical basis i.e. informing NGOs in the sector as to which agencies are operating in which areas- encouraging 'clustering' whereby agencies work in a few connected locations, and not dispersed ones; d) sharing policy level debates- leading to a harmonization of designs, costs, and beneficiary contributions; and e) informing the PWA of the proposed activities of the NGO community and informing the NGOs of the long term strategic, operational and tactical plans of the Water Authority.

44.2.3 EWASH Committee Composition and Membership

Clearly, the strength and usefulness of EWASH is dependent on the size of the membership.

Past and Current Membership has varied between a handful and about 20, although more and more agencies seem to be represented each time. A full membership list comprises some 40 organizations. It covers most international (INGOs) and Palestinian NGOs (PNGOs) active in the sector. Some of these organizations are very small and local, but often the smallest NGOs have been attending because it is more important for them to coordinate with other agencies than it is for *United Nations Development Program* (UNDP), etc. At present UN agencies are represented through the *United Nations Office for Coordinating Humanitarian Activitie*s (UNOCHA) and the *United Nations Refugee and Works Agency* for Palestine (UNRWA), while UNDP has been kept informed through the minutes. The PWA nominally has observer status on the committee but in fact their participation is key: Not only are the committee members seeking to coordinate their activities with each other, but also seeking to ensure compatibility with the wider/ longer-term strategy of the PWA.

Chair. This position has been held by the Oxfam GB Water and Sanitation Program Coordinator. Apart from the geographic scope of Oxfam's programs and the expertise that can be called upon from other situations elsewhere there is little reason why this should be preserved. There are suggestions that EWASH should be co-chaired by a Palestinian NGO and, in fact, the 2005/6 chair of EWASH is the Palestinian Hydrology Group.

44.2.4 Results of the EWASH Activities

The activities of EWASH have resulted in an overall more effective and efficient response to the emergency needs. The initial activities comprised collecting and sharing information, and coordination of the activities of the independent agencies.

Information Collected.

A water, sanitation and hygiene database, funded by Oxfam GB, has been run by the Palestinian Hydrology Group and is available at: <www.phg.org>.

Information Shared.

EWASH has provided a regular forum at which information may be shared and enabled a mutual updating of agencies on project progress, sources of materials, contractors, outstanding needs, experiences etc. This enabled NGOs to improve their effectiveness and ensure 'joined up implementation' such that results of one project are complementary to another.

An important element of the information sharing was the empowering of the Palestinian negotiating team in the *Joint Water Committee* (JWC) such that they have as much or more information of water activities on the ground as the Israelis.

Actions Coordinated.

The scope of information passed through the EWASH committee focused on the technical and geographic areas, but also touched upon program development and implementation methodology. Examples would be a presentation of the 'technical details of household sewage treatment plants' and an initiative undertaken to coordinate household cistern sizes, costs and prices.

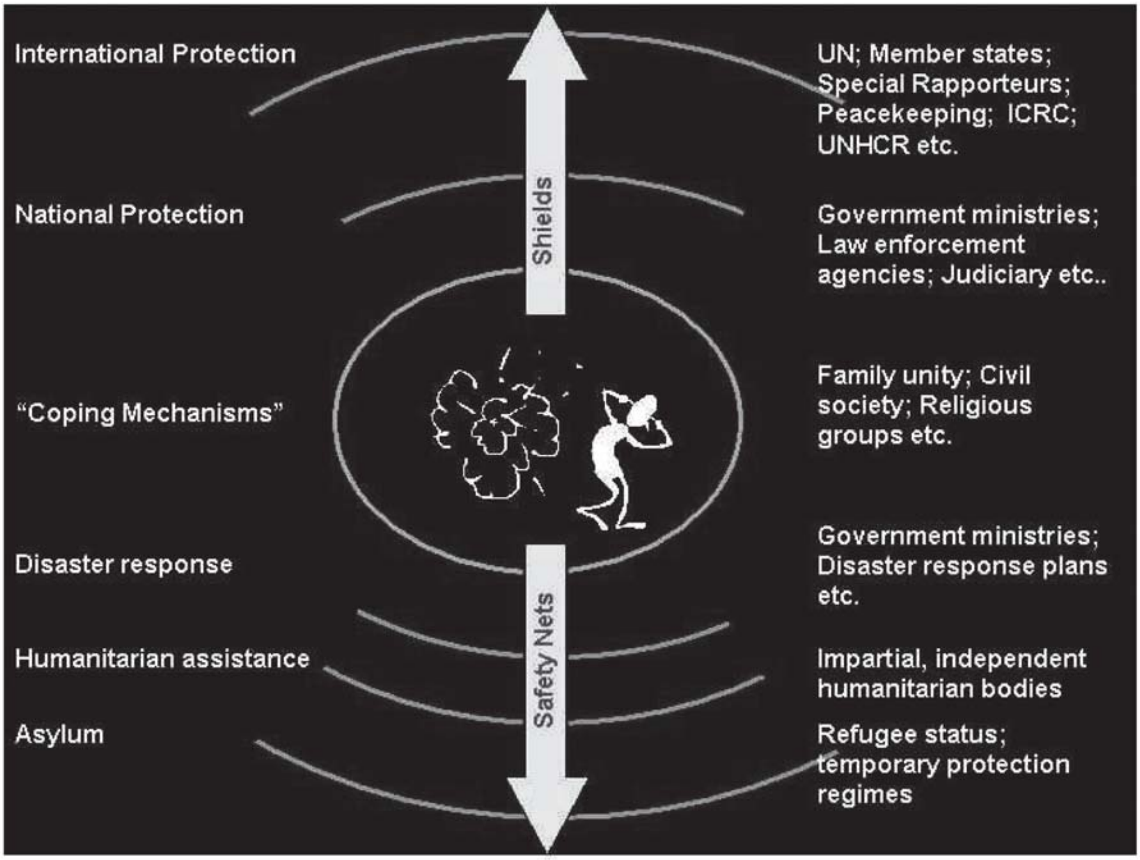
The EWASH forum also enabled NGOs to set their priorities in coordination with the strategic programs of the PWA and PA in general. EWASH and the NGO community maintain their independence, but sought to ensure firstly that there was no duplication between providers, and also that the activities of NGOs complemented, wherever possible, the plans of the government agencies responsible for water and sanitation. One case in point is where communities seek rainwater cisterns, but are about to be connected to a main supply; a community storage facility for piped water would be more appropriate and should be considered when considering options for reducing the impacts of the [artificial] water shortages

Information collated through this forum also led to the identification of lobbying issues; information on violations is provided for agencies to follow-up both with their program and with their advocacy program. Working together on advocacy issues provided more weight than working individually.

44.3 EWASH and Humanitarian Protection

The EWASH committee plays a wider role than just an information clearing house. It also serves as a Humanitarian Protection Agency, thus including the broader role of NGOs in humanitarian situations.

Figure 44.1: "Shields and Safety Nets as a Mechanism for Coping with Disruption. Oxfam GB, 2004.



44.3.1 Defining Humanitarian Protection

'Humanitarian protection' is, according to Oxfam GB doctrine "the challenge of making states and individuals take up their humanitarian responsibilities and filling in for them as much as possible when they do not". It is an approach that brings together different aspects of humanitarian response – from civil society building and advocacy to capacity building and direct assistance – rather than a specific set of activities.

Protection and the 'rights based approach'.

At the same time, many NGOs take a 'rights-based approach' to humanitarian response. This recognizes that people affected by crises not only continue to have rights under national and international law, but that states and individuals continue to have duties at multiple levels.

These rights and duties have crystalized into a humanitarian system (see figure 44.1) which operate both formally and informally at multiple levels. The system aims both to protect people from coming to harm during a crisis (*shields*) and to cope with its consequences (*safety nets*). NGOs taking this approach see their overall role is to help this system function more effectively. This implies that a coherent humanitarian response will not only *provide material assistance* but also *deliver policy and practice changes* at some or all of the levels in order to secure sustainable humanitarian assistance and protection for those affected by conflict or disaster.

44.3.2 EWASH as a Humanitarian Protection Agency

In looking at the role and functions of EWASH as a humanitarian protection activity we need to ask a few key questions: Is this a Humanitarian Issue? Are there people, affected by crises, who have their rights under national and international law abused? Are States and Individuals taking up their responsibilities? Does this require a coherent humanitarian response and provide material assistance as well as deliver policy and practice changes?

Is this a Humanitarian Issue?

When a population has neither the quantity nor the quality of the water for domestic or agricultural use then I would argue this is a humanitarian issue (see UNOCHA Consolidated Humanitarian Appeal document).

Are there people affected by crises who continue to have their rights under national and international law abused?

Civilians and their rights to life and water need to be protected from the actions of the occupying power and their agents (i.e. Israeli settlers). Israeli armed forces have cut off water supplies, prevented maintenance crews from undertaking their legitimate activities, and enabled the discharge of garbage and untreated wastewater into the catchment areas of neighboring villages. The quality of most water no longer meets World Health Organization (WHO) drinking water standards. The UN Special Rapporteur on Food has placed the remediation of this situation firmly as a responsibility of the Occupying Power. So yes, it is agreed that there are people who continue to have their rights under national and international law abused.

Are states and individuals taking up their responsibilities?

The Oslo II accords granted Palestinians limited responsibility and authority over water activities in the West Banks and Gaza. However 'any water activity' undertaken by the Palestinians has been constrained by Article 40. The ability of Palestinians to take up their responsibilities is further hampered by their physical inability move about the disputed territory. Therefore, the "State" [and individuals] can be said to be being precluded from taking up their full nominal responsibilities.

Humanitarian Responsibilities of the Israeli Occupying Power.

Another perspective is to regard the Israeli Occupation of West Bank and Gaza as not being mitigated by any agreement with the PNA: The argument goes that, until Occupation ends, the entirety of the responsibilities of the Occupier remains. The Israeli government appears to bend the spirit, if not the terms, of the treaty. The agents of the government create and then exacerbate damage to water and sanitation infrastructure. Examples include Rafah, Deir Sharaf, Madama, South Hebron, etc.

Does this require a coherent humanitarian response that will not only provide material assistance but also deliver policy and practice changes?

It is estimated over US $ 6 million is spent annually by INGOS in the sector merely trying to prevent further decline. It is clearly important that this money is spent wisely: It has the potential for providing significant and permanent benefits to the population, or it can be frittered away on short term ill advised projects that work against each other. The physical humanitarian projects must therefore be coherent to be truly effective.

This need for coherence extends beyond the physical response of delivering water and sanitation infrastructure. There has been a demonstrated need for the Palestinian ministries to take up the range of their responsibilities. However, some policies appear nonexistent, duplicative or contradictory. Highlighting the policy gaps and overlaps, while complementing the "state" agencies is one role taken up by NGOs. In some cases the INGO world, through EWASH, is able to bring a fresh perspective and expertise from similar situations elsewhere in the world to the benefit of the affected population.

In summary, the manner and context in which EWASH operates indicates that it meets all criteria for a 'humanitarian protection agency'. It, or its composite members, provide material assistance and also encourage policy and practice changes at a range of levels in order to secure sustainable humanitarian assistance and protection for those affected by conflict or disaster. .

44.4 EWASH and Civil Society

The EWASH committee plays a wider role than just an "information clearing house" and a "Humanitarian Protection agency". In encouraging policy and practice changes it also plays a role within Palestinian Civil Society.

44.4.1 What is 'Civil Society'?

UNDP's definition of civil society is a useful beginning:

> … Civil society is the sphere in which social movements become organized. The organizations of civil society, which represent many diverse and sometimes contradictory social interests, are shaped to fit their social base, constituency, thematic orientations (e.g. environment, gender, human rights) and types of activity. They include church related groups, trade unions, coopera-

tives, service organizations, community groups and youth organizations, as well as academic institutions and others (UNDP 1993).

Civil society is independent of the state and market and characterized by non-profit, voluntary organizations such as NGOs (Barber 1998; Dionne Jr. 1998; Hall 1992; Van Til 1988). Civil society is important in its ability to fill the inadequacies of liberal representative government or representative democracy and it is important to make democracy work. Civil society becomes the key variable for explaining the success of democratic government. Civil society covers various aspects of voluntary associations such as NGOs who are the interlocutors for stakeholders and interest groups. Typical key interests are the effective delivery of public services, such as the major interests of all involved in the water and sanitation sectors. An active civil society in these areas can lead to better institutional performance.

Historically, a wide variety of third parties have been involved in carrying out government functions when the government cannot act (Salamon 1995). Some NGOs are notable for their efficiency and recognized as a key participant of current and future governance models due to their flexibility and cost efficiency (Miranda/Lerner 1995). NGOs can be involved in civil society and collective decision-making through arguing, bargaining and voting (Elster 1998). The discussions can overcome the weakness of NGOs as they seek to further their own advantages or benefits without deliberation (Habermas 1989). Thus, civil society can lead to the development of democracy by mediating between citizen and state, by articulating citizen interests to government. EWASH illustrates this overcoming of such insulation and enables collaboration among all stakeholders in a collective decision making process.

44.4.2 How does EWASH Fit into the 'Civil Society'?

EWASH and its members represent many diverse and sometimes contradictory interests in the social sphere; EWASH members are certainly interested in the success of the government and better institutional performance, specifically in the fields of public service delivery, community policing, and health care service. The forum provides an opportunity for interests and expertise to flow vertically between the stakeholders-and horizontally between bodies seeking to represent these stakeholders. Although fiercely competitive when seeking grants and support for programs, to date the debate between EWASH members when considering their ultimate beneficiaries is characterized by a deliberative, collaborative, and altruistic approach. Interestingly, the PWA has singled out the NGO sector as one of the agencies most responsible for the delivery of water and sanitation services.

44.5 EWASH, Humanitarian Protection and Civil Society

How do these themes come together? How does this forum of Palestinian and international NGOs see their activities in meeting the duties of a humanitarian actor and their role in civil society?

The EWASH Committee started as an 'information clearing house', took on a role as a 'humanitarian protection agency' and plays a role within Palestinian civil society. EWASH members provide material assistance- that much is clear- but it is their modus operandi that is interesting: EWASH members work together in these themes in an informed and organized manner, and they do it well. EWASH as a body also encourages policy and practice changes: As such its functions fill the inadequacies and try to make democracy work. EWASH also provides an opportunity for the concerns of the grassroots to be collected, collated, and presented to the agency or agencies responsible making coherence out of voices of disparate villages.

44.5.1 What Does it Mean in Practice?

44.5.1.1 Contamination of Tankered Water

Background

When the Israelis enforce their tough restrictions on the movement of water tankers to needy communities, NGOs become involved in running, or otherwise supporting such water tankering. They do this for two reasons:

One is to provide a subsidy to compensate for the costs of closures (where roads are physically ripped up, forcing long, expensive, detours), extensive road blocks (where tankers may be held for hours and hours, reducing the number of delivery runs that can be made, and thus obliging the driver/operator to raise the price per M3 in order to make a living). These policies drive the price of water so far above the ability of impoverished communities to pay that a)water use is reduced to levels below that required for safe sanitary behaviours and b) non-potable water is used for drinking and cooking.

The second reason is the "protection" provided by identifying a specific tanker as being connected to an International NGO or the ICRC (Red Cross). Soldiers at the checkpoint soon become aware that gratuitously holding back such trucks will have ramifications beyond intimidation of the truck driver. The connection to the wider world is strengthened, calls may be made to the soldiers superiors, to international (UN and other) Rapporteurs, and to the Media.

But even in the best of times, tankering water is not a problem free operation: Water user groups, village and local councils have reported incidences of water born disease and in one case in point, tests revealed that the water being trucked was contaminated. The contamination was traced to several possible sources: poor quality water being used to fill the tanks, poor quality tankers, and/or poor practices being used by the tanker drivers.

EWASH Actions.

This issue and these findings were raised within EWASH. As a result, a program of tanker driver training was initiated and a commitment was made that no NGO member of EWASH would use a tanker driven by a driver who has not been through the training.

In addition, a cross-portfolio working group was formed bringing together the Palestinian Department of Motor Vehicles (who register the water tankers), the Ministry of Local Government (in whose municipal areas the water was collected), and the PWA (who is responsible for regulating water quality). This group sought to develop policies that water sold as potable is, in fact, potable.

44.5.1.2 Chlorination

Background

The key goal of most agencies involved in EWASH is to provide potable water at affordable prices, essentially to fill the humanitarian gap left between the responsibility of the occupying power and the capability of the civil (Palestinian) powers to meet the needs of the population. Clearly water quality is a key element of the information needs of these agencies.

The agency charged with regulating water quality is the PWA, but a number of other agencies have testing kits to enable them to identify common pollutants. One of the reports to come out of the water-monitoring program is the widespread lack of residual chlorine at the point of consumption. Residual chlorine provides a degree of protection from the most common contaminants, and is the first line of defense against water borne diseases.

The core of the issue appears to be on two scales. Water supplied by the bulk supplier (the West Bank Water Department) was chlorinated and so there was a degree of protection for these consumers. Most consumers, however, rely on local sources and, although a number of chlorination stations had been provided, few were still functioning. Therein lay the concerns.

This has been attributed to a) rural populations and village councils not fully understanding why they had to treat their water and so b) not treating the issue with the severity it deserves, c) effects of Israeli curfews and closures on ability to make enough money to pay for water treatment consumables or maintain the dosimeters.

Where the issue was taken seriously it was often not done properly, supplies of consumables were hard to come by (especially when the transition from Chlorine gas to liquid is concerned); there was confusion over which methods and concentrations were approved; i.e. it was reported that communities were using, either through force majeure, or through ignorance, 'non-potable' chlorine. This detergent chlorine had noxious trace elements and was poisoning the population.

EWASH actions.

EWASH played its role in Civil Society and expressed the concerns of the population. It also put on its Protection Agency hat, and encouraged the PWA to establish a chlorination task force to define a national policy and ensure the concerns of all stakeholders are heard. That process is ongoing.

44.5.1.3 Water Quantity

According to the OSLO 2 treaty 'all water activities' are subject to the Joint Water Committee (JWC). As almost all agencies in EWASH are involved in supplying water and sanitation infrastructure, most are severely constrained by its strictures. As NGOs seeking to meet a humanitarian need with limited funds it is galling to be diverted away from the efficient solution of problems to those activities that fall beneath or beyond the view of the JWC. As a result, EWASH members consider Article 40 of Oslo 2 as the most potentially egregious element of the treaty.

One issue of concern was the sporadic nature of the JWC meetings: when they do meet it is not unknown for them to be considered 'complete failures'- at least by the Palestinian counter party. For example on 4 June 2003 it was reported that no approvals were given, no new wells were approved, no more wells were to be licensed, and all aquifers in the West Bank were to be considered closed to Palestinian access.

Worse still is the cancellation of a series of consecutive bilateral meetings, leaving one side in an artificial drought. One quoted reason for such meetings to be cancelled is the apparent inability of PWA to regulate, or even be informed of, relevant water activities. The argument goes that, "If the PWA is unaware of the activities of EWASH members, but the Israelis are monitoring EWASH member activities, then the Israelis interlocutor is effectively handed the opportunity to accuse the Palestinians of negotiating in bad faith, and leave the negotiating table". This is clearly to the detriment of the Palestinian side, and the population that the EWASH members are charged with assisting.

However, the EWASH committee is a committee of peers, with the chair having no authority: But through the discussions around the EWASH table, members recognized the 'disempowering' effect on the PWA of leaving them in the dark with regard to their activities. Members may have major concerns regarding implication that NGOs would then "be working to the direction of the PWA" and thus giving up their independence/NGO status. However it was soon realized that the costs of any loss of "independence" would be borne by an extremely vulnerable group - as the PWA would be unable to argue effectively in the forum where an increase in the allocation of resources might be argued.

There were grave concerns that this extra step would slow and limit the capacity of NGOs to respond to the needs of the community. Through EWASH a compromise was reached whereby the PWA was informed of what is going on. It is understood that the PWA then informs the Israeli interlocutor on the understanding that 'no reply means no objections' and a situation was reached where coordination with the PWA was of immense value on a number of levels, not least an opportunity for NGOs to complement the huge USAID etc investments in new pipes and new wells.

(Author's note: It should be noted that this refers to the time before the election that brought in Hamas as the representative of the Palestinian people. There has since been a complete breakdown in communications between the two parties and the retraction of funding commitments from the US government).

44.5.2 Lobbying and Advocacy

The members of EWASH are linked to governments through the UN and donor agencies which support them. EWASH therefore has had the opportunity to raise issues as individual agencies, and to inform those with whom it has close and funding relationships. This may, or may not, have been useful when it lobbied to have the stalled JWC meetings restarted. It may also have been useful when problems such as the proposed siting of a waste dump on a wellhead in Nablus was considered. In both cases, NGOs lobbied widely, as EWASH members and as individual agencies.

Advocacy also happens when EWASH is invited to explain the breadth and depth of water issues in the *Occupied Palestinian Territories* (OPT) to the [UN] Operations Coordination Group. EWASH also contributed their combined wisdom and experience to the formulation of the *Consolidated Humanitarian Appeals Process* that goes out to the heads of government at the UN.

44.5.3 Current Activities

The EWASH Committee fulfils all roles noted above. Currently EWASH has been using the forum to coordinate its activities. Recently NGOs and agencies working in South Hebron and Gaza have been using the EWASH forum to coordinate their response to the destruction of water resources in these areas.

EWASH continues to bring the voices it hears in its activities at the grassroots to the attention of the 'powers that be'. As individual agencies and members of the committee EWASH continues to contribute to OCHA's Consolidated Appeals Process and it has ongoing sub committees looking at policies on chlorination and tanker regulation, etc.

44.5.4 Future Role

EWASH will continue to progress along the path laid out: it is reasonable to expect a degree of regional responses such as that experienced in Hebron. However, the overall role of the 'information clearing house' will be maintained and complement the knowledge of the PWA. EWASH as a 'humanitarian protection agency' will continue to encourage policy and practice changes wherever it comes across them in order to secure sustainable humanitarian assistance and protection. As such it will also continue to play a role within Palestinian Civil Society- and this will be strengthened by the widening links to Palestinian NGOs. It has not, considered the interrelationship with the future water governance institutions. Whether, or how, EWASH should fit into the proposed national water council remains to be seen. It would be a shame if the resources and energy of its members would be wasted.

44.6 Summary

EWASH was widely recognized as a positive contribution to effective coordination between the PWA, NGOs and other actors in the provision of water and sanitation in Palestinian communities. What was not so widely appreciated was that it played so many roles in the formal and informal institutional structures within the Occupied Territory.

The activities of EWASH evolved over time and as conditions permitted and demanded. It has transformed from an 'information clearing house', a 'humanitarian protection agency' and/to a part of Palestinian civil society. These roles and emphases of the committee will continue to evolve as the demands placed upon NGOs change and as the context changes. During the period under consideration the EWASH Committee clearly filled an important set of roles and was flexible enough to serve an important role as the parameters of that niche changed.

44.7 Appendix 1: The Humanitarian Emergency in Water

Palestinians have faced severe difficulties accessing safe water. Repeated IDF incursions have resulted in the destruction of water and sanitation infrastructure, and access restrictions have prevented Palestinians from reaching water supplies. Palestinian Authority resources are being diverted into repairing damages rather than maintaining the water and sanitation network. Contamination of water supplies has increased as a consequence of degraded infrastructure, increased use of tanker water and the inability of the Ministry of Health to monitor water quality (World Bank 2004). Communities are surviving on less water – average Palestinian consumption *per capita* in the West Bank is between 30-60 liters per day (including water losses), compared to 220 liters in Israel.

This emergency in the water sector continues to affect peoples' health and livelihoods in the occupied territories: It is not a natural phenomenon but rather an *artefact* of the occupation and the inequitable distribution of water between the two parties. The humanitarian crisis in the water sector results from the impact of the occupation on all stages of the water cycle:

The *quantity* of water per capita available for consumption has been reduced by un-repaired destruction and deterioration and the widening gap between increases in demand and stationary or reducing supply.

The *quality* of water is affected both by the unregulated discharge of waste water from both Palestinian and Israeli camps and settlements in the West Bank and run off from the garbage that is no longer be disposed of properly (due to the restriction on movement, or indifference, respectively). This untreated wastewater enters the water cycle through groundwater, percolates down to the aquifer and re-enters the supply of drinking water. Treatment of water between the wellhead and the household tap is dependent on treatment stations, and these have been destroyed during incursions, rendered useless due to lack of access to supplies and spares.

The *use* of these reduced quantities of poor quality, expensive water requires specific skills and knowledge- this is not universally present. Inappropriate practices result in higher incidences of disease.

That is why there is a humanitarian imperative to be involved in the water sector in the Occupied Palestinian Territories.

References

Bae, Kwi-Hee and Lim, Joon Hyoung, "Bringing the Civil Society Back In: The Implication of Civil Society in Democratic Governance", Unpublished - Prepared for the presentation at the 60th ASPA National Conference Orlando, Florida, April 10–14, 1999. See http://www-scf.usc.edu/khb/paper3.html

Barber, B.R., 1998: *A Place for Us: How to Make Society Civil and Democracy Strong* (New York: Hill and Wang).

Dionne Jr., E.J., 1998: "Introduction: Why civil society? Why now?", in: Dionne, E.J. (Ed.): *Community Works* (Washington, D.C.: Brookings).

Elster, J., 1998: *Deliberative Democracy* (Cambridge: Cambridge University Press).

Habermas, J., 1989: The Structural Transformation of the Public Sphere (Cambridge: MIT Press).

Hall, P.D., 1992: Inventing the tor and Other Essays on Philanthropy, Voluntarism and Nonprofit Organizations (Baltimore: Johns Hopkins University Press).

Miranda, R; Lerner, A, 1995: "Bureaucracy, Organizational Redundancy, and the Privatization of Public Services", in: *Public Administration Review*. Vol 55, 193–200.

Salamon, L.M., 1995: *Partners in Public Service: Government-nonprofit relations in the modern welfare state* (Baltimore: Johns Hopkins University Press).

UNDP, 1993: *UNDP and Civil Society* (New York: UNDP).

Van Till, J., 1988: *Mapping the Third Sector*(New York: The Foundation Center).

World Bank, 2004 : Forty Two Months: Intifada, Closures and Palestinian Economic Crisis (Washington, D.C.: World Bank).

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