

**WATER SCARCITY IN THE MIDDLE EAST:
REGIONAL COOPERATION AS A MECHANISM
TOWARD PEACE**

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WATER SCARCITY IN THE MIDDLE EAST: REGIONAL COOPERATION AS A MECHANISM TOWARD PEACE

WEDNESDAY, MAY 5, 2004

HOUSE OF REPRESENTATIVES,
COMMITTEE ON INTERNATIONAL RELATIONS,
Washington, DC.

The Committee met, pursuant to call, at 10:39, a.m. in Room 2172, Rayburn House Office Building, Hon. Henry J. Hyde (Chairman of the Committee) presiding.

Chairman HYDE. The Committee will come to order.

The purpose of today's hearing on water scarcity in the Middle East is to examine how regional cooperation designed to share scarce water resources might serve as a mechanism to build peace in the region. Today we will hear from Administration officials and independent water experts on how this goal might be achieved.

We owe much of the credit for our attention to these issues to the selfless work of a great public servant, the late Senator Paul Simon of Illinois. I am certain, had we not mourned his untimely death last year, he would be with us today sharing his visionary ideas about the world's water challenges.

Within 1 year of his retirement from the Senate, our former colleague Paul Simon wrote an important book entitled, *Tapped Out: The Coming World Crisis in Water Scarcity and What We Can Do About It*. In his book, Senator Simon recounted a conversation he had with the late Israeli Prime Minister Yitzhak Rabin. According to Simon, Rabin said that:

“If we solve every other problem in the Middle East but do not satisfactorily resolve the water problem, our region will explode. Peace will not be possible.”

We should heed Paul Simon's recommendations and support the countries of the Jordan River Basin in developing a multilateral approach which will guarantee water security for all people dependent upon the basin.

America has been involved in promoting cooperation on water resource issues in the Middle East for more than half a century. In 1953, President Eisenhower recognized the importance of the water issue when he sent Eric Johnston as his personal representative to the Middle East to negotiate the Johnston Plan to apportion the waters of the Jordan Valley. In his 1968 article, “A Proposal For Our Time,” outlining a massive international aid program to develop atomic-powered desalinization plants in the Middle East, President Eisenhower suggested that “the collaboration of Arab

and Jew in a practical and profitable enterprise of this magnitude might well be the first long step toward a permanent peace.”

A quarter of a century later, as a result of the Middle East peace process’s multilateral track, the Multilateral Working Group on Water Resources was created as a way to help facilitate regional cooperation on water problems. The working group has been a constructive element for Israelis, Jordanians, and Palestinians. In a place where hardship and loss of hope are widespread, cooperation on water has contributed to increased trust and confidence even during the worst of times. As former Prime Minister Shimon Peres said:

“If roads lead to civilization, then water leads to peace.”

The U.S. and the international donor community have played an important role in the peace process. The United States Department of State and the U.S. Agency for International Development have been instrumental in helping communities in the Middle East find solutions to water challenges. Programs aimed at the development of water infrastructure are an important factor in improving the quality of life in the region.

While nature may not recognize manmade borders, man has the ability to determine how natural resources can be shared for everyone’s benefit. Is it not realistic for the region’s water challenges to serve as motivation for peace rather than a point of contention, since any future territorial settlement between the people and the countries of the Jordan River Basin will be linked to their need for water?

While there is no substitute for water, there are ways to ameliorate the problem of water scarcity. Today, we will learn about ways to increase the supply of water and to improve the distribution, utilization, and management of current and future water supplies.

If Senator Simon were here today, I am sure he would agree that access to quality water resources is vital not just to sustainable development, but also to peace, and that the very act of joining together to solve water resource problems can itself make peace more likely. I hope Senator Simon’s contributions will be remembered today as we focus on the water challenges in the region.

We have three distinguished panels before us today representing the Bush Administration and water experts from the region and the United States. And I look forward to hearing from our distinguished witnesses about these important issues.

I now yield to my distinguished colleague, the Ranking Democratic Member, Tom Lantos, for any opening remarks he may wish to make.

[The prepared statement of Chairman Hyde follows:]

PREPARED STATEMENT OF THE HONORABLE HENRY J. HYDE, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ILLINOIS, AND CHAIRMAN, COMMITTEE ON INTERNATIONAL RELATIONS

The Committee will come to order.

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The United States and the international donor community have played an important role in the peace process. The United States Department of State and the United States Agency for International Development have been instrumental in helping communities in the Middle East find solutions to water challenges. Programs aimed at the development of water infrastructure are an important factor in improving the quality of life in the region.

While nature may not recognize manmade borders, man has the ability to determine how natural resources can be shared for everyone's benefit. Is it not realistic for the region's water challenges to serve as a motivation for peace, rather than a point of contention, since any future territorial settlement between the people and countries of the Jordan River Basin will be linked to their need for water?

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We have three distinguished panels before us today representing the Bush Administration and water experts from the region and the United States. I look forward to hearing from our distinguished witnesses about these important issues.

I will now yield to my colleague, Ranking Democratic Member Tom Lantos, for any opening remarks he may wish to make.

Mr. Lantos.

Mr. LANTOS. Thank you very much, Mr. Chairman. I want to commend you for calling this important hearing.

The issue of water in the Middle East is complex, emotional, and it requires dispassionate analysis. I am convinced that long after today's headlines have faded, the water issue will remain as one of the serious problems of this very critical area.

The Middle East is historically a water-challenged region, and we need to explore the best means of averting a regional humanitarian disaster. The Middle East suffers a chronic water deficit that is worsening daily as a result of the unhappy combination of

population increase, industrial development, and long periods of drought. The past 5 decades have seen a steady decrease in the amount of precipitation.

The Middle East, of course, is a very large region. It is particularly fitting that we are focusing on the area inhabited by the Israelis, Palestinians, and Jordanians since this area suffers most severely in the region.

For several years it has been virtually a cliché that the next war in the Middle East will be fought over water. For this view perhaps the proper metaphor is found in Lawrence of Arabia, where Omar Sharif shoots dead a stranger for drinking from his watering hole. In studying the testimony for today's hearing, I am pleased to see that, in fact, there are other opinions; that water is not necessary a zero-sum game, and that there is significant cause to believe that Omar Sharif's metaphor need never come to pass.

Thanks to advances in technology, and particularly the emergence of desalination as an affordable technique, new water can actually be produced to counterbalance the deficits run by most of the states in the region and to take the edge off disputes between regional parties. Next year a desalination plant will come on line in Ashkelon, Israel, that will produce 100 million cubic meters of water per year.

I am certain we will hear many viewpoints from our witnesses today, but I am struck in particular by Dr. Fisher's testimony contrasting the cost of water and the cost of war. The cost of settling the Israeli-Palestinian water dispute on an annual basis, he argues, may be cheaper than the cost of a single fighter jet.

I am also pleased by two other trends in the Israeli-Palestinian-Jordanian triangle. First of all, there is growing consciousness of the need for conservation and efficient use of resources. Israel, Jordan, and the Palestinians have the region's lowest rates of per capita usage of water, and Israel's per capita usage has actually diminished by some 50 percent over the past 2 decades.

Whatever their other disputes, the parties clearly recognize the importance of water to their neighbors. All parties have continued to place importance on honoring commitments undertaken in their bilateral agreements on water, in particular the Israeli-Jordanian peace agreement of 1994 and the Israeli-Palestinian interim agreement of 1995. In fact, Israeli-Palestinian water arrangements represent one of the few areas in which the Oslo II agreement continues to hold. These arrangements have been reinforced by more recent agreements between Israeli and Palestinian water commissioners, committing the parties to continued cooperation even under fire.

Apparently, Mr. Chairman, Israeli workers under military protection even repaired damage to Palestinian wells in Jenin as fighting raged around them during Operation Defensive Shield some 2 years ago.

In this regard, I want to commend diplomats, including Mr. Satterfield, for their effective role in chairing a trilateral water committee with Israel and the Palestinians that keeps the lid on difficulties related to implementation of Israeli-Palestinian water agreements. I also want to commend USAID for implementing

major water and sewage treatment projects in both the West Bank and Gaza.

Mr. Chairman, it seems to me that the most dire zero-sum predictions about the water situation in the region need not come true. With good will, intelligent analysis, efficient use of funding, and effective American leadership, water can be a source for cooperation and coexistence, not war, in the Middle East.

I look forward to hearing the views of the Administration and other expert witnesses, and I ask unanimous consent to submit a statement on this subject prepared by the Jewish National Fund.

Chairman HYDE. Without objection, so ordered.

Mr. LANTOS. Thank you, Mr. Chairman.

[The information referred to follows:]

PREPARED STATEMENT OF THE JEWISH NATIONAL FUND, SUBMITTED FOR THE RECORD BY THE HONORABLE TOM LANTOS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Jewish National Fund appreciates the opportunity to present testimony to the Congressional Committee on International Relations at its Hearing on Water Scarcity in the Middle East.

For committee members unfamiliar with JNF, allow me give you some background. Jewish National Fund is a non-profit apolitical organization founded in 1901 to serve as caretaker of the land of Israel. During the first half of the 20th century, JNF set out to achieve its goal by purchasing land in what was then Palestine. Following the successful establishment of the state in 1948, JNF evolved to meet Israel's most pressing needs, including the ongoing water shortage and other environmental challenges. Over the past century, we have planted over 240 million trees, developed over 250,000 acres of land, and created more than 450 parks.

In western industrialized nations, such as the United States, the water allocation is 9,000 cubic meters per person. In Israel, the allocation is 300 cubic meters per person. That's a stark difference. And while it is true that Israel has a higher water consumption rate than its neighbors, a population boom is causing a severe water shortage.

The reason that it is important that we be here today is that JNF's unique experience at making the desert bloom gives us the privilege of being the world authority on arid land issues, including forestry and water, something we are willing to share with all nations. JNF is solely responsible for increasing water supply in Israel through water reclamation and recycling as well as water harvesting. We have built 160 reservoirs, and are responsible for dams, river reclamation and water recycling projects in Israel. JNF has also worked on a number of regional issues including the rehabilitation of the Alexander River, which was just featured in the March 16 issue of the NY Times, and was awarded an international prize for JNF's ability to bring together Israelis and the Palestinian Authority to work on a joint issue.

And that is just the beginning of the work JNF has done to resolve and provide a model for water scarcity issues in the region.

JNF is a member of the Middle East Regional Cooperative, under the auspices of the U.S. Forest Service's Middle East programs. As part of the cooperative, our scientists work in cooperation with Jordan, the Palestinian Authority, Turkey and the U.S.

JNF organized and is the founding member of the International Arid Lands Consortium, an organization based at the University of Arizona whose members include six American universities, JNF, Egypt and Jordan. The IALC supports multilateral peer reviewed research and demonstration projects in IALC member countries. Currently, the IALC is working on projects in Jordan, Afghanistan, Pakistan, Yemen and is moving toward a project in Haiti, all under the auspices of a U.S. A.I.D. grant.

Our current activity with Jordan is as follows. Through our involvement with the International Arid Lands Consortium, JNF facilitated researchers from the University of Arizona working on a Water Friendly Garden in Aqaba, as well as a demonstration site in Mafraq, the latter is awaiting approval by the U.S. A.I. D. Mission. In addition, the team is working on a wastewater related project with the University of Jordan and Jordan University of Science and Technology, as well as technical assistance to Jordanian partnering institutions. A Water Demand Management Conference is scheduled in Jordan from May 30-June 3 and faculty support

is being provided. Finally, once visas are approved, several tours of Jordanians will be coming to the U.S. for study and workshops in bio-solids, wastewater analysis and instrumentation, drought risk analysis and high solids irrigation.

In addition, JNF has been part of international study teams consulting on water and soil projects in Chile, Paraguay, Mexico, Turkey, Burkino Faso and Nigeria, and most recently East-Timor. Our forestry program, which has planted over 240 million trees during the 20th century, is now being used as a model in countries such as Afghanistan for its success at preventing soil erosion, decreasing air pollution, improving water quality, and providing a green lung to the region.

JNF's work has been presented at the United Nations, both in Johannesburg at the World Summit on Sustainable Development and at last fall's United Nations DPI/NGO conference, where we featured former Senator Paul Simon and projects that helped bring life back to the land.

I bring this to your attention because resolving the water scarcity in the Middle East is not something that can be resolved overnight. JNF has worked many years on this issue. Although in Israel JNF has been successful at recycling water, this water is not used for human consumption. Instead, it is used for agriculture and keeps Israel's farmers market competitive. We have combined our work in water recycling with the training of farmers in techniques that provide the best utilization of water possible. We have research and development centers and our research has shown a number of things that help. For example, we can show a farmer, particularly in the Negev, Israel's driest region, how much water to use and at what points in the plant's growth cycle to use it, so precious water is not wasted.

Second and more importantly, we have planted hundreds of millions of trees. Trees are important not only because they retain the soil and provide needed shade, but also because the roots hold water in the soil. This is important particularly during the rainy season, when much of the water would otherwise be lost. Also, the water held by the trees that eventually seeps into riverbeds is cleaner and potable water.

By building reservoirs to hold the water from rain, and planting trees, which hold the water in the soil, we have provided a model to the region. And the reservoirs we built enabled Israel to provide Jordan with 50 million cubic meters of water annually as part of the 1994 peace treaty. However, what most people do not know is that the water supplied to Jordan annually is stored in JNF reservoirs. Since water is a key element in the peace treaty, it would not have happened to offer the 50 million cubic meters of water if JNF had not foreseen this problem years ago and had initiated the building reservoirs.

As an example of regional cooperation, JNF built the Besor Reservoir Complex, which is used for irrigating citrus groves and fields in 12 communities in the Eshkol Regional Council, and plays a major role in the battle against desertification. This area once had only non-irrigated crops, such as winter wheat, and today it is producing an average of 25,000 tons of fruit providing a net income of \$1.5 million dollars for the 12 communities.

The Besor Reservoir Complex is a series of three interconnected reservoirs, with a total capacity of 7 million cubic meters. The water for the reservoir is a combination of floodwater, from the winter floodwaters of the Besor River and recycled water from the greater Tel Aviv area.

JNF's development of water resources in Israel, *including that which is shared with the Palestinians*, has been far superior to most any other state in the region. Israel substantially upgraded the Palestinian water system, and the Palestinians now have access to water almost unequalled in the Middle East. All international statistics show this.

As the water shortage in the Middle East loomed overhead, Jewish National Fund adapted its role as caretaker of the land to meet the pending need for water. For the past 20 years, Jewish National Fund has worked side by side with the people to address the water shortages so critical to the long term survival of the region, not only Israel. An appeal to JNF by the government of Israel for more reservoirs has the organization committed to building another 75 reservoirs during next five years. These are some of the immediate solutions to alleviating Israel's water crisis and are an integral part of its plans for supplying water over the long term.

We feel we have the practical and scientific expertise that can be applied to the regional water shortage that should not be overlooked. We stand ready to apply our

experience and expertise with all countries in the region. Water has no boundaries. It is the essence of life.

Respectfully Submitted,

RONALD S. LAUDER,
President, Jewish National Fund
 RUSSELL F. ROBINSON,
CEO, Jewish National Fund
 JOSEPH HESS,
Vice President, Jewish National Fund.

Chairman HYDE. The Chair would announce that we expect a vote about 11:30 on the rule and previous question, and then there will be 2 hours of debate and then final passage. So it is my hope and expectation that we can promptly and expeditiously get to our panel of witnesses. We have two gentlemen over in Tel Aviv; thanks to the magic of technology, they can hear us. And so we would like to get to them, and they are on the final panel.

So with that, the Chair recognizes Mr. Ackerman. If you will have an opening statement.

Mr. ACKERMAN. Thank you, Mr. Chairman.

Today the Committee is focusing on one of the most important and contentious issues between Israelis and Palestinians, the allocation and management of scarce water sources—resources. But while this issue is difficult and central to any future Middle East peace agreement, it is not more important than what is currently going on in Iraq. It is not more important than the transfer of sovereignty to God knows who in 57 days. It is not more important today than our failure to adequately share the burden of reconstruction. It is not more important than contractor fraud and waste of U.S. taxpayer funds. It is not more important than knowing in advance what the status of our forces will be after the transfer of sovereignty. It is not more important than the vast and likely irreversible damage done to our national image in the Middle East due to the abuse of Iraqi prisoners. And it is not in short what this Committee should be talking about today.

When are these subjects finally going to attract the Committee's attention? Water and water scarcity are important. Normally I would be extremely pleased that the Committee was devoting attention to the issue. But these are not normal times. Our Nation is at war, and our efforts in Iraq, though performed by brave, dedicated, and honorable men and women, are floundering. Our responsibilities should call our attention elsewhere right now.

Had the Committee begun focusing on Iraq up to this point, we might be entitled to indulge our interests in the future of water as a vital element in any future Israeli-Palestinian peace, but we have not focused on Iraq. We have looked at Saddam Hussein's human rights record, we have looked at environmental damage he did to Iraqi swamplands, and we have looked at allegations of corruption in the old U.N. Oil-for-Food Program. To our shame, however, since October 2003, not a minute, not 1 minute of our time, has been spent thinking about the future of Iraq.

Our Nation deserves better. Committee oversight should not be defined as overlooking as much as possible.

On the subject of water, I would note only a few points. The Middle East and North Africa has 5 percent of the world's population, but only 1 percent of its fresh water, clearly making it the most

water-stressed region in the world. The three major water sources in the region are obviously best managed by a series of multilateral agreements governing the distribution and development of such a scarce resource. But as important as such agreements are, they seem accessible only in the distant future.

Cooperative water management by various regional governments may well contribute to a more stable Middle East in the future, but we clearly have a long way to go from making such arrangements a reality. At this time, however, our attention should not be focused on dreams of water in the desert in the future, but on the fighting in the desert today. I do look forward to hearing from our witnesses.

Chairman HYDE. I thank the gentleman for his remarks. His flare for criticism is in full blossom, and I am sure he could do a better job than we do, but we do our best. I would advise the gentleman that our Committees and our Subcommittees are busy. We are doing a lot of things apropos of Iraq and Oil-for-Food and other things the gentleman is not privy to. We have a hearing next week on the transition in Iraq. We will have witnesses from the State Department, from the Department of Defense, and the gentleman will be a full participant, and he can continue his critique.

Ms. Ros-Lehtinen.

Ms. ROS-LEHTINEN. Thank you, Mr. Chairman.

Chairman HYDE. The gentlelady from Miami.

Ms. ROS-LEHTINEN. Thank you, Mr. Chairman. Thank you for convening this very important hearing on an important subject, and that is water scarcity in the Middle East.

In a region struck by war and strife, to have to deal with water scarcity is certainly one additional problem that is not needed. Add to this an extended drought, and the problems of the region only worsen. Today's hearing is important in that we must examine ways to alleviate the situation that impacts each and every person in the region.

As our witnesses today will testify to, there are, in fact, bodies of water that can lessen this problem, but they are, due to geography and politics, not as easily reached as all would wish.

Mr. Chairman, I am particularly grateful for the Committee's invitation to one witness in particular, Professor Haim Shaked, who is in our audience of the University of Miami. Professor Shaked is a personal friend and a renowned expert in the field of Middle Eastern issues. His proposals that he will discuss later today for a joint commission provide a measure of hope for an otherwise bleak situation. I hope that his proposals receive serious consideration.

A commission can override the political difficulties that often arise in this part of the world, and in this context I would like to understand from our witnesses what is the long-term environmental prognosis for the region if action is not taken to solve this water crisis? And, furthermore, would an international donors conference be the route to take in order to raise the funds for the various proposals to address this problem? And I am gratified that not only are there proposals to improve the situation, but that in some places, such as the Alexander River cleanup in Israel, both Pal-

estinians and Israelis have come together to clean up a river for the use of both communities.

I hope that our witnesses can tell us if they foresee future opportunities whereby the political circumstances in the region could be correctly aligned to allow for work on this project to continue and spread, and to what extent does the political situation regarding Israel's withdrawal plan impact the infrastructure working on the water situation,

So I thank the Chairman for all of the work that he has done on the issues of the Middle East, and this is but one of the many examples where our Committee has done an incredible amount of oversight in the problems of the region. So I thank the Chairman for the time.

Chairman HYDE. Mr. Blumenauer.

Mr. BLUMENAUER. Thank you, Mr. Chairman. And I am pleased that you indicated we will be doing more oversight as it relates to Iraq. I have no quarrel with our doing more; I think it is important. But I would take modest exception to my colleague from New York, because there is never, I think, a good time for us to spend as much time as we need to on these critical issues that deal with water.

I would note that we will have more people in the world die by noon today unnecessarily from waterborne diseases than were lost in the World Trade Center tragedy and the Pentagon. And it is not just in the Middle East that this is a sticking point. We can just reflect in this Committee about the control by China of the major watersheds in Asia.

This is an area of potential conflict, where death is occurring on an ongoing basis. Some of us were in Johannesburg 2 years ago when the international community—and this is an area where I was pleased the United States moved to provide some leadership—made a commitment that we were going to give 233,000 people around the world every day access to safe drinking water and 400,000 people a day access to sanitation. And, sadly, I think the record will show that we are not in very good shape in terms of making that commitment a reality. It is not clear to me that we are where we need to be.

I treasure, Mr. Chairman, my copy that I received from Senator Simon of his book dealing with the water challenge. I am concerned that this Committee, this hearing, the work that has been done might spur us to greater action. We are the world's largest donor; but in terms of the amount of gross national product, we are the least generous of countries. And so we have got, I think, something that we could do.

Water is an easier guide to sort through these problems. We can quantify, we can look at water quality, we know basically where it is and where it is flowing. And I think this, I hope, Mr. Chairman, would be a first step that we could focus more on water and oceans as a way of understanding how our Committee can make a contribution in helping shape policy, working with the Administration and NGOs.

I would just request, Mr. Chairman, that in the future that we might look at adding to these panels the people who are in the private sector who are involved with the provision of water infrastruc-

ture around the world. They have a sort of insight on the ground that we don't often hear that I think might add a dimension to our distinguished experts. And I would ask, Mr. Chairman, with your permission, to add some information from an internationally recognized expert from the upper West Coast in Oregon, Professor Aaron Wolf from Oregon State University, that might supplement the record, if that would be all right.

Chairman HYDE. Without objection, so ordered.

[The information referred to follows:]

DEHYDRATING CONFLICT

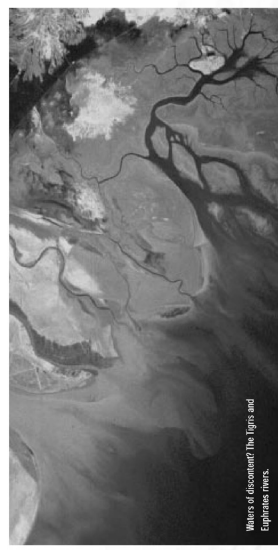
Remember the last time two nations went to war over water? Probably not, since it was 4,500 years ago. But today, as demands for water hit the limits of a finite supply, conflicts are spreading within nations. And more than 50 countries on five continents might soon be spiraling toward water disputes unless they move quickly to strike agreements on how to share the rivers that flow across international boundaries. | By Sandra L. Postel and Aaron T. Wolf

Talk of water wars reawakens around the globe these days. United Nations Secretary-General Kofi Annan said last March that "there competition for fresh water may well become a source of conflict and wars between nations." In a recent report of the U.S. State Department, he said that "the likelihood of all-out global water wars is small, but the likelihood of interesting conflicts will increase during the next 15 years," as countries press against the limits of available water.

Some dismiss these warnings as alarmist, and history seems to be on their side. The only recorded incident of an outright war over water was 4,500 years ago between two Mesopotamian city-states, Lagash and Umma, in the region we now call southern Iraq. Conversely, between the years 805 and 1884, countries signed more than 3,600 water-related treaties, many showing great creativity in dealing with this critical resource. An analysis of 1,831 international water-related events over the last 50 years reveals that two thirds of these encounters were resolved peacefully, and one third led, for example, to implementation of joint scientific, technological work and signed 157 water treaties.

Sandra L. Postel directs the Global Water Policy Project in Amherst, Massachusetts. She is also a senior fellow with the Worldwatch Institute and a visiting senior lecturer in environmental studies at Mount Holyoke College. Aaron T. Wolf is an associate professor of geography at Oregon State University's Department of Geosciences, and director of the Transboundary Freshwater Dispute Database project.

have a nasty habit of spilling over borders and becoming tomorrow's international wars. Second, water disputes between countries, though typically not leading to war directly, have fanned decades of regional tensions, thwarted economic development, and risked provoking larger conflicts before eventually giving way to cooperation. The obsession with water was being more important questions: What are the early signs and likely locations of water-related disputes, and what can governments and international agencies do to prevent the eruption of violence and political instability?



Writing of discontent? The Giris and Euphrates rivers.

INTERNAL STRESS

On July 6, 2000, thousands of farmers in the Yellow River basin of eastern China clashed with police over a government plan to recapture runoff from a local reservoir for cities, industries, and other users. The farmers had long relied on that runoff to irrigate their crops, and a bad drought had made the supply more critical than ever. The incident took place in Shaanxi, the last province through which the Yellow River flows. But it is not merely because the geography of water channels is noteworthy because the geography of water channels is erupting within countries in the downstream regions of overtopped river basins. China's Yellow River has been running dry in its lower reaches on and off since 1972, and the dry spells have lengthened markedly in recent years, including a record 226 days in 1997. Likewise, water disputes seem to be brewing between Thailand's northern and southern regions as Bangkok's main river supply, the Chao Phraya,

divides. And there is intensifying friction in the lower portions of the Indus River, where Pakistan's Punjab and Sindh provinces have been feuding over water for several years. This past April, protests in Karachi turned violent as demonstrators shouting "Give us water" clashed with police.

These incidents should not be dismissed as isolated and unrelated. Water stress is spreading as populations increase (see map on page TK). By 2015, nearly 3 billion people—40 percent of the projected world population—are expected to live in

countries that find it difficult or impossible to mobilize enough water to satisfy the food, industrial, and domestic needs of their citizens. This scarcity will translate into heightened competition for water between cities and farms, between neighboring states and provinces, and at times between nations.

The largest and most combustible imbalance between population and available water supplies will be in Asia, where crop production depends on irrigation. The region's population is 36 percent of the world's renewable fresh water. China, India, Iran, and Pakistan are among the countries where a significant share of the irrigated land is now jeopardized by groundwater depletion, scarce river water, and a fertility-sapping buildup of salts in the soil, or some combination of these factors. Groundwater depletion alone places 10 to 20 percent of grain production in both China and India at risk. Water tables are falling steadily in the North China Plain,

Water in Thailand's northern and southern regions as Bangkok's main river supply, the Chao Phraya,

PHOTO: GUY LAWRENCE/GETTY IMAGES; PHOTO: GUY LAWRENCE/GETTY IMAGES

which yields more than half of China's wheat and one third of its corn, as well as in northwest India's Punjab, another major breadbasket.

As farmers lose access to irrigation water and see their livelihoods deteriorate, they may not only resort to violent protest but migrate across borders and to restive and already overcrowded cities. Such has been the case in Pakistan, where falling agricultural output has prompted a massive rural migration to large urban centers, leading to renewed outbreaks of ethnic violence.

Internal water stresses will also shift international trade patterns. Countries currently dependent on grain imports, such as the United States, will face increasing stress by importing more of their food, provided they have the foreign exchange to do so. It takes about 1,000 cubic meters of water to grow one ton of grain. By importing wheat and other staples, water-stressed countries can allocate more of their scarce fresh water to cities and industries, which generate far more economic value per liter than agriculture does. Israel, for example, has done very nicely with this approach. Currently water-stressed countries in Asia, Africa, and the Middle East account for 26 percent of global grain imports. As an additional billion people are added to water-stressed countries over the next 15 years and as more countries join the ranks of food importers, demand for international grain will

increase. A good portion of that increase may come from China, India, and Pakistan—all currently grain self-sufficient, but unlikely to remain so for reasons of water and land scarcity. Their governments will inevitably form stronger alliances with the nations from which they choose to import food. For those nations without sufficient foreign exchange to turn to imports, notably those in sub-Saharan Africa, higher world grain prices will likely mean greater hunger and more calls for humanitarian aid.

Finally, a new cause of water-related tensions has surfaced in just the last few years—the transfer of water rights to private entities. In the United States, public utilities have sold water rights to private multinational corporations. Drying privatization is a confluence of forces: the mounting costs and political liabilities of providing urban water services, increased pressure on governments from the International Monetary Fund (IMF) and the World Bank to reduce water subsidies and public-sector debt, and the growing power of private corporations seeking to profit from the sale of water and related services. Especially where privatization takes place in the presence of poverty and inequality, which is to say in most of the developing world, it can lead to civil protest and violence.

Recent events in Cochabamba, Bolivia's third largest city, underscore these risks, following the privatization of Cochabamba's water system, which had

been plagued by corruption and mismanagement, water rates skyrocketed—resulting in water bills for some residents equal to a quarter or more of their income. Months of civil unrest culminated in April 2000, when the La Paz government sent soldiers into Cochabamba, where some 30,000 protesters had amassed in the central plaza. Several days of violence ensued, leaving one person dead and more than a hundred injured. The conflict abated only when the water system returned to public control.

Water rights are also being sold in other isolated cases. Activists in Colombia and South Africa likewise have opposed the privatization of water and other municipal services. Meanwhile, IMF loan agreements with at least half a dozen countries last year called for some degree of water system privatization. The number of urban dwellers worldwide is projected to nearly double—to 5 billion—by 2025. Unless governments and leaders strengthen municipal water agencies and seek private-sector involvement toward equity as well as profit, many of the world's poorest and most vulnerable people will face water shortages as severe as those that have recently been reported in Cochabamba and may be forthcoming.

A Parched Planet

Cubic Meters of Water per Person by Basin

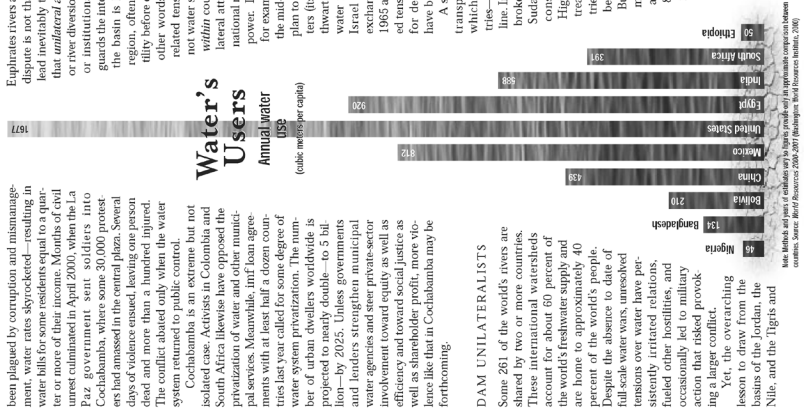


Euphrates rivers and other regions of water dispute is not that worsening scarcity will lead inevitably to water wars. It is rather that *unilateral actions* to construct a dam or river diversion in the absence of a treaty or institutional mechanism that safeguards the interests of other countries in the basin is highly destabilizing to a region, often sparking decades of hostility before cooperation is pursued. In other words, the red flag for water-related tension between countries is unilateral action (in the case of riparian or littoral countries) but rather a unilateral attempt to develop an international river, usually by a regional power. In the Jordan River basin, for example, violence broke out in the mid-1960s over an "all-Arab" plan to divert the river's headwaters (Israfel's intention to siphon water from the Sea of Galilee). Israel and Syria sporadically exchanged fire between March 1965 and July 1966. Water-related tensions in the basin persisted for decades and have recently begun to dissipate.

A similar sequence of events transpired in the Nile basin, which is shared by 10 countries—of which Egypt is last in line. In the late 1950s, hostilities broke out between Egypt and Sudan over Egypt's planned construction of the Aswan High Dam. The signing of a treaty between the two countries in 1959 defused tensions before the dam was built. But tensions between Egypt and Ethiopia, where some 85 percent of the Nile's flow originates, and a war of words has raged between these two nations for decades. Along with civil war and poverty, such verbal threats have likely

Water's Users

Annual Water Use (cubic meters per capita)



DAM UNILATERALISTS

Some 261 of the world's rivers are shared by two or more countries. These international watersheds account for about 60 percent of the world's freshwater supply and are home to approximately 40 percent of the world's people. Despite the absence of date of treaties governing the use of shared waters, tensions over water have periodically iritated relations and fueled other hostilities, and occasionally led to military action that risked provoking a larger conflict.

Yet, the overarching lesson to draw from the basins of the Jordan, the Nile, and the Tigris and

inhabited Ethiopia's water development, leaving the Horn of Africa more vulnerable to drought and famine. Meanwhile Egypt, the regional power, has continued to pursue large-scale river basin schemes unilaterally. As in the case of the Jordan, only in recent years have the Nile nations begun to work cooperatively toward a solution.

Similar scenarios have unfolded in a number of other river basins. India unilaterally constructed a barrage during the 1960s and early 1970s on the Ganges River at Farakka, near the border with

The unprecedented degree of current water stress is creating more zero-sum situations both within and between countries.

Bangladesh, in order to channel more river water to the port of Calcutta. This diversion left Bangladesh with significantly less water for irrigation during the dry season. A 20-year period of intermittent hostility and instability ensued, including increased migration of Bengali refugees across the border to India.

The current situation in the Salween basin is a big dam or other development project, leading to a protracted period of regional insecurity and hostility, typically followed by a long and arduous process of dispute resolution. A two-year study of conflict and cooperation within international river basins by researchers at Oregon State University found that the likelihood of conflict increases significantly whenever two factors come into play. The first is that some large or rapid change occurs in the basin's physical setting (typically the construction of a dam, river diversion, or irrigation scheme) or in its political setting, especially the breakup of a nation that results in new international rivers. Secondly, the change in setting is accompanied by a treaty that manages that change—i.e., when there is no treaty spelling out each nation's rights and responsibilities with regard to the shared river nor any implicit agreements or cooperative arrangements. Even the existence of technical working groups can provide some capability to manage contentious issues, as they have in the Middle East.

Looking ahead, then, which river basins are ripe for the onset of tensions or conflict over the next 10 years? Where are dams or diversions

planned or under construction that may hurt other countries and where there is no mechanism for resolving resulting disputes? The accompanying map (see page TK) shows the location of 17 such basins, along with the four in which serious unresolved water disputes already exist or are being negotiated. These basins at risk encompass 51 nations on five continents but are not evenly distributed. Eight of the basins are in Africa, primarily in the south, while six are in Asia, mostly in the southeast. Few are on the radar screens of war-and-security analysts.

Consider the Salween River, which rises in southern China, then flows into Myanmar (Burma) and Thailand. Each of these nations plans to construct dams and development projects along the Salween, and no two sets of plans are compatible. China, moreover, has not lately been warm to notions of water sharing. It was one of just three countries that voted against a 1987 U.N. convention that established basic guidelines and principles for the use of international rivers. Add in other destabilizing factors in the Salween basin—including the status of their indigenous assistance agreements, opium production, and the ethnic tensions in Bangladesh—and the familiar conflict trajectory emerges. Without a treaty in place, or even regular dialogue between the nations about their respective plans, there is little institutional capacity to buffer the inevitable shock as construction begins.

Consider, too, the Okavango, the fourth largest river in southern Africa. Its watershed spans portions of Angola, Botswana, Namibia, and Zimbabwe, and its vast delta in northern Botswana offers world-renowned wildlife habitat—the "jewel of the Kalahari." In 1996, drought-prone Namibia revived colonial plans to divert Okavango water to its capital city of Windhoek, Angola and especially Botswana. The plan would have had significant potential harm to the people and ecosystems that depend on the Okavango's flow for their existence. The main institution that can help manage the dispute is the fledgling Okavango Commission, formed in 1994 to coordinate plans in the basin. The commission has recently received renewed support from the Southern Africa Development Community, the U.S. Bureau of Reclamation, and other agencies, but the water dispute continues to simmer.

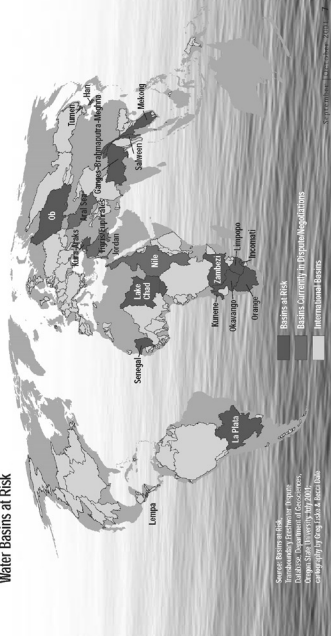
al waste regularly push the level of water pollution to 10 to 100 times international standards. On top of the pollution problems, some forecasts project severe water shortages within 10 years. These water strains exacerbate, and are exacerbated by, relations over other contentious issues in the region, notably those of Niigorno-Karabakh and the proposed pipeline to transport Caspian crude oil across the region to Turkey.

REDUCING WATER PRESSURE

History supports the hopeful notion that fresh water may foster cooperation more often than conflict in the years ahead. Water sharing has regularly brought even hostile neighboring states together. But the unprecedented degree of current water stress is creating more zero-sum situations—in which one party's gain is perceived as another's loss—both within and between countries. The challenge to governments and international bodies is to recognize the new geography and causes of water-related conflict and to embrace three guiding principles as they act to promote water security.

First, efforts to increase the productivity of water use—output per unit of water—are key to defusing tensions as water stress worsens. Measures such as

**Up for Grabs
Water Basins at Risk**



Source: RiverWatch, Brookings Institution, Digital Divide, and University of Toronto. Original map by the U.S. Army Corps of Engineers.

drip irrigation (a highly efficient technique that delivers water directly to the roots of crops), shifts in cropping patterns, recycling and reusing wastewater, and water-thrifty household appliances enable cities and farming regions to do more with less water. Since agriculture accounts for two thirds of water use worldwide, and 80 to 90 percent in many developing countries, increasing the productivity of irrigation water is particularly critical. Several water-short urban areas, including greater Los Angeles and Beijing, are investing in conservation improvements on nearby farms in exchange for the water needed to sustain the cities. The main strategy of desalination, the city obtains additional water through a reasonable cost, and cooperation replaces competition. Moreover, where water conservation and productivity improvements eliminate the need for a new dam or river diversion, or allow a big project to be scaled down in size, they also address a major source of tension and conflict. As the costs of desalination decrease, the desalting of contaminated aquifers and of seawater may generate new drinking water supplies and thereby ease tensions in water-scarce regions as well.

Second, stronger polities are needed in most countries to regulate groundwater use, to price irrigation and other water in ways that encourage conservation, and to protect forest rivers and lakes from degradation. Greater assistance to governments from international agencies in carrying out these policy and management reforms could help lessen the likelihood of future water conflicts. Letting globalization loose in the form of poorly regulated privatization of water services or unstrained private funding of dam construction will likely cause more

problems than it solves. In this regard, the 2000 report of the Independent World Commission on Dams calls for strong foundations for more socially responsible planning and assessment of dams. It is an important step forward. Among other things, the report calls for an open decision-making process that includes all those affected by a proposed dam; a thorough examination of the full range of alternatives to determine if a dam is really the best choice; negotiations with and adequate compensation for those adversely affected by dam construction; and, where international rivers are concerned, regional cooperation and col-

laboration. While some governments have publicly endorsed the commission's recommendations, others—India for instance—have disavowed them.

Third, governments and international organizations must act early and constructively. Some of the most tense water disputes of the 20th century simmered for decades before the rival parties resolved their differences. After three decades of tension in the Jordan basin, Israel and Jordan included a water-sharing provision in the peace treaty they signed in 1994. Tensions among the Nile basin countries are finally easing, thanks in part to unofficial dialogues between Egypt and Sudan. The Nile basin is especially tense since the early 1990s and more so to a multilateral-level "Nile Basin Initiative" facilitated by the United Nations and the World Bank. India and Bangladesh ended a 20 year dispute in 1996 with the signing of a treaty that sets out specific terms for sharing the dry-season flow of the Ganges.

The prevailing ad hoc patterns—implementing agreements, sometimes decades after a crisis emerges—is not only risky and inefficient, but in many cases preventable. The key is establishing a process of cooperation early in the trajectory before serious hostilities erupt that make it difficult for nations to sit around a negotiating table together. The India-basin water dispute is a good example. After their independence in 1947, India and Pakistan nearly

Letting globalization loose in the form of poorly regulated privatization of water services or unstrained private funding of dam construction will likely cause more problems than it solves.

to pursue its agricultural and economic plans without risking the ire of the other. Long term programs of joint fact-finding, technical cooperation, and other initiatives that establish a climate of cooperation among countries can pave the way for resolving disputes when they do arise. The U.S. State Department, other donor countries, and a number of U.N. agencies have established a Global Alliance for Water Security aimed at coordinating assistance in priority regions, which may help countries get ahead of the crisis curve.

Most of humanity's long history with water management has focused on developing ways to capture

and deliver water in ever greater quantities to people, industries, and farms. We have more or less mastered the technologies that enable us to bend nature to our will. This success, however, has not created a water-secure world. Together, more effective technologies, policies, and international institutions can help prevent and resolve water disputes. But the stresses on rivers and water supplies are now so great and so widespread that we cannot wait for these measures to gradually evolve. We must implement them before long periods of verbal threats, hostilities, environmental degradation, and human suffering engulf more regions of the globe. **EB**

Want to Know More?

For an overview of global water stress and the sustainability of irrigated agriculture, see Sandra Postel's *Pillar of Sand: Can the Irrigation Miracle Last?* (New York: W.W. Norton, 1989) as well as many publications of the International Water Management Institute. Also see Postel's "Growing More Food with Less Water" (*Scientific American*, February 2001). For coverage of a wide range of water topics and data, see Peter Gleick's *The World's Water: The Biennial Report on Freshwater Resources* (Washington: Island Press, 1998 and 2000) and the Web sites of the Pacific Institute for Studies in Development, Environment, and Security and the World Resources Institute's environmental information portal. An excellent new source on technologies and measures to conserve water is Amy Vickers's *Handbook of Water Use and Conservation* (Amherst: Waterflow Press, 2001).

There is good recent literature on both the dangers and promises of shared river systems. Amn Elhanan focuses on developing countries in *Hydropolitics in the Third World: Conflict and Cooperation in International River Basins* (Washington: U.S. Institute of Peace Press, 1999). The Middle East is covered extensively by Asit Biswas, ed., *International Waters of the Middle East: From Euphrates-Tigris to Nile* (Oxford: Oxford University Press, 1994) and Hussein Amery and Aaron Wolf's, eds., *Water in the Middle East: A Geography of Peace* (Austin: University of Texas Press, 2000). For a diplomat's perspective of the process from armed conflict to unofficial dialogue to peace negotiations, see Mumber Haddadin's *Diplomacy on the Jordan* (Dordrecht: Kluwer Academic Publishers, forthcoming). An edited volume of classic papers on water disputes at various scales is Wolf's, ed., *Conflict Prevention and Resolution in Water Systems* (Cheltenham: Edward Elgar, 2001).

Wolf, Shira Yoffe, and Mark Giordano's "International Waters: Identifying Basins at Risk" (Water Policy, forthcoming) gives details on the Oregon State University (OSU) study on indicators of water conflict and basins at risk. Related articles and primary information related to conflict and cooperation in international waters can be found at OSU's Transboundary Freshwater Dispute Database project Web site.

For more information on dams, see the report of the World Commission on Dams, *Dams and Development: A New Framework for Decision-Making* (London: Earthscan, 2000) and the Web site of the International Rivers Network. An interesting interview with Oscar Olivera, who led the protest over privatization of Cochabamba's water system, appeared in *Multinational Monitor* (June 2000).

>>For links to relevant Web sites, as well as a comprehensive index of related Foreign Policy articles, access www.foreignpolicy.com.

Chairman HYDE. And I thank the gentleman. I hope he will have lunch with Mr. Ackerman and discuss with him the importance of this subject. And I am—

Mr. ACKERMAN. Mr. Chairman.

Chairman HYDE. Yes, Mr. Ackerman.

Mr. ACKERMAN. I don't take the things you say very lightly, and I hope that you don't take the things that I say very lightly either. I know how important the issue of water is, and perhaps you have missed my point. I tried to make it as clearly and succinctly as I possibly could.

I don't know about other Members of your Committee, Mr. Chairman, but I have personally traveled to the Middle East, to Israel and four of its neighboring countries, exclusively on the issue of water and discussed it with heads of state in each of those countries as well as the private sector for a very long period of time.

The point I tried to make, which obviously apparently went unnoticed, was the fact that there are other important issues that I believe, as a Member of this Committee and as the Ranking Member of the Subcommittee on the Middle East, are critical this date. Water in the desert is important, but American blood in the sand is important as well. And not 1 minute's time of this Committee since October 2003 has been spent on this issue.

I have said it for the third time. I think discussing water issues are very, very important. They are critical issues, they are long-term issues. But this Committee seems to be finding issues that have importance as a diversion to the job that we should be doing.

I hope I made myself clear, Mr. Chairman.

Chairman HYDE. I think it is pointless for us to continue this give and take. I disagree with the gentleman profoundly about our intention and the time we have spent on the subject of Iraq. It occupies almost every waking moment, and we talk about it, and we work on it, and we have worked on it. But that is again getting away from the subject at hand. And I will try to wrench us back in that direction.

Mr. Rohrabacher.

Mr. ROHRABACHER. Thank you very much. And I will try to control my political nature, as we all have a political nature here, and look at the issue today. And, in fact, one of the things that I am pleased with the current Administration about is that they have a strategic view and a long-term view rather than just always a short-term view of how to approach things in the Middle East. And I am so pleased with your leadership, Mr. Chairman, on calling this hearing today in order to draw attention to the issue of water. And there is no more strategic issue that needs to be dealt with if we are going to have peace in the long run in that region than the issue of water.

It was 1 year ago when I introduced H.Con. Resolution 238, which is aimed at trying to encourage more of a focus on the water issue in an effort to bring peace between the Israelis and the Palestinians, and, yes, the Jordanians as well.

I might add that shortly after submitting that legislation, which is still in the hopper, I received a letter from Senator Paul Simon right before his death, and it was a very inspiring letter, and he gave me a copy of his book. And I might add again that we over-

came politics. Senator Paul Simon overcame politics, I overcame politics, and I had a great communication with him. And I believe that his spirit should be guiding us today.

Let me note that if anything comes out of these hearings today, I hope it is a call, a call on all sides and all factions to agree to work with all other sides and all other factions in the Middle East in order to increase the amount of water available in the region. That is a noble cause. If we can just get all the sides and all the factions in the Middle East working to solve that problem independently of all the other issues at hand, number one, it will make conflict less likely in the Middle East, because you will have a higher level of water, and water—and the scarcity of water is in and of itself something that could cause conflict. So we have lessened that cause for conflict. Plus if we get people focused on something that they can work together on and they can solve problems, it will demonstrate and it will get them used to working together to solve other problems and other issues. And no other—I can't think of a better way to give people an incentive to work together and to learn from each other and to learn how to solve problems than to working together in tackling the water issue in that area.

Also, let me note that I certainly agree with our witnesses today that an investment in water is far more important in the long term in peace, for the cause of peace, than simply investment in weapons systems. One is a short-term view of providing weapons to deter conflict between these two groups of people, but in the long term an investment in water will give people a reason not to fight one another.

So I would suggest that we move forward with the spirit of Senator Paul Simon, and let us try to be brutally honest on this issue. Let me note it was a long time before I realized that the Golan Heights issue is not just a security issue. When I went to Israel and talked to both sides, I might add, I was surprised to learn that the Golan Heights is—a major portion of that problem is a water issue in the Golan Heights area.

Let us get serious about this, and let us talk about solving that problem. Let us talk about making sure that when we come up with peace plans, for example, strategies of how to map out a peace plan, that we realize that water is part of that, and that these gerrymandering pictures of the fences and the borders are often designed by parties based on where the water is. While we haven't taken it as seriously as we can—and when I say we, I mean the United States. And I thank you for your leadership, Mr. Chairman, in trying to bring up this discussion, because it is a valuable, valuable asset. Thank you.

Chairman HYDE. I thank the gentleman and would comment, as the brand-new father of triplets, you are remarkably alert. Mrs. Rohrabacher must be doing the heavy lifting. But we will talk about that later.

Ambassador Watson.

Mr. SMITH OF MICHIGAN. Mr. Chairman, can I make just a very brief statement?

Chairman HYDE. Yes. I will get to you in just—

Mr. SMITH OF MICHIGAN. Oh, excuse me.

Ms. WATSON. Thank you, Mr. Chairman. And I want to congratulate the new father of triplets, and give my regards to your wife and your children.

I feel that we have issues that really take front and center stage. And this also takes front and center stage, too, because I think many of the problems that we are facing in this part of the world are contingent on how we treat and how the United States sees and reacts to what is going on.

Water is certainly a major issue, so I do hope that the witnesses will address some of the concerns that I have. According to some sources, each Palestinian is allotted 83 cubic meters of water per year, while each Israeli is allotted 333 cubic meters of water per year. The World Health Organization recommends a minimum domestic water consumption of 100 liters per capita per day. Palestinians average 57 to 76 liters per day per capita. Something is unequal here, and how much of it is political, how much of it is happenstance, how much of it is or relates to accessibility of water.

In the landlocked nations such as Jordan, there is a real problem. Are there political barriers, for instance, that would keep water from being sent from Turkey underground to these areas?

So I do hope, as you make your presentation, you will clarify, because I join my colleagues, That if we are seeking to democratize this area of the world and bring peace, we need to know the correct way to go about doing it. Do we start with water, or do we start, as has been said, with blood in the sand? Where do we begin? And how do we relieve the political aspect of this, take it out of the picture? And how do we work in some kind of unity and solidarity to bring peace and do it with water?

Thank you, Mr. Chairman.

Chairman HYDE. Thank you, Ms. Watson.

Mr. Smith.

Mr. SMITH OF MICHIGAN. Mr. Chairman, very briefly, because we certainly do want to get to our witnesses.

I recently did a presentation on the House Floor on the worldwide problems of water. In fact, this morning we are having a hearing in the Science Committee on some of the problems of our oceans' depletion, contamination, and an inability of the ocean to provide food. And I think even though we are concentrating on the water problems of the Middle East today, water—fresh water is becoming an increasing challenge throughout the world, including in the United States.

And make no mistake, water is food; and these kind of challenges involving water can be more challenging and result in more conflicts maybe than what we are even facing in Iraq today.

And I yield back. Thank you.

Chairman HYDE. Thank you.

[The prepared statement of Mr. Nick Smith follows:]

PREPARED STATEMENT OF THE HONORABLE NICK SMITH, A REPRESENTATIVE IN
CONGRESS FROM THE STATE OF MICHIGAN

I want to thank Chairman Hyde for holding this hearing today. And I would also like to thank our distinguished witnesses for joining us. I look forward to hearing their testimony. As worldwide population expands, the corresponding demand for drinking water, agricultural production, and industry use also expands. Today, we look at the Middle East but fresh water is a worldwide problem

The Middle East has a history of tension over water. Recently Syria and Turkey increased tensions dangerously over rights to the Euphrates River. Saddam Hussein drained the marshes of the Marsh Arabs, ending a way of life that had existed for thousands of years. When you combine the exploding populations of the region with primarily agricultural economies and natural scarcities, water becomes an important geopolitical factor.

Water is already a source of concern in the Jordan Valley. Today Israel is considering partially resolving its water shortage by importing water from Turkey by oil tankers. Gaza has almost no source of safe water, a rising population, and a poor sewage system that has resulted in contamination of ground water. Gaza and Israel have started building desalination plants.

These approaches to today's problems illustrate the range of solutions that need to be considered in the future. Technology, like desalinization and decontamination of sewage water, will increase the amount of water available. Transportation systems will allow people in the region to move water to where it is needed. More water efficient agricultural techniques will lower the need for water. However, in the end, there will need to be cooperation between Palestinians, Jordanians, and Israelis to address their regional problem together. I look forward to hearing about current and future efforts in this area.

Again, I would like to thank the Chairmen for holding this hearing. I applaud his forward thinking on this important issue. This is an issue that must be solved to maintain a sustainable peace, and, by starting now, hopefully we can make progress towards peace through better cooperation.

Chairman HYDE. Mr. Chandler.

Mr. CHANDLER. Mr. Chairman, thank you very much. I am pleased to have the opportunity to hear a little bit today about the water problem in the Middle East. I am aware of the importance of water, and I am aware of many of the things that have gone on in the Middle East to try to deal with that problem. It is going to be interesting to hear what you all have to say. Thank you very much for being here.

Chairman HYDE. Thank you, sir.

Mr. Pitts.

Mr. PITTS. Mr. Chairman, I will waive my right to speak.

Chairman HYDE. You are a gentleman and a scholar. Thank you.

We will have to recess while we vote. I think there are two votes, and then we will return promptly. So I am sorry to put you off for so long, but that is the way this operates. Thank you for your patience.

[Recess.]

Chairman HYDE. The Committee will come to order.

The Chair will introduce the witnesses in the first panel. Mr. John Turner was sworn in as Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs on November 13th, 2001. And prior to his appointment, he was President and Chief Executive Officer of the Conservation Fund, a national nonprofit organization dedicated to public-private partnerships to protect land and water resources. Assistant Secretary Turner received a Master of Science Degree in Wildlife Ecology from the University of Michigan.

Ambassador Satterfield is a career member of the Senior Foreign Service. He served overseas in Jeddah, Tunis, and Damascus, and as American Ambassador to Lebanon. He served on the National Security Council staff from 1993 to 1996, and was Director of the Department of State's Office of Israel and Arab-Israeli Affairs from 1996 to 1998. Ambassador Satterfield assumed the position of Deputy Assistant Secretary on June 25, 2001, and the President has

recently announced his intention to nominate him to be our next Ambassador to Jordan.

Mr. James Kunder is the Deputy Assistant Administrator of the Bureau for Asia and the Near East at the U.S. Agency for International Development. Mr. Kunder was previously Director for Relief and Reconstruction in Kabul, Afghanistan.

We are honored to have you all appear with us today.

And, Mr. Turner, please proceed with a 5-minute summary of your statement, and the full statement will be made a part of record.

STATEMENT OF THE HONORABLE JOHN F. TURNER, ASSISTANT SECRETARY, BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS, U.S. DEPARTMENT OF STATE

Mr. TURNER. Mr. Chairman, Members of the Committee, I certainly appreciate this opportunity to appear before you today to discuss water scarcity and opportunities for cooperation. In my brief comments this morning, I would like to briefly address water availability in general around the globe, transboundary water disputes, and touch upon some of our diplomatic efforts.

Regarding the global water situation, the statistics today are stark, even frightening, as referred to by both Congressman Blumenauer and Congressman Smith. Today more than 1 billion people lack access to safe drinking water, 2.4 billion lack access to basic sanitation. Diarrheal diseases alone cause 1.8 million deaths per year; most are children under 5. I think we would all agree it is totally unacceptable that the world loses 5,000 to 6,000 children each day due to diseases from unsafe drinking water; indeed, the equivalent of two World Trade Centers.

The economic impacts are staggering. The CIA estimates that, by 2015, nearly half the world's population will live in countries that are water-stressed. At the World Summit on Sustainability, Secretary Powell launched the Water for the Poor Initiative, a \$970 million, 3-year initiative focused on the following three areas: Access to drinking water and sanitation, watershed management, and productive water use in agriculture and industry. More than 100 initiatives are being implemented under this program.

In fiscal year 2003, USAID estimates that the U.S. effort on water resulted in more than 19 million people gaining improved access to water and sanitation.

Turning briefly to transboundary water issues, while the mechanics of providing access to water is often a local issue, ensuring adequate supplies of water is often a regional issue. More than 260 of the world's river basins are shared by two or more countries. These shared basins are the home to more than 40 percent of the world's population. As competition over scarce resources continues to grow, tensions are likely to increase.

We have taken proactive measures to address this problem. In 2001, Secretary Powell launched an action plan on transboundary water. It is designed essentially to do three things: Improve conservation and management of water, mitigate tensions associated with shared water, and use water where appropriate as a diplomatic tool to build trust and promote cooperation, as Congressman

Rohrabacher referred to, in those places where other tools might not be available.

Our approach is to support the development of new or to strengthen existing regional institutions to facilitate cooperative management of shared water resources. My colleague Ambassador Satterfield will discuss our work on the Jordan River Basin.

I would like to highlight a couple of examples from the Africa region where several basins are coming under increased pressure and are going to be critically important to regional growth and stability in the future.

Africa's Okavango River originates in Angola and flows through Namibia into Botswana, where it terminates in the Okavango Delta, certainly one of the richest areas of biodiversity in the world. In 2001, the U.S. hosted a study tour for representatives of the Okavango River Basin. We were able to demonstrate U.S. water management practices and create a shared experience that brought the countries closer together.

Mr. Ackerman talked about water scarcity in North Africa. In the case of the Nile, 7 of the 10 countries within the Nile Basin have been at war with themselves or their neighbors within the past 10 years; 6 out of the 10 countries are among the 10 poorest in the world. For many, water is a scarce resource key to economic growth, development and peace in the future. Egypt is particularly dependent on the Nile, and views access to Nile waters as a national security priority.

Consistent with the restrictions on aid to countries in the basin, the U.S. has supported the regional dialogue components of the Nile River Basin through the U.N. Development Program. We have also hosted a study tour for members at the Secretariat of the Nile Basin Initiative to build their capacity to better manage the regional institution.

In closing, Mr. Chairman, fresh water and transboundary water issues are extremely complicated. In cooperation with other Federal agencies and nongovernment partners, the State Department is pleased to be working on a country-by-country basis to, one, improve water management; two, reduce water-related diseases; and, three, mobilize resources for long-term water, wastewater infrastructure; and regionally, to facilitate the management of shared water resources. We believe implementing successful, cooperative strategies and access to fresh water is one of the key paths to a future of a more peaceful world. Thank you, Mr. Chairman.

Chairman HYDE. Thank you, Mr. Turner.

[The prepared statement of Mr. Turner follows:]

PREPARED STATEMENT OF THE HONORABLE JOHN F. TURNER, ASSISTANT SECRETARY,
BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS,
U.S. DEPARTMENT OF STATE

Chairman Hyde and other Members of the International Relations Committee, I appreciate the opportunity to appear before you today to discuss water scarcity, particularly in the Middle East. I would like to briefly address water availability in general, transboundary water disputes, and our diplomatic engagement.

THE GLOBAL WATER SITUATION

The statistics are stark. Today an estimated 1.1 billion people lack access to safe drinking water; 2.4 billion lack access to basic sanitation. Each year, over 3 billion people suffer from water related diseases resulting in 3-4 million deaths. Diarrhoeal

diseases alone cause 1.8 million deaths per year—most are children under five. The economic impact of the health related aspects related to unsafe water is estimated at \$380 billion per year. In agrarian-based developing countries (countries that often lack water storage capacity), GDP often correlates directly to rainfall—when there is rain, the economy prospers; during droughts, it falters. In some countries water mismanagement and water pollution can reduce GDP by more than 2%—enough to keep a country in poverty, or if remedied, set it on a path towards economic growth. Water related disasters between 1992 and 2001 in developing countries accounted for 20% of the total number of natural disasters and over 50% of the all disaster-related fatalities.

As populations continue to grow and current freshwater sources degrade, conditions are expected to worsen. The CIA reports that, by 2015, nearly half of the world's population will live in countries that are water-stressed (i.e., have less than 1,700 cubic meters per capita per year). These data have not been lost on the international community. In 2000, the United Nations General Assembly adopted the Millennium Declaration—agreeing to halve, by 2015, the proportion of the world's population who are unable to reach or afford safe drinking water. At the World Summit on Sustainable Development (WSSD) in Johannesburg in 2000, countries similarly agreed to halve, by 2015, the proportion of the world's population without access to basic sanitation.

To address these issues, Secretary of State Powell launched the “Water for the Poor” initiative at WSSD. The 970 million dollar, three year, initiative is focused on increasing access to drinking water and sanitation, improving watershed management, and promoting productive water use in agriculture and industry. Some of the approaches under this initiative show considerable promise: Point-of-use approaches such as the Safe Water System—a market-based process for developing and distributing technologies for disinfecting water at the household level. Coupled with social marketing and hygiene education, these systems can significantly reduce diarrheal disease and, in some cases, achieve full cost recovery. Development Credit—partial loan guarantees to support local capital investment in water and wastewater treatment infrastructure. These mechanisms can significantly leverage U.S. support and help develop and strengthen local capital markets. Water management plans—working on a country-by-country basis to facilitate the development of integrated water resources management plans to optimize the benefits of water among competing uses. In FY03 alone, USAID estimates that U.S. work on water resulted in more than 19 million people gaining improved access to water and sanitation. We are working to build support for these approaches through several international fora including the World Water Forum, the UN Commission on Sustainable Development, and the G8.

TRANSBOUNDARY WATERS

Ensuring adequate supplies of water for human consumption, agriculture, energy and industry is, in many cases, a regional issue. More than 260 river basins are shared by two or more countries. These shared basins are the home to more than 40% of the world's population. Historically, water has rarely, if ever, been the sole cause for war. To the contrary, water has often been a source of cooperation. Even during times of war, countries have abided by existing water agreements and often continued payments. Discussions over water have often built goodwill and provided a basis for regional dialogue on other issues. That said, the CIA has identified several basins throughout the world where future water conditions and the emerging geopolitical environment may lead to increasing tensions including the Nile, Jordan, Tigris-Euphrates, and Indus.

In 2001, the Secretary of State launched an action plan on transboundary water designed to improve conservation and management of water resources, mitigate tensions associated with shared waters, and use water, where appropriate, as a diplomatic tool to build trust and promote cooperation in those places where other tools might not be available. As a first step, the Department of State with the CIA hosted a workshop with government, military and non-government experts to identify key regions “at risk”. We then worked, in close cooperation with our USAID colleagues, to build programmatic and diplomatic activities to support increased cooperation on shared waters in many of these regions.

Transboundary water disputes are extremely complex, deeply rooted in history, and often take years to decades to resolve. These problems involve sovereignty, individual and collective rights, economic growth and power. These are also extremely technical issues that require an understanding of water flows (both above and below ground), water quality, needs, and uses. Establishing a framework for the management of shared water resources often means defining who gets what water under

what conditions and what constitutes harm or damage should one country pollute waters that may impact another. Often, the first step is years of building trust and cooperation through joint capacity building and information sharing. Over time, the conversations can become more regularized and substantive—covering a range of water-related issues including health, energy, agriculture, and trade.

The Department is directly or indirectly supporting work in several basins throughout the world. My NEA colleague David Satterfield will discuss our work in the Jordan River Basin. I would like to give you a few examples of what we are doing in Africa—a region where several basins are coming under increasing pressure and are going to be critically important to regional growth and stability.

The Okavango River originates in Angola and flows through Namibia into Botswana where it terminates in the Okavango delta—one of the richest areas of biodiversity in the world. Preserving the ecosystem is important, as is meeting the growing needs for water in all three countries. Considerable benefits could be derived from strengthened basin-wide planning and management. The United States has helped catalyze regional dialogue to build trust and establish a foundation for regional initiatives. In 2001, the United States hosted a study tour for government representatives of the Okavango River Basin Commission (OKACOM). The tour demonstrated U.S. water management practices, including our cooperative institutions with Mexico and Canada, and created a shared experience that brought the countries closer together. Due, in part, to these efforts, the countries have re-established regularized meetings of OKACOM and are now discussing several joint initiatives. Many challenges remain, but the countries are working together in a productive fashion and several donors are engaging to protect the human and environmental needs of the Okavango basin.

Seven of the ten countries within the Nile Basin have been at war with themselves or their neighbors within the past ten years. Six out of the ten countries are among the ten poorest in the world. For many, water is a scarce resource key to economic growth and development. Egypt, the downstream riparian, is particularly dependent on the Nile and views access to Nile waters as a national security priority. (Egypt has a 1959 agreement with Sudan that established specific water rights. No such agreement exists among all 10 of the Nile riparian countries.) Cooperation is critical to optimizing the potential benefits of the river system among the competing needs. The riparians recognize this and have recently launched the Nile Basin Initiative to develop a framework for joint management of the basin's resources as well as bi-lateral, sub-regional and regional development projects.

Consistent with restrictions on aid to countries in the basin, the United States has supported the regional dialogue components of the Nile Basin Initiative through the United Nations Development Program. The United States also hosted a study tour for the recently established secretariat of the Nile Basin Initiative to build its capacity. The work is conducted in partnership with the World Bank and several other donors active in the region. Several U.S. agencies including USAID and the Department of the Interior are involved. These efforts are beginning to show promise. Through the Nile Basin Initiative, the Nile countries have defined a shared vision for the development of the basin and have developed several joint projects. The countries have also been discussing a new legal framework. The United Nations Convention on the Law of Non-navigational Uses of International Watercourses has been helpful in this regard.

Adopted by the United Nations General Assembly in 1997, the Convention provides a framework for managing shared waters, including general principles on equitable and reasonable utilization of international watercourses, an obligation not to cause significant harm and a general obligation to cooperate. While the Convention has not entered into force, it has served as a useful guide to countries negotiating international watercourse agreements. In the case of the Nile, the riparian countries used the Convention as a starting point to frame their discussions.

These are just two examples of U.S. efforts to facilitate cooperation among riparian states on transboundary watercourses. The Department, in partnership with USAID, U.S. agencies, and other donors, is actively engaged in other basins throughout the world. We have also established the Global Water Alliance, a group of donors that meet informally to share experiences and further diplomatic and development cooperation on transboundary rivers. These efforts complement U.S. engagement with a broad array of international organizations, financial institutions and intergovernmental organizations that address water issues.

Chairman HYDE. Ambassador Satterfield.

**STATEMENT OF THE HONORABLE DAVID M. SATTERFIELD,
DEPUTY ASSISTANT SECRETARY, BUREAU OF NEAR EAST-
ERN AFFAIRS, U.S. DEPARTMENT OF STATE**

Mr. SATTERFIELD. Thank you, Mr. Chairman, Members of the Committee. It is a pleasure to talk to you this morning concerning water in the Middle East, and we certainly do agree with the views expressed by the Chair and Members of the Committee present regarding the importance of addressing this issue in as comprehensive and multilateral fashion as possible.

I would like to take just a few minutes to briefly summarize the three topics addressed in my written statement: The water situation in the Jordan River Valley, water in the peace process, and the future of water in cooperation with the region.

The climate in the Jordan River Basin, which is the area at focus in the peace process, is semiarid to arid. In addition to inadequate precipitation, seasonal and annual variations, along with the distribution of rainfall, it makes managing water resources extremely complicated and difficult. The cycle of multiple drought years followed by 1 or 2 years of good rainfall, so familiar in the American West, is unfortunately also the norm in the Jordan Basin. The net result of this is that the people in Israel, Jordan, the West Bank, and Gaza live in a constant state of water scarcity. With population growth and economic development in the future, water resources in the basin will come under even more and still greater increasing stress.

With respect to the peace process, water has been discussed in a variety of multilateral fora in the peace process as well as in bilateral discussions. The bilateral track is where negotiations on the broad spectrum of political issues, including those related to water, have taken place. Both the Israel-Jordan peace treaty and the Israel-Palestinian interim agreement of 1995 contain extensive water provisions in which, among many other things, joint water committees were established to implement the provisions of the agreements.

The Israel-Jordanian Joint Water Commission and the Israel-Palestinian JWC have continued to operate without pause since agreements were signed, and the United States has worked closely with both institutions to assist the parties in agreement implementation.

In addition to the bilateral track process, in early 1992 we established the multilateral track of the peace process consisting of five working groups to focus on technical issues. Despite the fact that those working groups have not formally met since late 1996, projects which were initiated by the Water Working Group have remained active and have continued to be productive. The projects focus mostly on the needs of Jordanians, Israelis, and Palestinians. The robustness, the success of this multilateral approach is clearly demonstrated by the fact that in the last 3½ years of violence, during which time political negotiations have largely gone into abeyance, Israelis, Palestinians, and Jordanians continue to work together on the multilateral water projects. The regional parties themselves clearly believe these projects are too important to allow them to stop. The U.S. and other donors and supporters agree and have continued their engagement and support of the projects.

There is one other class of regional water engagements I would like to mention. Over the years there have been numerous ideas for very large-scale regional water infrastructure projects whose objective would be to generate significant quantities of additional water to meet the needs of Palestinians, Jordanians, and Israelis. While such projects might in principle be able to alleviate water shortages in the region, there are several reasons why, as a practical matter, none of these projects has yet been realized.

First, they are extremely expensive. Second, these kinds of projects can take on a more political character as they raise by their very scope political concerns among parties that have not yet concluded final peace agreements. And, finally, there are many unresolved practical and technical questions surrounding these projects, including environmental concerns and questions of ultimate economic viability.

I would like to say a few words about one project idea currently being discussed, the Red-Dead conveyance project. This project is designed in principle to move Red Sea water from the Gulf of Aqaba some 180 kilometers north to the Dead Sea. Cost estimates for the full project range from 4- to \$5 billion. As currently envisioned, the project would generate 850 million cubic meters of desalinated water a year for use by Jordan, Israel, and Palestinians.

Given the scale of the Dead-Red project and the many outstanding questions surrounding it, the Department of State has not yet taken a position on whether the project could or should be pursued. Rather, we have told the three parties involved, Israelis, Jordanians, Palestinians, that if they want to work together to explore this project in more detail, and if they can agree on how they will work together, we would be willing to work with them. The World Bank has taken a similar position with respect to the parties and the Bank's own participation in feasibility studies.

In closing, Mr. Chairman, let me just reemphasize water cooperation among Jordanians, Palestinians, and Israelis is an active and ongoing pursuit that takes place today through a number of bilateral and multilateral mechanisms. The regional parties, through their work together, continue to demonstrate that the old adage about the next war in the Middle East being over water is not a given. Thank you.

[The prepared statement of Mr. Satterfield follows:]

PREPARED STATEMENT OF THE HONORABLE DAVID M. SATTERFIELD, DEPUTY ASSISTANT SECRETARY, BUREAU OF NEAR EASTERN AFFAIRS, U.S. DEPARTMENT OF STATE

Thank you, Mr. Chairman. Water is a topic of great importance in the Middle East, and the United States has long recognized the key role water plays in relations between Middle East neighbors and in economic development of their societies. Since the October 1991 Madrid conference, water has been an integral part of the peace process, and the United States has worked continuously with parties in the region and members of the international donor community on a wide range of water issues. Over the years, the work the regional parties have done together on water, both among themselves and with the support and participation of the international community, continues to demonstrate that the old adage about the next war in the Middle East being over water is not a given. Rather, our experience in the Middle East clearly illustrates that water can be a positive force for cooperation and does not have to be a negative force resulting in conflict.

Before expanding on these thoughts, I would like to briefly discuss the general water situation in the region. Then I will spend a few minutes describing in more

detail how water fits into the peace process, including the ongoing cooperation in the multilateral track of the process. And finally, I would like to comment on the future of water and cooperation in the region.

WATER IN THE JORDAN RIVER BASIN

As established at the Madrid conference, the core parties to the peace process are Israel, Jordan, the Palestinian Authority, Syria, and Lebanon. From a water resources perspective, then, the focus is on the Jordan River Basin. In the Middle East generally, and the Jordan basin specifically, the climate is semi-arid to arid, with all the limitations on water availability such a climate implies. In many respects, the water resources situations in the Jordan basin and the western United States are similar. In addition to not receiving adequate quantities of precipitation generally, the temporal and spatial variability of rainfall in both the Jordan basin and western United States make managing water resources quite complicated and difficult. In the Jordan basin, it rains only in the winter, with the rainy season spanning from approximately November through March. No rain falls at all during the summer months when demand for water is the highest. In addition to dramatic seasonal variations, annual variations in total rainfall are equally dramatic. The cycle of several years of drought followed by one or two years of good rainfall that is so common in the western United States is also the norm in the Jordan basin. The Jordan basin is just coming off two relatively wet winters (2002–2003 and 2003–2004). However, the previous three winters—1999–2000, 2000–2001, and 2001–2002—were very dry, and all governments instituted cuts in water allocations, especially to agriculture, in response to the drought conditions. In addition to temporal variability, the spatial variability in rainfall further complicates water management. Rainfall is highest in the northern Jordan basin, and decreases steadily as you go south. However, most water consumers live in central and southern parts of the basin. Thus, water must be moved from where it falls to where it is consumed.

As suggested above, the people in Israel, Jordan, and the West Bank and Gaza live in a constant state of water scarcity. A widely used rule of thumb is that a population is considered to be in a state of “water stress” if the average annual per capita availability of water is below 1,000 cubic meters. Israeli, Jordanian, and Palestinian average annual per capita availabilities are all significantly below that level. Israel, which has the most advanced water infrastructure and water management capabilities in the region, has an average annual availability of only some 250–300 cubic meters per capita. Jordan, at some 170–200 cubic meters per capita, and the Palestinians in West Bank and Gaza, at some 70–90 cubic meters per capita, are under even greater water stress. By comparison, average annual water availability in the United States is on the order of 7,000 cubic meters per capita.

Most of the naturally occurring water resources available to Israelis, Palestinians, and Jordanians are already being utilized. With population growth and further economic development, in the future those water resources will come under increasing stress. Since the mid-1990’s, the United States, through its bilateral foreign aid programs, has provided substantial assistance to the Jordanians and Palestinians in the water sector. Through our support for major water infrastructure projects and projects designed to enhance the water authorities’ capabilities for improved water management, we have helped the parties make better use of their water resources. My USAID colleague Jim Kunder will provide more details on those programs.

WATER IN THE MIDDLE EAST PEACE PROCESS

Water has been discussed in a variety of fora in the peace process. In the bilateral track, where Israel has negotiated bilaterally with its Arab neighbors, negotiations on the broad spectrum of “political” issues, including those related to water, have taken place. The various agreements that have been concluded to date have arisen out of these negotiations. The October 1994 Israel-Jordan Treaty of Peace (Article 6 and Annex II) contains an extensive discussion of water issues of common interest to both countries. Through the work of the standing Israel-Jordan Joint Water Committee that was established under the treaty, the two countries have been implementing the treaty’s various water provisions over the last ten years. Similarly, the Israelis and Palestinians have been working together through an Israeli-Palestinian Joint Water Committee on water issues that were addressed in Article 40 of their September 1995 Interim Agreement. The United States has assisted the parties in implementation of their agreements, when requested. In the case of the Israeli-Palestinian interim agreement, the agreement established a formal U.S.-Palestinian-Israeli Trilateral Water Working Group to assist with implementation of the agreement’s water provisions. The trilateral group has met regularly over the last 9

years. In the case of the Israel-Jordan treaty, though no formal trilateral mechanism was established, we have regular discussions with Israeli and Jordanian water officials concerning implementation of the treaty's water provisions. Any future Israeli-Syrian and Israeli-Lebanese treaties, as well as any Israeli-Palestinian permanent status agreement, also will contain substantial water provisions.

In addition to the bilateral track of the process, in early 1992, the United States and Russia, as co-sponsors of the peace process, established what is known as the multilateral track of the peace process. As constituted at that time, the multilateral track consisted of five working groups focusing on: water resources; the environment; refugees; regional economic development; and arms control and regional security. The multilateral track was designed to: 1) support the bilateral track of the peace process; 2) bring regional parties together to explore practical, technical solutions to key regional problems; and 3) build confidence among the parties to create a dynamic that reinforces cooperation and peace. Unlike the bilateral negotiations that involve only Israel and its four immediate neighbors, in the multilateral negotiations, we broadened participation to include a total of fifteen regional delegations and 34 non-regional delegations. The Multilateral Working Group on Water Resources' agenda included the following four topics under which activities were conducted: 1) enhancing water data availability; 2) principles of water management, including conservation; 3) enhancing water supply; and 4) principles of regional cooperation. In the early days of the working group, our initial efforts were modest, as it took time for the regional participants to adjust to and become comfortable with the idea of cooperating together. Over time, the group developed larger projects, several of which have continued to this day.

Before briefly describing the current projects, let me say a few words about the multilateral process itself. Through 1996, each of the multilateral working groups met regularly in plenary session. Individual project activities took place on a regular and frequent basis between plenary meetings. While the project work was kept focused on technical issues, holding the plenary meetings was more closely tied to the political climate in the region. In late 1996, the political situation took a downturn, the bilateral negotiations slowed, and we had to stop holding plenary sessions of the working groups. Unfortunately, we have not been able to hold any plenary sessions since that time. Despite the lack of any plenary meetings of the Working Group on Water Resources since 1996, projects initiated by the working group have remained active and productive. Projects have continued first and foremost because the regional participants—the projects focus mostly on the needs of the Jordanians, Israelis, and Palestinians—have decided the projects are too important to allow them to stop. And the United States and other donors have agreed it is important for the projects to continue and so have continued to support the projects.

The three main water projects currently active are: 1) the Regional Water Data Banks project; 2) a Public Awareness project; and 3) the Middle East Desalination Research Center.

1) In the Regional Water Data Banks project, Israeli, Jordanian, and Palestinian water officials—supported by the United States, the European Commission, France, and the Netherlands—work together to increase their capabilities to gather, store, and analyze a wide range of water data. The issue of sharing water data is considered political, and thus, the project does not directly address sharing data. Rather, the project focuses on technical aspects of water data, with the objective of giving the regional parties the technical tools they need to share data that are meaningful, whenever the political decision to share data is made. In the early days of this project, as with most other working group projects, most ideas for project activities came from donors. Over time, the regional parties have taken on more responsibility for guiding the project. Now, the Israelis, Jordanians, and Palestinians meet among themselves regularly to discuss and agree on the direction for the project and new activities they want to propose to the donors.

2) At the beginning of the Public Awareness project, the Palestinian, Jordanian, and Israeli participants agreed the project should focus on increasing the awareness of water issues among children in the region, since that segment of the populations will be the decision makers of tomorrow. With U.S. support, the parties have produced: a) a public awareness video targeting children emphasizing the scarce nature of water in the Middle East and the need to use water wisely; and b) more recently, a student resource book on water (in Arabic, Hebrew, and English versions), which the parties have introduced on a pilot basis into a small number of their schools. The latest project activity just now starting keeps the focus on schools and will design and install rain harvesting systems in select schools. Teachers and students will use these systems for in-

structional purposes, and, in addition, the systems will provide additional water for the schools' use.

3) The Middle East Desalination Research Center, which has its headquarters in Muscat, Oman, has been operating since 1997. The United States, Oman, Israel, Japan, Korea, and the European Commission have provided support to the Center. The Working Group established the Center in recognition of the fact that although most of the world's desalinated water production is in the Middle East, most of the expertise and technological capacity resides elsewhere. The Working Group agreed that the Middle East will need to make greater use of desalination in the future but that the cost of desalination will have to come down for its use to become more widespread. All the Center's activities—the training programs, the outreach and information sharing programs, and the cooperative research program—are designed to increase desalination expertise in the Middle East and to help address the issue of cost reduction.

In addition to projects mentioned above, I should mention two other programs where the United States also has supported regional water-related activities. Under the Multilateral Working Group on the Environment, we have supported a number of activities on the important issue of wastewater treatment and reuse. Also, USAID's Middle East Regional Cooperation (MERC) Program, which is not part of the peace process per se but which funds cooperative research projects between Israeli and Arab scientists, has supported a variety of water projects.

To sum up the multilaterals, the model for cooperation incorporated in the multilateral peace process is based on the premise that it is possible to create synergies through awareness of common problems, such as water. By focusing on problems related to regional water scarcity, the participants in the process have been able to transcend the realm of competing interests and create a situation in which all parties share benefits. Because the multilateral water working group has kept its work focused on technical issues (while leaving the "political" water issues to the bilateral track), the regional projects developed by the Working Group on Water Resources have been able to withstand the vagaries of the political process. The robustness and success of this approach is most clearly demonstrated by the fact that during the last three and a half years of violence and instability in the region due to the Intifada, during which time political negotiations have largely been in abeyance, Israeli, Palestinian, and Jordanian water officials and experts continue to work together on a range of regional water projects.

THE FUTURE OF WATER AND COOPERATION

To date, the multilateral water projects have focused on capacity building and technical assistance efforts, as described above. One reason is that the financial resources donors have available for regional activities are generally limited. For the United States, we have been able to provide on the order of \$1–2 million per year for the regional water projects we support. However, despite these relatively modest efforts, the importance of the cooperative efforts on water the Israelis, Palestinians, and Jordanians have undertaken with our support (and that of other donors) should not be underestimated. The parties have told us repeatedly that the projects provide them with important practical benefits, and they have urged us to continue our support. We have assured the parties that as long as they continue to want to work together, we will continue to work with them.

As good and productive as the multilateral water projects have been, since the projects are technical in nature, we cannot expect them to resolve the broader political aspects of water. Thus, only when the Palestinians and Israelis get back to the bilateral negotiating table will it be possible for them to come to agreement on their outstanding political water issues such as water allocations. However, even though they do not directly address the bilateral water issues, the multilateral water projects do provide important technical assistance that will be helpful to the parties whenever they do get back to the negotiating table. Additionally, in the interim, the regional water projects help to maintain open channels of communications between the parties, which should also help facilitate the restart of the bilateral water negotiations.

There is another class of regional water projects I would like to mention. Over the years there have been numerous ideas for large scale regional water infrastructure projects whose objectives would be to generate significant quantities of additional water—on the order of 800 million to 1 billion cubic meters per year—to meet the water needs of the Palestinians, Jordanians, and Israelis. These ideas have included: 1) large scale desalination facilities on the Mediterranean coast; 2) large scale importation of water from Turkey via pipeline or canal; and 3) the Red-Dead conveyance project. While such projects might in principle be able to help alleviate

water shortages in the region, there are a number of reasons why none of these projects have progressed very far. First, these projects would be very expensive, costing anywhere between \$2 to 5 billion or so. Second, by their very nature, these kinds of projects take on a more "political" character, as they can raise political concerns among parties that have not yet concluded peace agreements. And third, there are many outstanding issues related to some of these projects, including environmental concerns and questions of economic viability.

Let me say a few words about the Red-Dead conveyance project, since it is an idea currently being discussed. The project is designed to move Red Sea water from the Gulf of Aqaba through a pipeline/canal conveyance approximately 180 kilometers to the Dead Sea. Since the Dead Sea is some 410 meters below sea level and the Gulf of Aqaba is at sea level, water dropping through that 410 meters of elevation can be used to generate hydropower, and the power can be used to desalinate a portion of the Red Sea water. The project as currently envisioned would generate 850 million cubic meters of desalinated water a year for use by Jordan, Israel, and the Palestinian Authority. In addition, a portion of the Red Sea water would flow directly into the Dead Sea, so that the level of the Dead Sea, which has been dropping almost 1 meter per year for the last thirty years or so, could be controlled. Proponents of the project argue that this project would reverse the negative environmental impacts produced by the continual lowering of the level of the Dead Sea.

The scale of the Red-Dead project is large, to say the least. If the envisioned desalination capacity were realized, the resulting desalination facility would be 5-6 times larger than the world's largest desalination facility currently in operation. And there are many crucial questions about the project that remain unanswered, such as: 1) will the introduction of Red Sea water into the Dead Sea have a major negative impact on the chemistry of the Dead Sea water?; 2) while introducing Red Sea water into the Dead Sea to control the level of the Dead Sea may alleviate some environment problems, will such introduction cause other negative environmental impacts?; 3) what will the environmental effects at the head of the Gulf of Aqaba be, where the Red Sea water will be siphoned into the project?; and 4) will the cost of the desalinated water delivered to customers in Amman or other population centers be too expensive for consumers?

Given the scale of the Red-Dead project and the outstanding issues surrounding it, the State Department has not taken a position on whether the project could or should be pursued. Rather, in our discussions with the Jordanians, Israelis, and Palestinians, we have told them that if they want to work together to explore this project idea in more detail, and if they can agree on how they will work together, we would be willing to work with them, if they so desire. Since last year, the parties have been discussing a terms of reference for a project feasibility study. However, up until now, they have not come to final agreement on a T.O.R., largely because of some Israeli and Palestinian political concerns.

In closing, I hope my discussion has demonstrated that water cooperation among the Jordanians, Palestinians, and Israelis is an active and ongoing pursuit, which takes place through a number of mechanisms. The governments in the region have recognized that they must continue to cooperate in order to be able to provide water for their people, regardless of the political situation in the region. And the United States, as it has done for so many years, will continue to work with the parties to facilitate their cooperation, and we will continue to encourage the international donor community to do so as well.

Mr. SMITH OF MICHIGAN [presiding]. Thank you. Mr. Kunder.

STATEMENT OF JAMES KUNDER, DEPUTY ASSISTANT ADMINISTRATOR, BUREAU FOR ASIA AND THE NEAR EAST, U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

Mr. KUNDER. Thank you, Mr. Chairman. I will summarize my written statement very briefly.

The people of the Middle East, as the Committee has pointed out, live in one of the most watered deprived regions of the world. Increasing water shortages and the climbing cost of supply are very serious constraints to economic growth in the region. This situation calls for concerted action by government, water users and donors working in partnership, and in that context we much appreciate the opportunity to testify here today.

Responding to these water challenges is a top priority for USAID assistance to the region. Our programs in Jordan, West Bank and Gaza, Egypt and Lebanon focus on increasing access to water and wastewater services, improving the quality and expanding the reuse of wastewater, developing alternative sources of water through desalination, reforming water policy and strengthening water institutions. In this regard, we are expending between fiscal year 2003 and 2005 in excess of the \$970 million that was pledged in the President's Water for the Poor Initiative in Johannesburg in 2002.

Despite all the conservation measures and without downplaying the importance of those measures, in the Middle East demand will eventually outstrip supply and new sources of water will be needed. Additional supplies can be obtained through the treatment and reuse of domestic and industrial wastewater and through desalination of brackish water and seawater. USAID is supporting both of those developments in the Middle East.

In closing, many countries in the Middle East face chronic water shortages that pose serious constraints to economic development. Responding to these challenges will require new approaches that emphasize integrated water conservation and management, more efficient use of water, collaborative problem solving of water disputes and the development of alternative sources of water that I mentioned earlier.

Just as the U.S. Government and other nations once led a green revolution to increase water production around the world, these new approaches in their totality, implying conservation, production and management, are so significant that full implementation of these initiatives would amount to a veritable blue revolution. The Administration is beginning to put in place the elements of that blue revolution with our current programs in the Middle East.

Specifically, in the Middle East regional cooperation will become increasingly important. USAID, working in partnership with the State Department, will continue to work with our partners to help improve management and increase access to water supply and wastewater services. The challenges are great and the cost of inaction is unacceptable.

Thank you.

[The prepared statement of Mr. Kunder follows:]

PREPARED STATEMENT OF JAMES KUNDER, DEPUTY ASSISTANT ADMINISTRATOR, BUREAU FOR ASIA AND THE NEAR EAST, U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

SUMMARY

Chairman Hyde, Members of the Committee, I am pleased to be here today, with my State Department colleagues, to testify on the subject of water scarcity in the Middle East. The governments of the Jordan River Basin, Jordan, Israel, Lebanon, Syria, and the West Bank and Gaza, face a looming water crisis. In this arid region, supplies of renewable water are limited while demand is rapidly rising, largely due to population growth, agricultural use, and increasing industrialization and urbanization. As a result, per capita water availability continues to fall. Daily per capita water consumption is quite low throughout the region, and the cost of supplying water continues to increase. The extreme water scarcity and increasing costs of supply are very serious constraints to economic growth across the region. In addition, with increasing scarcity, pressures to overexploit groundwater resources will grow, and competition over water among different sectors and among countries may intensify.

The challenges facing the water sector in the Middle East are daunting. Continuing past practices may plunge the region deeper into crisis, so the cost of inaction is unacceptable. At the global level, the Bush Administration announced an initiative to improve sustainable management of water resources at the World Summit on Sustainable Development in Johannesburg in 2002. This initiative will accelerate and expand international efforts to achieve the goals of the UN Millennium Declaration including halving, by 2015, the proportion of people unable to reach or afford safe drinking water. Through the U.S. Agency for International Development (USAID), the United States will invest \$970 million over three years (2003–2005) for enhancing access to clean water and sanitation services, improving watershed management, and increasing the productivity of water. For FY 04, estimated obligations in the Middle East (over \$180 million) account for more than half of USAID's total funding for drinking water supply projects and related activities.

Although USAID's investments in the water sector are strategic and substantial, to raise region-wide coverage to 90 per cent for water supply and 80% for sewerage and sanitation, the World Bank estimates that water investment requirements are on the order of \$5 billion annually. Funds from public sector donors alone are expected to meet less than 5% of the increased financing requirements. Access to clean drinking water and sanitation for much of the world, including the countries of the Middle East, will only become a reality through substantial municipal and private sector investment.

The critical water situation throughout the Jordan River Basin calls for concerted action by governments, water users, donors and the private sector working in partnership. New approaches are needed that emphasize integrated water management, collaborative problem-solving at all levels, conservation of water quality and quantity, more efficient use of water, and development of alternative sources of water. In response, USAID is committed to increasing the quality and quantity of water in the West Bank and Gaza, Jordan, Egypt, and Lebanon. At present, our efforts focus on increasing the supply of water, improving treatment and reuse of wastewater, and encouraging effective management of water systems.

USAID also believes that regional solutions play an important role in resolving the serious water shortages in the Middle East. Although regional cooperation has proven challenging, I agree with Deputy Assistant Secretary Satterfield that water can provide both an opportunity for cooperation as well as a source of tension. The Bush Administration endorses and supports regional approaches that bring together water resource managers and experts from neighboring countries, build partnerships and networks that promote trust, confidence, and understanding of one another's problems, and provide opportunities for countries to work together to solve water-related problems.

PRIORITY WATER RESOURCE ISSUES:

Before providing a regional perspective on USAID's activities in the water sector, I would like to briefly review the general water situation in the region.

Three priority issues dominate water resources management challenges in the Middle East: (1) water shortages; (2) degradation of water quality; and (3) public and private sector resource management performance.

WATER SHORTAGES

Problems of water scarcity and pollution can be found throughout the world, but are particularly acute for the people of the Jordan River Basin (Jordan, Israel, Syria, Lebanon, and the West Bank and Gaza). According to statistics published by the World Bank, a country or region will experience water scarcity when renewable water supplies fall below a threshold of 1,000 cubic meters per person per year. Water consumption in the Jordan Valley currently falls below the absolute scarcity level of 500 cubic meters of water per person/year. At these levels, chronic water shortages are a fact of life. Within the Basin, in parts of Jordan, Israel, and Gaza, more water is being withdrawn from their rivers and aquifers than is being replenished.

When water supplies become scarce, pressure to exploit groundwater and other resources unsustainably will grow, and competition can become intense. In recent years, much of the water in the Jordan River basin has been used for agriculture, with approximately 30% allocated to municipal and industrial uses. However, as populations and urban areas grow, the demand for water resources is likely to increase, requiring shifts away from agriculture—a socially and politically sensitive issue. Addressing water use in agriculture will be a crucial area for future water use management. Encouraging this shift towards higher value uses will require a number of actions including reduction of subsidies; increased technical efficiency of

irrigation; development of strategies to regulate, monitor, and control groundwater extraction; and potential reallocation of water from low-value irrigation by trading water rights.

The governments of the Jordan River Basin are faced with the reality that much of the available water is of a transboundary nature. Thus regional cooperation, though difficult, is vital. Where water shortages coincide with other sources of tension, the threats to regional security are most worrisome.

DEGRADATION OF WATER QUALITY

Water contamination by fertilizers and pesticides; dumping of municipal and industrial wastewater into canals, rivers, and lakes; and uncontrolled solid waste dumping along river banks—all of these actions further reduce the availability of freshwater water suitable for domestic and agriculture use and increase the cost of treatment and reuse of water. In addition, water contamination due to inadequately treated wastewater affects public health, particularly of children, who are the primary victims of waterborne disease. This situation has resulted from a number of factors, including lack of access to capital, inadequate regulatory and enforcement capability, and general lack of public awareness and concern.

PUBLIC AND PRIVATE SECTOR RESOURCE MANAGEMENT PERFORMANCE

Lack of effective mechanisms to plan and manage water resources in a collaborative and integrated fashion and to resolve disputes over water resources is a key challenge to improving water resources management. Such mechanisms are critical to promoting institutional coordination and overcoming the bureaucratic and political realities that impede integrated water resources management in developing countries. Overlapping mandates and jurisdictions frequently contribute to fragmentary, unfocused water management programs, counterproductive competition and duplication of efforts. In addition, competing and powerful vested interests frequently stand to lose, and therefore often oppose changes in water resource management arrangements. This leads to government gridlock and inaction or to disputes within and/or among Ministries, between governments and communities, between governments and particular sectors using water, or even between governments across national borders.

USAID RESPONSE

As Israelis, Palestinians, and Jordanians face increasing water scarcity and shortages, pressure to overexploit groundwater and other water resources will grow, intensifying competition for scarce resources at local and national levels.

Addressing the water crisis in the Middle East will require concerted, coordinated action along a number of fronts. New approaches are needed that emphasize integrated water resources management, collaborative problem solving at all levels, more efficient use of water, development of alternative sources of water, and regional cooperation. Changes in the way water is valued, managed, and conserved are key. Governments need to improve water planning and management, support policy reforms to encourage decentralization and public-private partnerships, and develop appropriate water pricing and cost recovery systems to ensure more sustainable delivery of water and sanitation services. The role of the private sector in this process is vital.

What is the Bush Administration doing to respond to these challenges? The answer is a great deal. Given the central role of water in the Middle East, USAID has made water a top priority. In FY 2004, excluding Iraq, USAID expects to obligate over \$180 million for water supply and sanitation programs in the Middle East. These programs in Jordan, West Bank and Gaza, Egypt, and Lebanon focus on increasing access to water and wastewater service, improving the quality and expanding the reuse of wastewater, developing alternative sources of water through desalination, reforming water policy and strengthening water institutions.

Jordan

Jordan is one of the ten most water-deprived countries in the world. Available per capita freshwater lags far behind most other countries. Daily water consumption is also quite low, and the cost of supplying water continues to rise. This extreme scarcity and the increasing cost of supply of water are very serious constraints to Jordan's economic development. Historically, USAID has emphasized water as a central concern because failure to effectively manage scarce water resources would undermine all other aspects of development in Jordan. Already, existing aquifers are being depleted at a rapid rate and water rationing is a fact of life for most Jordanians.

Annual water demand in Jordan is projected to increase to 1.3 billion cubic meters by 2005, far above the current 750 million cubic meters now available on a sustainable basis. Per capita freshwater potential in Jordan also lags far behind that available in most other countries: for Jordan, it is on the order of a meager 170 cubic meters annually, a third of that available in Israel and Syria, a sixth of that available in Egypt, and less than a fortieth of that available in the United States. Despite this grim situation, more than half the water entering the Amman water system is unaccounted for, with half of this loss attributed to administrative losses (e.g., inadequate billing and collections) and the other half due to leakages. Improving the use of existing water supplies will help stretch scarce water resources even further. This includes reducing losses due to physical leaks, contamination and poor irrigation practices.

Jordan has developed a 14-year, \$5 billion plan to guide water investments in the coming years. The plan hinges on two main approaches to narrowing the gap between water supply and water demand. First, it entails improved water supply management. Second, it involves increased water use efficiency. Both approaches aim at ensuring that scarce water supplies are stretched further. Both approaches also figure prominently in USAID's own water sector program. In addition, through its involvement in improving wastewater management, USAID is helping abate serious environmental degradation while augmenting water supplies from a source that would otherwise be wasted.

Through 1998, USAID's activities to strengthen water institutions focused on improving data collection and analysis, and installing new information management systems for the Ministry of Water and Irrigation (MWI), the Water Authority of Jordan (WAJ) and the Jordan Valley Authority (JVA) and developing key water policies. During 1999, USAID designed and began a new water policy implementation program focused on reducing groundwater depletion and optimizing the reuse of treated wastewater. USAID also initiated a new program to encourage private sector participation in the water sector and an activity to strengthen the government's capability to develop, contract and manage major infrastructure projects. With USAID assistance, the MWI has a major Build-Own-Transfer (BOT) wastewater project and supports the operation of the first decentralized, public water company for Jordan—the Aqaba Water Company.

To improve the efficiency of water use in the agriculture sector, USAID is providing a variety of technical assistance focused on restructuring irrigation tariffs, increasing cost recovery, and stimulating internal competitiveness for JVA. In coordination with other donors, USAID is also engaged in policy dialogue with the Government of Jordan (GOJ) on the need for significant structural reforms in the irrigated agriculture sector.

Improving the quality of wastewater is also a USAID priority. Four major projects are currently in the design or construction phase. Construction of a new wastewater treatment plant near Petra is now complete. The plant provides modern wastewater facilities for four communities and helps to reduce environmental degradation around the Petra National Park, a World Heritage Site. Construction is underway on wastewater conveyance and treatment facilities for expansion of the wastewater facility in Aqaba. USAID is also supporting the construction of a new wastewater treatment plant to replace the currently overloaded plant at As-Samra. When complete in 2006, this private sector operated, BOT plant will serve over 2 million residents of Greater Amman and Zarka. Both these projects will help Jordan meet its commitments under the 1994 Peace Treaty with Israel to reduce pollution in the Gulf of Aqaba and the Jordan River. Lastly, contracting is underway on a construction contract for a wastewater treatment plant for Mafraq in northern Jordan.

West Bank/Gaza

The West Bank and Gaza suffer from a chronic water shortage. Hundreds of rural villages across the West Bank have no piped water, and hundreds more have it only in the winter. Residents typically use less than 30 liters per capita per day because of the high costs of water delivered by truck. Fewer and fewer families can afford basic water supplies. The continuing shortages constrain economic growth and damage the environment and health of Palestinians.

Water quality is also poor and much of the water being used is untreated. About two-thirds of drinking water in rural households is contaminated with bacteria. Palestinian ground water supplies have increasingly become polluted as a result of agricultural chemicals, inadequate sewage treatment and over-pumping of wells. Untreated sewage is dumped in valleys and the Mediterranean Sea, decreasing the quality of the already inadequate groundwater supply and polluting the soil, sea, and coastline.

In response, USAID is implementing a multi-year program that combines the rapid development of new water sources, improved systems for water distribution and management, and wastewater treatment. Despite the challenges posed by the Intifada (including shortages of critical building materials, limited access to the work site, and physical danger to workers), well drilling, pipeline construction, and delivery of essential water infrastructure continues with impressive results.

In Hebron, the interests of Palestinians and Israelis have merged and led to the design of the Hebron Wastewater Treatment Plant. This \$50 million USAID project will address Israel's concerns to protect the shared aquifer and eliminate stream pollutants in the northern Negev. For the Palestinians, the plant will protect public health, clean-up the environment, and develop agricultural uses for water which is now wasted. This is a clear example of how water projects can serve as a mechanism for cooperation in the Middle East.

In the West Bank, the heightened security situation and economic crisis have decreased access to water for the people in rural villages. Through the \$50 million West Bank Water Supply program, USAID has dramatically increased the amount of water available to Palestinians in the West Bank. In a region chronically short of this vital resource, USAID continues to address this problem by drilling new wells; constructing reservoirs and transmission systems to take water from wells to towns and cities; and building distribution systems to deliver water to homes. Through USAID's \$9 million Village Water and Sanitation program, construction of new water systems for under-served villages west of Hebron will begin later this year, and construction near Nablus will begin in 2004. In the meantime, USAID is providing water via tanker trucks to severely affected areas.

Through the Mission's \$28 million Coastal Aquifer Management Program, USAID is undertaking a number of activities to improve the management of Gaza's water system. A computerized model of the coastal aquifer highlights the dangers of over-pumping and points the way to sustainable water management.

SUPPLY AUGMENTATION

Despite all conservation measures, in the Middle East demand will eventually outstrip supply and new sources of water will be needed. Additional supplies can be obtained through the treatment of reuse of domestic and industrial wastewater, and through desalination of brackish water and seawater. USAID is supporting development of both options in the Middle East.

In the Middle East, Israel has been a pioneer in the recycling of wastewater, demonstrating that wastewater can be used effectively and safely, and reducing the need for addition of organic matter and fertilizers to irrigation waters. The Israeli experience has shown that recycled wastewater is one of the least expensive and most attractive alternative sources of water for agriculture. Elsewhere in the Middle East, due to concerns over the availability of high quality groundwater, public health, and agricultural export markets, the unregulated use of treated wastewater has been discouraged. However, the growing population, industrialization, and tourism are all increasing demand for freshwater resources. At the same time, major efforts to rehabilitate and construct wastewater treatment facilities, including those funded by USAID and other donors, are resulting in increased supplies of high quality effluent, which is a viable source for meeting agricultural and other non-potable water demands. In addition, USAID is working with the Government of Jordan, other local partners, and water users to introduce direct water reuse in industry, agriculture, and urban landscaping in Jordan.

Desalination, though relatively costly, is another technical option currently under development in the region for the production of freshwater. Construction of a seawater desalination plant on the coast of Gaza is currently suspended due to security concerns. We hope this project can go forward once the security situation is stabilized. Brackish water desalination may offer a more economically attractive option than seawater desalination to increase water supply in Jordan and other countries in the region. To augment water supply for Amman, USAID is supporting construction of a large brackish water desalination plant at Zara Ma'in in the Jordan Valley.

In areas of serious water shortage, where the demand for potable water significantly exceeds available supply, seawater desalination may offer a viable option for meeting the rapidly growing demands and mitigating the environmental problems associated with over-extraction of the groundwater aquifers. As international experience with desalination plants has expanded in recent years, the construction and operating costs have fallen, making the plants increasingly attractive.

CONCLUSION

In closing, many countries of the Middle East face chronic shortages of water that pose serious constraints to their economic development. Responding to these challenges will require new approaches that emphasize integrated water conservation and management, more efficient use of water, collaborative problem solving of water disputes, and development of alternative sources of water, including desalination and wastewater reuse. Just as USAID and other development agencies once led a "green revolution" to increase food production around the world, the new approaches required in water production, conservation, and management are so significant that full implementation of these initiatives would amount to a veritable "blue revolution." The Bush Administration is beginning to put in place the elements of that "blue revolution" with our current programs in the Middle East. Specifically in the Middle East, regional cooperation will become increasingly important. USAID, working in partnership with the State Department, will continue to work with our partners to help improve management and increase access to water supply and wastewater services. The challenges are great but the cost of inaction is unacceptable.

Mr. SMITH OF MICHIGAN. Thank you. I recently returned from Libya, where Colonel Ghadafi took pride in his human made river and a 12-foot aqueduct going hundreds of miles. Looking into the pros and cons, there is a concern that he is robbing Peter to pay Paul, if you will. It is reducing some other supplies that eventually might cause problems, and I am wondering if these kind of predicaments as we look at developing new supplies might also be a problem.

And Mr. Turner, in particular, regarding the Nile Basin Initiative that seems to be successful so far, and its cooperation, are there any lessons that might be applicable to what we are talking about for the Middle East?

Mr. TURNER. Mr. Chairman, the challenges of water basins, each one is unique and different. But I think there are some wonderful lessons from the Nile Basin when we consider the poverty of that area, the violence and war that has swept over it. The lessons I think are several, that you can start to build trust and cooperation by starting, first of all, to let the shared riparians get good information, start training their professionals at the technical level, showing them best models like we have here in the United States.

One of the things we have learned from the Nile Basin is that it is good to go ahead and proceed with one track on individual projects which can gain confidence in the members and a second track trying to put together a legal framework. Our involvement there has been helping with environmental assessment, helping train professionals with exchanges, and work with UNDP on those type of accesses.

So I think that the Nile Basin is a real success story, that those people that have been at war together, water is bringing them together on a basis of—to cooperate, because it is really the economic lifeblood of that region, are the waters of the Nile.

Mr. SMITH OF MICHIGAN. To what extent was access to water in the Sea of Galilee a contributing factor to maybe the breakdown in negotiations between Israel and Syria here 8 years ago? Ambassador Satterfield or Mr. Turner.

Mr. SATTERFIELD. Mr. Chairman, there were many factors that produced the nonconclusive outcomes to those negotiations. Quite frankly I think the issue of water in the Sea of Galilee itself and its alternate usage and control by Israel was not at the end of the day one of the more significant factors. It was an issue of sov-

ereignty and territorial boundaries upon which the negotiations ultimately foundered.

Mr. SMITH OF MICHIGAN. Regarding USAID attempts to address the water problems, how far we should go? Maybe Ambassador Satterfield. Also comment on USAID's funding and efforts in terms of ultimate success, whoever wants to comment.

Mr. SATTERFIELD. Mr. Chairman, I would defer to my colleague from AID, please.

Mr. KUNDER. Of the 970 million that we are projecting to spend worldwide for water between 2003 and 2005, more than half of that will be spent in the Middle East. So a significant portion of the available resources globally are going into this water starved region.

But to go back to some of the comments Mr. Blumenauer was making earlier, World Bank estimates that approximately \$5 billion are required annually in the Middle East region alone to meet the global targets for access to save drinking water. So are there enough resources going in? Well, there are significant resources going in, but we are not on track to meet those goals, given that kind of World Bank estimate.

So naturally what we are focusing on is not expecting any of the mega bucks that for something like the Red-Dead Sea project in the short term, we are focusing on the desalinization plans. We are focusing on the conservation efforts. We are focusing on getting the pricing and the policies right. We are looking at whether we can divert water away from some of the excessive uses in agriculture. So we are looking for ways to align the resources available with the scale of the problem. But that is what the numbers tell us today, Mr. Chairman.

Mr. SMITH OF MICHIGAN. And maybe this question is for the next panel, but research in desalinization. Bring us up to date on it. We know it is possible. But it is all still very costly. What is the potential for research?

Mr. SATTERFIELD. There is an enormous potential for desalination in the Middle East. Israel is opening a new major desalination facility very shortly. There have been numerous proposals for shared Israeli/Jordanian desalination centers. They were in fact contemplated in the treaty between Israel and Jordan. There are several issues that involve desalination. One is of course cost and that is a very significant factor for the parties in the region today.

The second view is appropriate disposal, particularly for inland desalination facilities of the brine that is produced. There is a major groundwater pollution problem created by brine reserves. That is an issue that has to be dealt with, and when it is dealt with there will be a cost to that attached as well.

Finally come the ever present political and security issues, which would involve both construction of and alternate usage of waters from desalination facilities, particularly those which would involve Palestinian/Israeli shared usage.

Mr. SMITH OF MICHIGAN. Gentlemen, thank you. Mr. Ackerman.

Mr. ACKERMAN. Thank you very much. In his prepared testimony, Mr. Kunder says that despite all conservation measures in the Middle East, demand will eventually outstrip supply and new

sources of water will be needed. Is that universally agreed to? Care to comment, either of the other two? Mr. Turner?

Mr. TURNER. I agree. I think that that challenge that demand will outstrip supply is certainly true for the Jordan River Basin and their underground aquifer tap, and it is certainly true in many other river basins out around the world that the U.S. and our partners face, yes, sir.

Mr. ACKERMAN. Are you in agreement, Ambassador?

Mr. SATTERFIELD. A figure, Mr. Congressman, that may be of interest to you, it has been estimated that by the year 2040, combined Jordanian, Israeli, Palestinian demands for water would outstrip supply by between 870 million to 3.5 billion cubic meters per year. It is a very dramatic gap between supply and available demand.

Mr. ACKERMAN. Ambassador, you note that Middle East Desalination Research Center was established in Oman 7 years ago under the auspices of the Water Working Group. The work of the center is supported by Israel and Oman. Also involved in support are the United States, the EU, Japan and Korea.

Could you tell us a little bit more about the work and the activities of the center? Does it conduct research? Are there scientists who are resident there? Is it staffed entirely by Omanese or other nationalities as well? Are the Israelis involved in the science and research? And given the regionwide water scarcity problem, could you suggest possibly why no other Arab countries are involved?

Mr. SATTERFIELD. Mr. Congressman, the Middle East Desalination Research Center does indeed conduct from its base in Muscat, Oman a variety of outreach efforts and educational efforts as well as research. They encompass all of the areas which you have addressed: Its training programs for individuals in the nations involved in the Middle East who are involved in water resource development and management; its research on desalination options, water usage options; reducing the cost and the environmental impact of desalination. All of these form part of the work of the center. We have tried to reach out, and the other participants in the desalination center have tried to reach out to as many participants as possible, from the regional community and from the international community. While the center has remained active, with Israelis, with Arabs, with international parties participating during these 3½ years of violence, our ability to mobilize broader support within the region has been constrained as the broader support for the multilateral track has been constrained by the events starting in 1996, but it remains our goal obviously to bring in as many parties in the region as possible in this engagement.

Mr. ACKERMAN. If the Palestinians are hurting for water as well as the Israelis, why wouldn't Arab states participate in trying to relieve that burden? Ms. Watson, who is no longer here, carried the water, so to speak, for the inequities she cited between the amount of water Israelis use and the amount of water Palestinians use. Is there no interest on the Palestinian side, or the Arab side I should say, in solving the problem?

Mr. SATTERFIELD. I wouldn't characterize it as much a lack of interest as a lack of resources available to them. With the exception of Lebanon, there are equally inadequate groundwater resources

available to other Arab states as there are for the three key states, Israel, the Palestinians, and the Jordanians that we are focusing on today.

In terms of political support for the process, that is something we would very much like to see, and I think no Arab state is opposed to an equitable distribution of water or adequate supplies of water for Palestinians or others in the region. But in terms of their own resources, they themselves are facing major water crises from Saudi Arabia through North Africa.

Mr. ACKERMAN. I have been interested in this area for quite some time. It was in 1991 that I visited then President Ozal in Turkey and he had developed a plan with some degree of detail that would bring a pipeline from Turkey through several front-line states into the area of the Israelis and the Palestinians. Whatever became of that plan? It seemed at the time his big concern was that in some of the Arab world there would be people interested and willing to blow up the pipeline.

Mr. SATTERFIELD. Mr. Congressman, there have been several proposals which have been kept alive by the Turkish government to supply fresh water to states in the Middle East. Some involve barge transport using large bladders. Others involve the Peace Pipeline that you were describing. In each case the reasons for non-pursuit of these ideas, which continue to circulate and to surface—they have not been shelved—are cost, economic feasibility. The cost of the Peace Pipeline is enormous, on the order of \$35 billion. And even the freshwater bladder shipment schemes are quite costly. This has been the issue. Rather than politics, it has been economics that have shaped this.

Mr. ACKERMAN. Is there a cheaper way to do this?

Mr. SATTERFIELD. To move freshwater from Turkey to the countries of the Middle East and then for that water to be appropriately utilized in those countries' water systems carries a very heavy price tag. There are very few cheaper ways. There are few cheap ways to do it. There are relatively more expensive and less expensive ways to go about it. The pipeline is the most expensive option.

Mr. ACKERMAN. A few years back I was in the Middle East looking at the possibility of desalinization plants and visited a number of countries as well as our projects that were going on within the Palestinian areas. Could you tell us about desalinization efforts? Maybe any one of you. How many plants are there? How many are projected and what are the costs of desalinization plants?

Mr. KUNDER. Mr. Ackerman, I don't have the exact figures here. I will be glad to provide them for you. But I want to say it is a significant part of what we are doing, both in Jordan and the West Bank and Gaza area. The economics are getting better, in the sense that technology is driving the price down.

To go back to what Assistant Secretary Turner said earlier, unfortunately the other variable in that equation is that people are willing to accept increasingly deteriorated water quality, and that is why we have some of the kind of health care problems. So this thing can bulge—this problem can bulge out a couple of different ways. But desalinization, we believe, as opposed to some of the other mega projects that you alluded to earlier, is the technological way to go in the Middle East.

Mr. SATTERFIELD. Congressman, if I could add, we had planned through the Agency for International Development a major desalination project in Gaza. Unfortunately, we have just announced our decision to suspend that project and another water carrier project because of the security situation in Gaza. It is a very sad reminder of the fact that the realities of the security situation on the ground, security for American contractors, for American direct hire employees does play a role in our ability to proceed with obviously projects of great benefit to the peoples of the region. And we see this as another incentive for the Palestinians to do what they need to do and have needed to do for so long, which is to restore law and order in Gaza and the West Bank, and to end the terror and violence. It has prices that go far beyond the peace process.

Mr. ACKERMAN. One of the things that frustrates me and I think so many others is that if the Palestinians understand the critical need for water, why they do not speak out against those who would build them a plant and against those who would kill those people, Americans and others, and why they would blow up the plant just to make a political point against people who are working so hard and so desperately and sincerely to try to ameliorate what is a tremendous problem.

Mr. SATTERFIELD. It is a terrible situation.

Mr. ACKERMAN. I guess that is rhetorical.

Mr. SATTERFIELD. Three Americans were killed in the Gaza Strip last October. The Palestinian Authority has not brought those responsible to justice. The situation overall in Gaza remains one of sharply deteriorated security. In light of both of these circumstances, we simply cannot proceed with these new projects. We are sustaining the current AID project under way in Gaza, but we are not going to be able to begin these new undertakings.

Mr. ACKERMAN. Is there an expiration on the funding of those projects? Would that have to be reauthorized or—

Mr. KUNDER. The decision is to suspend at this point, sir, and at this point we will not face any need to reprogram those funds just yet.

Mr. ACKERMAN. Thank you.

Mr. SMITH OF MICHIGAN. Just a quick follow up. Mr. Kunder, normally terrorist have not attacked humanitarian projects. Has any AID project been destroyed or attacked by terrorists?

Mr. KUNDER. In the West Bank, in Gaza specifically, sir?

Mr. SMITH OF MICHIGAN. Well, or any place.

Mr. KUNDER. There has been damage to our projects because of the ongoing instability in the region, not direct attacks, but damage.

Mr. SMITH OF MICHIGAN. By terrorists or by who?

Mr. KUNDER. By both Palestinian organizations and by the IDF, by the Israeli Defense Forces, but as part of the ongoing conflict, not as part of an attack on one of the USAID projects.

Mr. SMITH OF MICHIGAN. Mr. Rohrabacher.

Mr. ROHRABACHER. Thank you very much. What is the final price tag on the Red Sea to the Dead Sea project if we were going to— if everybody decided to get on board and said okay, we have got the agreement, we have got the cooperation? What is the final price tag on that?

Mr. KUNDER. The best estimates, Congressman, are in the range of 4- to \$5 billion for the project.

Mr. ROHRABACHER. Four to \$5 billion. And you mentioned an amount of water that that would produce again. Could you—

Mr. SATTERFIELD. It is about 850 million cubic meters a year.

Mr. ROHRABACHER. 850 million. Now could you—what is—maybe you could let us know what 850 million cubic meters of water, what is that?

Mr. SATTERFIELD. This would be a production five to six times greater than that of any existing desalination complex project or facility in the world. It is an amount of water which would make a very significant impact on the needs of Jordan, Israel and the Palestinians.

Mr. ROHRABACHER. What type of population could be serviced by 850 million cubic feet of water?

Mr. SATTERFIELD. Congressman, I can get you those figures on what the magnitude of populations.

Mr. ROHRABACHER. You are talking about a city of a million people or 500,000 people.

Mr. SATTERFIELD. It would not be a city. It would be an area of many villages, many cities.

Mr. ROHRABACHER. I understand that.

Mr. KUNDER. Roughly, sir, 850,000 people at current, at good usage rates.

Mr. ROHRABACHER. Okay. Got it. So 850,000 people could be serviced.

Mr. SATTERFIELD. Another figure I have just been given, Congressman, which may be interesting is the total Israeli consumption, that is including agriculture, is twice that figure.

Mr. ROHRABACHER. Oh, so, it would be—

Mr. SATTERFIELD. This would be half of the total amount of current Israeli water consumption.

Mr. ROHRABACHER. Okay. And we are only talking about \$5 billion for that project, do you other gentlemen concur with that price tag? Is that a guesstimate?

Mr. SATTERFIELD. That is an estimate.

Mr. ROHRABACHER. It seems to me that right next door there are a lot of other people who have got a lot of money in that area. I mean, how far is it to fly from, I guess from Jordan to Riyadh or someplace else with lots of oil and—

Mr. SATTERFIELD. Congressman, while the cost would have to be addressed, that is not the primary reason why the project has not proceeded. The primary reason is not a question of funding, or even funding being available for the feasibility study, which the World Bank is willing to undertake. It is the absence of political agreements among the parties necessary for the World Bank or indeed any other credible institution to begin that. There is no agreement between Israel and the Palestinians on how the issue of Palestinian representation in this project will be managed.

Mr. ROHRABACHER. Well, I am glad I asked that question then. I think that we have a \$5 billion price tag, which is doable, I mean that is a doable figure. That is not some outrageous—\$35 billion for a pipeline is a lot of money. \$5 billion to try to produce this asset there, this pipeline from the Red Sea to the Dead Sea and get the

electricity and the water from that—speaking about water, I am going to have some right now—I think it behooves us in Congress to focus on the very challenge that you are talking about then. If we have something that is a reasonable price tag, it behooves us as Americans and our government to try to say to all of the parties involved exactly what I stated in a very—my first opening statement, which is the time is long since past when all factions should put aside other considerations and agree to work together on this one issue. And maybe not just the issue of water in general, but perhaps on this project specifically. And I would think that those of us who have some influences on various parties in the Middle East should stress that on those who we have influence. I don't think—it should not be tolerated that someone is putting some other political consideration or even security consideration in the way of getting this project underway because this project being successfully completed will have security and political implications that are positive implications.

So if nothing comes out of this hearing today, perhaps it should be a consensus among those of us on this Committee that if on no other project, on the Dead Sea—Red Sea to Dead Sea project, we expect all of the parties to work together and I would hope that 2 or 3 months from now—I will be talking to the Chairman—we could have a report from our government as to who is holding up what.

Mr. SATTERFIELD. Mr. Congressman, if I could just add, following your remarks, while there are political difficulties that have held up the initiation of the World Bank feasibility study, a study which we strongly support and believe ought to be undertaken, I would only note for the record that experts on the various issues involved with projects of this kind, including the long-term economic feasibility, the environmental impact, have grave doubts and concerns about the nature of such a project on the Gulf of Aqaba and its environmental status, on the Dead Sea and Jordan Valley and Jordan Basin in terms of the environmental impact there, as well as, even if funded and developed, this would over time yield the results estimated. But the feasibility study is the opportunity to study that in all of the appropriate detail, and that is what we would support proceeding with.

Mr. ROHRBACHER. Well, of course we are not going to move forward without a feasibility study that takes into account all of those things, into consideration. But I will tell you right now that we would be living in a bird's nest, you know, throughout the United States of America if we waited for everybody who had a concern about something before we built a dam that would produce electricity or a water system. In California we would be in a desperate desertlike situation in southern California, which we almost are, if it wasn't for the fact that we decided at some point you take all things into consideration and there are pluses and minuses to any type of change in the environment and then move forward on what seems to be best for human beings, I might add in the long run, and not just today's human beings but future generations as well. Because good environmentalism does not take the human aspect out of the consideration. So \$5 billion and a lot of study and how much would this study cost, this feasibility study?

Mr. SATTERFIELD. About 15 million.

Mr. ROHRABACHER. 15 million. All right. So we have a \$15 million challenge. Now, that seems doable. So let's see if we can proceed, if nothing else, let's see if we can proceed on this specific \$15 million expenditure, plus trying to make sure that there is an agreement between all the parties and let's say 3 or 4 months from now let's all get together and make sure—and my office is open. I will be perfectly—I will be very happy to meet with the parties. I am sure the Chairman would be happy to do it under his auspices. I am sure the other side of the aisle believes that—Mr. Ackerman, would you believe that this would be a bipartisan support?

Mr. ACKERMAN. Any day you want to spend 15 million, deal me in.

Mr. ROHRABACHER. So let's leave it at that. I think that if nothing else comes out of this hearing, let's make a commitment to move forward on this, and then we can go move on those other things so we have something to show around here. I understand there is a study showing that hot air can be turned into energy, but unfortunately—

Mr. ACKERMAN. That is not a personal reference, is it?

Mr. ROHRABACHER. I think it is in reference to the way we do business here in Washington. But let's try to overcome some of those obstacles.

Mr. SMITH OF MICHIGAN. Mr. Rohrabacher, thank you very much, and we will now proceed with the second panel. Gentlemen, thank you again.

Our second panel will be two of the witnesses that will be with us here, and then on our monitoring screen from far away that have been very patient, two of our witnesses will join us electronically. Mr. Gidon Bromberg is the Israeli Director of Friends of the Earth Middle East, the only regional environmental organization bringing together Israel and Jordanian and Palestinian organizations. Mr. Bromberg holds a Master's Degree in Environmental Law from American University and he is also a member of the Israeli Bar Association. So welcome, Mr. Bromberg.

Our second panelist will be Dr. Ihab Barghothi, and he is the Economic Advisor to the Palestinian Water Authority. He is responsible for the coordination of policy, capacity, building and infrastructure programs supported by USAID, the World Bank and the European Investment Bank. Dr. Barghothi holds a Doctorate in Economics from Southern Illinois University in Carbondale.

And Dr. Uri Shamir, who is on the left side of our screen, is Professor Emeritus on the faculty of Civil and Environmental Engineering at the Technion in Haifa. He is also the Founding Director of the Stephen and Nancy Grand Water Research Institute. Dr. Shamir is a consultant to Mekorot, Israel's national water supply company, and to the Israeli Water Commission. He is also a member of the Israeli water negotiating team. And Dr. Shamir holds a Doctorate in Civil Engineering from the Massachusetts Institute of Technology.

And Dr. Elias Salameh is a Professor of Hydrology and Hydrochemistry at the University of Jordan. In 1983, he founded the Water Research and Study Center at the University of Jordan. And Dr. Salameh, his work on water-related issues has been pub-

lished in international journals. He holds a Doctorate in Hydrology and Hydrochemistry from the Technical University in Munich, Germany.

And we are honored to have this kind of expertise join us today and help guide this Committee. Your written testimony without objection will be totally entered into the record, and to the extent that you can come close to 5 minutes in your presentation we would appreciate it. And if, Mr. Bromberg, you would proceed.

**STATEMENT OF GIDON BROMBERG, ISRAELI DIRECTOR,
FRIENDS OF THE EARTH MIDDLE EAST**

Mr. BROMBERG. Thank you very much, Mr. Chairman, for the opportunity to present before this House. I will present from my statement four key issues that I want to highlight that I think are pertinent to this hearing and particularly pertinent for this House and Congress to hear about.

First of all, peace deals with people and I don't think we have heard enough about people this morning. We need to get to the hearts and minds of people. Working on water issues, as I think as everyone has agreed, will advance peace between peoples.

I want to highlight the fact that there is untapped potential in cross-community cooperation on water issues. At Friends of the Earth Middle East we have, for the past 3 years, led cooperation between 11 cross-border communities, Israeli, Palestinian, Jordanian, that are seeing tremendous results, and awareness programs taking place, the creation of water trustees, thousands of water saving devices implanted, schools converted into model water saving buildings, and common petitions signed by Palestinians, Israelis, Jordanians, to save and better share water. I think that this shows untapped potential in terms of advancing peace. The reason I raise it here in this House is because there is no funding mechanism in place for Congress, to mandate the U.S. Government to further support such activity. The funding that we received from the U.S. was a one-time Wye River grant. The limited nature of the Wye River Program is really inadequate as far as supporting cooperation on water issues, and as far as supporting peace.

Secondly, I want to refer to the issue of water infrastructure. As we heard from the earlier panel, these projects are currently suspended, and I think that this is very alarming. If we all agree that building of infrastructure in water issues advances peace, then I think that we defeat the purpose of working on this issue if we are going to suspend these projects, at least for the West Bank-Gaza at this time.

I want to highlight a report that we recently produced which talks about the 60 million cubic meters of untreated sewage pouring into a shared aquifer, Israeli-Palestinian, contaminating the most important source of drinking water for both peoples. If this suspension means that the Hebron sewage treatment plant is not to be built, or there is no date for its being built, then we are further risking the scarce water resources that we share.

My third point is on the reaping of the peace dividend. I believe that there is a congressional mandate on USAID to work bilaterally and not regionally. This is problematic when we are dealing with a transboundary issue such as water. When we build a sew-

age treatment plant in, for instance, Hebron, both Israeli and Palestinian communities benefit. However, USAID is restricted from working with the two communities that benefit and therefore misses out on the peace dividend. I think the way to reach the hearts and minds of the populace is denied because of this restrictive mandate.

Finally, although many words have been said in relation to the Dead Sea, I want to highlight the needs to approach the issue in a comprehensive fashion. The Dead Sea is unique to the world, not only to the region. The Dead Sea is dying because of manmade intervention. The issues facing the Dead Sea are complex. There will not be one way to save the Dead Sea. We need a comprehensive approach, and I think we are going to hear in other presentations later, some ideas on this comprehensive approach.

Finally, I want to share with the Chair and with Mr. Lantos, a petition, a call from Palestinian, Israeli, and Jordanian children, calling for better solutions for sewage and water problems that we face. I have two such posters that I would be very grateful if the Honorable Members would take. I also want to highlight several reports that I have brought here with me, dealing with our Good Water Neighbors Project dealing with the sewage issue and dealing with the Dead Sea.

I thank you very much, sir.

[The prepared statement of Mr. Bromberg follows:]

PREPARED STATEMENT OF GIDON BROMBERG, ISRAELI DIRECTOR, FRIENDS OF THE
EARTH MIDDLE EAST

Friends of the Earth Middle East (FoEME) is a unique regional organization made up of Jordanians, Palestinians and Israelis committed to protecting our shared environment and advancing peace between our peoples. The organization was created in 1994 to raise public awareness on transboundary environmental issues, promote sustainable development and support efforts for a just and lasting peace. The organization, a non-profit group, today has hundreds of volunteers, 27 paid staff and works out of 3 main offices in Amman, Bethlehem and Tel-Aviv. The organization works closely with the relevant Israeli, Palestinian and Jordanian government offices, as well as the US Embassies and USAID missions in the region. This testimony from the outset recognizes the leadership of our local governments on water cooperation issues and the essential and positive contribution made by US government agencies.

FoEME has a proven track record of creating cross border community partnerships. Through a US and EU government supported grant FoEME created 11 partnering communities in Israel, Jordan and West Bank/Gaza. Water issues were identified by FoEME as the focus of the cross border partnership, under the project title 'Good Water Makes Good Neighbors'. The project has witnessed hundreds of young people from schools and community groups becoming water trustees in their respective communities. The water trustees carry out water awareness programs within their community and at the cross border level conduct dialogue and where possible exchange visits with their neighboring water trustees. Significant achievements include; the installation of thousands of water saving devices, the conversion of 11 schools into model water saving buildings, the collection of over 15 thousand signatures from the general public calling for local level water and sewage solutions, and meetings of cross border mayors and municipal engineers to discuss cooperation on water issues.

The willingness to cooperate on water issues at the community level exists because water is understood by all our peoples as essential to life. Due to the transboundary nature of the water resource and regional water scarcity it is well understood by the general population that when it comes to water we are dependant

in each other to protect the resource and have a responsibility to share it¹. FoEME receives regular requests from non-participating communities desiring to participate and we could duplicate our Good Water Neighbors project ten fold within one year if the relatively small financial resources to do so were made available.²

At the water policy and infrastructure level there is some excellent inter governmental experience in cooperation, but further potential to advance cooperation exists. I would like to highlight two examples where immediate progress could take place on shared water resources—the Mountain Aquifer and the Dead Sea Basin.

The Mountain Aquifer is an underground set of water basins shared territorially by Israel and the West Bank. Its waters presently constitute the best quality drinking water for both peoples. It supplies over a third of all water used by Israel and the vast majority of water consumed by Palestinians in the West Bank. Despite its obvious importance, an estimated 60 million cubic meters of sewage the vast majority being untreated are released annually above the aquifer. Currently for the over two million Palestinians living in the West Bank only five sewage treatment plants exist and only one actually works catering for 50,000 people. Some 15 million cubic meters of sewage are produced annually from Israeli settlements in the West Bank, a large portion if not the vast majority insufficiently treated.

Whether disposed of in cesspits or discharged into streambeds, untreated sewage threatens the future availability of good-quality safe drinking water from the Mountain Aquifer for both Israelis and Palestinians and is therefore a prime issue to promote cooperation. The US and German Governments are the largest donors to the Palestinians in this sector having together committed to invest in the building of sewage treatment plants some \$230 million together. Despite the large financial commitment made little progress has been achieved, with all sides blaming each other for the lack of progress. The Israelis and Palestinians however openly express their commitment presently to cooperate on this issue. At FoEME we spent many months trying to understand why little progress had been achieved and we recently published a report detailing our findings and recommendations. The report is titled, 'A Seeping Time Bomb: Pollution of the Mountain Aquifer by Sewage.' We concluded that while in the past there have been some poor policy decisions on the issue by both Israel and the Palestinian Authority that led to stalemate, the willingness to move forward exists today and it is the donor states, the US and Germany that are reluctant to make the investment needed. See Appendix 1, Section 7, Recommendations, 'A Seeping Time Bomb: Pollution of the Mountain Aquifer by Sewage,' FoEME Report, 2004.

An additional opportunity for cooperation exists at the cross border community level once these investments on infrastructure move forward. The building of sewage projects constitutes concrete evidence of positive results from cooperation with the communities benefiting on either side. Therefore financing should also be directed to cross border community awareness so that the peace dividend of all USAID infrastructure projects are identified and well understood by the communities benefiting. Congressional requirements placed on USAID West Bank Gaza mission however prevent USAID from directing any financial resources to cross border community programming.

Finally the drying up of the Dead Sea also presents itself as another important opportunity for regional cooperation. Over the last 40 years the Dead Sea has lost a third of its surface area and it continues to drop in depth by over a meter on average every year. The demise of the Dead Sea is totally man made due mostly to upstream water diversion and in the opinion of FoEME is an example of how the water economy in the region is out of balance. Notably, however, Jordanian, Israeli and Palestinian government representatives have recently identified the issue of 'Saving the Dead Sea' as an issue of national priority.³ As another transboundary water body 'Saving the Dead Sea' requires regional cooperation.

¹ Lack of adequate sewage and solid waste infrastructure leading to water pollution and high disparity in water consumption levels between Palestinians, Jordanians and Israelis remain however issues of real concern that if not resolved could result in the further intensification of the Middle East conflict.

² However there does not exist a funding mechanism to support further cross border community cooperation. The US government grant received by FoEME and some 16 other organizations to support cross border activities will cease at the end of this year. It was granted under a one-time appropriation called the Wye River Program, providing supplemental funding appropriation to facilitate the implementation of the Wye River Accords signed between the Israelis and Palestinians in 1998. A recent Congressional initiative to provide financial support to NGOs that promote reconciliation and coexistence efforts specific to the Middle East is very much welcomed by FoEME.

³ From a December 13, 2001, Jordan Times front page article His Majesty the King of Jordan 'stresses the importance of Dead Sea Preservation.' In the Johannesburg Summit in 2002 and

It is clear from the public statements made by our governments that a real opportunity for cooperation exists. In our opinion in order to benefit from this momentum, the focus of cooperation should be comprehensive, on how to promote sustainable development around the Dead Sea area. All the alternative means to raise the water level including the rehabilitation of the River Jordan must be carefully considered but also other development issues such as tourism development, cultural heritage protection, urban and rural settlement, industry and agriculture, all impacting the Dead Sea Basin. To this extent US assistance in advancing World Heritage listing for the Dead Sea Basin and investigating lessons to be drawn from the US Canadian International Joint Commission are potential framework approaches to move cooperation forward.⁴

See Appendix 2, Comments to World Bank Terms of Reference to Red Dead Conduit.

In conclusion I want to congratulate the Honorable Chair and the House Committee for holding this hearing today on the issue of water as a mechanism for cooperation and peace. Investing in water issues particularly when involving the communities impacted directly advances Middle East peace efforts and indirectly world security. As I have tried to highlight in this short presentation there is much that all parties including the US Congress could do to further assist in moving forward this peace and security effort.

APPENDIX 1:

A SLEEPING TIME BOMB: POLLUTION OF THE MOUNTAIN AQUIFER BY SEWAGE
A REPORT OF FRIENDS OF THE EARTH MIDDLE EAST

Section 7.—Recommendations

Israel:

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 Israeli government, as follows:

1. It is recommended that the Minister of National Infrastructure appoint a senior staff member to advance the issue at the diplomatic and political levels. This senior staff person should invest maximum effort to assist donor countries in implementing sewage treatment projects in the West Bank through, *inter alia*:
 - a. Removing obstacles and administrative barriers to their operations;
 - b. Coordinating between them and the Israeli security services in the issuance of permits to workers, engineers and vehicles involved in sewage treatment projects;
 - c. Coordinating between donor countries and the Israeli security services on the release from Customs of goods and materials required for sewage treatment projects.
2. The use of the Mountain Aquifer's pollution for propaganda against the Palestinian Authority is damaging, and creates distrust regarding Israel's genuine good will to find solutions. 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 even through these difficult times. The shared interest of all the region's inhabitants to preserve scarce water resources must be the priority.
3. Israeli settlements in the West Bank discharge significant amounts of untreated sewage in the recharge area of the Mountain Aquifer. The Ministry of the Environment should take immediate legal action against settlement municipalities that fail to implement Israeli sewage treatment standards.
4. The involvement of Israeli authorities in the planning stages of donor-funded sewage infrastructure can prevent delays at a later stage. For example,

the Kyoto Water Forum in 2003, 'Protecting the Dead Sea' was the title of the Governments of Jordan and Israel presentations. Israel and the Palestinian Authority have identified the need for World Heritage consideration for the Dead Sea area.

⁴ FoEME has strongly advocated regional cooperation for the Dead Sea and published 6 reports related to Dead Sea Development issues. Two recent pertinent reports are: 'Let the Dead Sea Live—Concept Document for World Heritage and MAB Listings of the Dead Sea Basin' 2000 and 'Sustainable Management of Dead Sea Basin Water Resources—A Comparative Analysis with North American Experience,' 2004.

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.

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 use of the Mountain Aquifer's pollution for propaganda against Israel is damaging, and creates distrust regarding the genuine good will of the Palestinian Authority to find solutions. Pollution in the aquifer's recharge area originates from both Israeli and Palestinian sources, and can only be solved through maximum cooperation between all sides even through these difficult times. The shared interest of all the region's inhabitants to preserve scarce water resources must be the priority.
3. 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.

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 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.

Recommendations to all Parties

1. 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.
2. 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 com-

mittee, 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.

3. 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.
4. 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.

APPENDIX 2:

COMMENTS OF FRIENDS OF THE EARTH MIDDLE EAST TO THE WORLD BANK TERMS OF REFERENCE FOR THE RED SEA—DEAD SEA WATER CONVEYANCE PROJECT; FEASIBILITY STUDY AND ENVIRONMENTAL AND SOCIAL ASSESSMENT.
COMMENTS TO MAY 26, 2003 CONFIDENTIAL DRAFT.

The Sustainable Development of the Dead Sea Area

The project that the World Bank should be commissioned to prepare a ToR should therefore focus on how to promote sustainable development around the Dead Sea area with all the alternative means to raise the water level considered but also other development issues. The water level alternatives would include the Red Dead conduit, the Med Dead conduit, restoring water flows down the River Jordan, a combination of restoring some water flow down the Jordan River and a smaller conduit project and the no water level action alternative. Furthermore other issues such as tourism development, cultural heritage protection, urban and rural settlement, industry and agriculture impacting the Dead Sea area must be investigated and considered. These development issues are over and beyond the question of raising the water level of the Dead Sea. To this extent investigation of World Heritage and Biosphere registration for the Dead Sea area and the development of an integrated management plan and authority need to be included in the ToR.

In the view of FoEME, investigating the promotion of sustainable development around the Dead Sea should be the issue of the project in question and therefore the focus of the World Bank ToR as this would better reflect the shared vision of all three-core parties. From a December 13, 2001, Jordan Times front page article His Majesty the King of Jordan ‘stresses the importance of Dead Sea Preservation.’ In the Johannesburg Summit and the Kyoto Water Forum, ‘Protecting the Dead Sea’ was the title of the Governments of Jordan and Israel presentations. Jordan, Israel and the PA have identified in writing the need for World Heritage consideration for the Dead Sea area.

Focusing on the sustainable development of the Dead Sea area as the focus of ToR would make better sense of the many sections of the current ToR that go into great detail concerning the lower River Jordan when the Red Dead conduit project alone would have no impact on the lower Jordan River nor the Jordan Valley.

APPENDIX 3.

RELEVANT US FEDERAL GOVERNMENT FUNDING RECEIVED BY FOEME:

Good Water Project, Years 2002–2004, \$477,000, Wye River Program, US Embassy Tel-Aviv.
Environmental and Socio-Economic Review of Proposed Red Dead Conduit, 2004–2005, \$500,000, MERC Program, USAID.

Mr. SMITH OF MICHIGAN. Thank you very much, and the record will show that the Committee is receiving—and you also wanted to submit those journals at your left hand?

Mr. BROMBERG. Yes.

Mr. SMITH OF MICHIGAN. I just wanted the journals in the record.

[The materials referred to are not reprinted here but are on file with the Committee.]

Mr. SMITH OF MICHIGAN. Now we are going to Tel Aviv, and Mr. Ihab Barghothi is the Economic Advisor to the Palestinian Water Authority, and on the right side of our screen. Thank you very much for your patience and for being part of this Committee hearing.

**STATEMENT OF IHAB BARGHOTHY, PH.D., ADVISOR,
PALESTINIAN WATER AUTHORITY**

Mr. BARGHOTHY. Thank you, Mr. Chairman, for inviting us to brief you on something about the water authority and the water sector in Palestine. Let me start by saying that I feel sorry for the loss of Senator Paul Simon, who I had the honor to meet on several occasions while studying at Southern Illinois University at Carbondale, and I think that is a great loss to the Senate and to the American people.

Let me start by saying something about the water situation here. Everybody as noted feels that and knows that water is scarce in Palestine and in the Middle East region, and therefore there exists a need to manage the scarce water resources. However, we feel that the management of limited water resources in the Palestinian area and the Middle East is very complicated, and it has been complicated by a political situation. Interim water rights established under the old agreement have not yet been confirmed by final status negotiations for obvious reasons. In spite of the uncertain political situation, government agencies established under the Palestinian Authority have continued to plan for development of the water sector. The Palestinian Water Authority was established in 1995 to serve as the primary regulatory agency governing the Palestinian water sector. By its own definition, PWA 2000, its roles and responsibilities include the following: First of all, to secure Palestinian water rights; second, to strengthen national policies and regulations, then to build institutional capacity and develop human resources, improve information services and assessment of water resources, regulate and coordinate integrated water and wastewater investment and operation, enforce water pollution control and protection of water resources, build public awareness and participation, promote regional and international cooperation.

In an effort to fulfill these roles and responsibilities, the Water Authority has successfully developed a visionary national water plan, drafted and ratified a comprehensive national water law, and organized a National Water Council charged with providing ongoing guidance to water sector development.

Mr. Chairman, everybody knows that we have a huge gap in supply and demand of water resources here, and accordingly, the Water Authority put together a management strategy to manage the scarce resources, and the management strategy basically highlights the need to manage the water supply as well as emphasize the conservation of the water resources to increase the water supply, at the same time invest more into the rehabilitation of distribution systems and then to look at the wastewater as an alternative source of water. And of course on top of it, the idea of building an sustainable institution has been embedded into the strategy. And accordingly, we are trying to reform, rehabilitate, and restructure the water sector in the Palestinian areas by which we would

be able to integrate the water services into regional utilities. We believe that will help us to build a more sustainable sector.

Mr. Chairman, if I may add, from the discussions that I have been hearing so far everybody is drawing a dark picture about the water situation in the Middle East area. Everybody is saying that we have scarce resources, we have problems, and so forth. But we believe in the future and we believe that the Middle East is not doomed to thirst. As an economist, I have been taught in economics schools that the Malthus theory, by which Malthus was predicting that people are doomed to die of hunger because of their resources; however, Malthus was wrong because he failed to have faith and believe in the human capability and technology to put together projects that will invest in the human capabilities to do something for the humanity. And accordingly, I don't have any fear about the future of the Middle East facing this thirst or this gap of scarce resources.

We believe in human beings. If they put themselves together and work together and invest in technology, we will be able to provide a better future for the Palestinians as well as Israelis and Jordanians. People, they need to have more faith in the future, and instead of investing in war they have to put more emphasis into the peace because with peace we can build a better future for everybody.

We as the Palestinian Water Authority, know that it is a very long and tedious process. However, as Mr. President, Abraham Lincoln, used to say, we may be slow walkers, but we will never walk backward.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Barghothi follows:]

PREPARED STATEMENT OF IHAB BARGHOTHI, PH.D., ADVISOR, PALESTINIAN WATER
AUTHORITY

Ihab Barghothi, Ph.D.

Advisor

Palestinian Water Authority

5 May 2004

House Committee on International Relations

I. INTRODUCTION

The Palestinian Water Authority (PWA) was founded in 1995 as a central and autonomous authority under Presidential Resolution No. 90. Its powers and responsibilities were defined in By-law No. 2/1996. The PWA is the main regulatory and policy-making body for water resources management and development in both West-Bank and Gaza. It is in charge of regulation, comprising tariff review, water law and legislation, water extraction licensing and monitoring, overall sector planning and coordination, and establishing standards for drinking water and wastewater quality, as well as other technical standards. This Background Information came to present to the readers in (4) chapters the most basic needed information that one should know about the water sector.

- Chapter one: gives brief view about the historical background of the water sector and its legal framework development.
- Chapter two: shows the institutional framework of the water sector and the role of each level.
- Chapter three: presents the water policy and strategy that lay down the basis for efficient and equitable water management in Palestine.
- Chapter four: presents brief aspects of water resources in Palestine.

1. HISTORICAL BACKGROUND

Palestine is located in a semi-arid region of the Middle East with limited water resources that are already under considerable strain due to the overall demand in the region exceeding the available water supply and the deterioration of the quality of the natural water resource.

In addition to the natural constraints, Palestine has also suffered from the imposition of artificial restraints resulting from the conditions of Israeli occupation under which Palestinians have lived since 1967 as well as the colonization program which has more than 185 Jewish settlements constructed under its umbrella.

Legislation in Palestine is complicated. Throughout history, were laws and other related laws were introduced by governments and occupiers. The prevalence of the interests of the occupying powers over the needs and interests of the Palestinian citizen is reflected in most of the legislature. The use of the natural resources derive from the plans, interests and goals of the occupying powers, and the written laws therefore often contradict the interests of the indigenous people.

Since 1967 the Israeli policy, as regards water allocations in the West Bank and Gaza Strip, has deprived the Palestinian people of their basic human rights for adequate water quality and quantity, thus hindering socio-economic development in the Palestinian areas – particularly in agriculture which could form a major growth platform for the Palestine economy in its present low state of development.

Israel has imposed stringent restrictions on the Palestinians concerning the development of their water resources. This policy has ignored the basic principles of international law and the United Nations Resolutions adopted in that regard. Although actually dating back to year 1948, the policy was publicly revealed after the 1967 war when Israel declared all water resources in the region as State Property (Proclamation No. 2: 1967).

This Proclamation was followed by many military orders prohibiting the Palestinians from developing their resources. For instance: the development of new deep wells to meet demand is strictly curtailed; extraction from existing wells is closely monitored; and supplies from the Israeli transmission network to Palestinian towns is often withdrawn so that Israeli seasonal agricultural demands can be prioritized.

Present water administration and regulations in Palestine are derived from Islamic water law principles together with concepts and interpretations which have been imposed on pre-existing regulations, local uses and customs. Some of these superimposed laws date from the last century, promulgated by the Ottomans. Others were enacted by the British mandate power during the 1930s. between 1952 and 1967 the Jordanian government enacted several laws. The water laws and many other related laws were changed and amended in Jordan and Egypt after 1967.

The PWA has been given the mandate through By-law No. 2(1996) to manage the water resources, execute the water policy, establish, supervise and monitor water projects, and to initiate coordination and cooperation between the parties affected by water management. The Water law which has been signed lately by the President mentioned and assured these responsibilities, The Water Law include within its articles the institutional framework of each levels in the water sector, the roles of each level, and some water regulations, etc.

The water sector in the West Bank and Gaza Strip, is one of the most important strategic sectors for the Palestinian Authority, having been underdeveloped over the past thirty years. This was as a consequence of the imposed, strict Israeli water sector Military Orders in Palestine. These orders have kept the control of the Palestinian water resources under Israeli control, and did not permit any Palestinian water institutions of water resources. Moreover, the existing Palestinian institutions were

restricted to operating and participating in an extremely limited range of activities regarding water supply administration, including operation and maintenance. Therefore, there has been no chance of promoting a new water institution, nor strengthening the existing ones to be involved in formulating water plans and strategies for Palestine. Against this background, a considerable disparity appeared between growing needs and the services supplied. Large parts of the community, especially in rural areas (37% of the population), have been deprived of any kind of services. The infrastructure has not been developed in these areas and, moreover, the water infrastructure installations in urban areas have deteriorated over the past thirty years, becoming insufficient or meet the needs of the community. This was due to a number of reasons, such as:

- The water installations were not designed to meet the needs of the community over a thirty year period.
- High loss percentages, through pipe leakage and illegal connections, have enlarged the gap between the actual and the recovered costs of the supplied water. This has in turn weakened the economic status of the water institutions to a level that it became hard to rehabilitate their infrastructure installations (pumping stations, networks, etc.).
- Until the establishment of the Palestinian Water Authority (PWA) in April, 1994, there was no single institution responsible for modifying the existing plans and conducting new ones, that could meet the various water-related demands of the community.

Despite all these difficulties, the challenge of developing the water sector has always been the Palestinians' top priority. The non-existence of a national government planning body has had a very detrimental effect on the water sector. Nevertheless, the existence of non-governmental water institutions (NGO's) has played an important and unique role in building up a water professional team which has been involved in monitoring and developing the available water resources. Moreover, they have been successful in highlighting the seriousness of the water problems locally and internationally. They also have been the major source for water related information, and were thus acting as the national planning bodies in this regard.

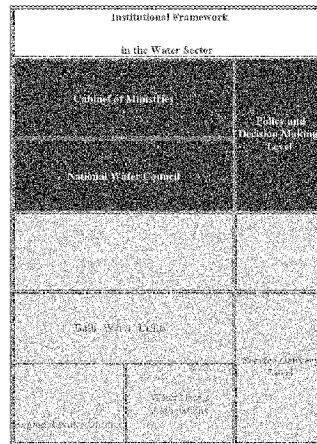
2. INSTITUTIONAL FRAMEWORK OF THE WATER SECTOR

The roles and responsibilities in the water sector in Palestine were scattered fragmented and unclear. For the last 30 years of occupation, this continued situation of mixed roles and responsibilities in the water sector has led to inefficient management and uncoordinated investments. When Palestinian Water Authority (PWA) has been established it found an urgent need for restructuring the water sector in order to regulate, monitor and control the managerial, technical and financial performance at the national, regional and local levels.

The institutional reforms within the water sector have adopted some principals for water policy, and three important principles are:

- The water sector should be regulated by one responsible body, with the separation of the institutional responsibility for policy and regulatory functions from those of service delivery;
- It is intended to establish three regional utilities in the west bank and one in Gaza; and
- Encourage involvement of the private sector in the funding and implementation of projects.

In response to these principals, the overall institutional framework of the water sector is as follows:



2.1 The National Water Council “NWC” (Policy Making Level)

The NWC is chaired by the President of the Palestinian National Authority (PNA) and consist of five ministers, six other members representing government and non-government organizations and the head of the PWA as the secretary of the Council. The members of the NWC comprises to review and approve national water policy, review and approve quotas, reconsider the issue of private ownership of water, examine the central water projects and approve their implementation, and enhance regional and international co-operation in water.

2.2 The Palestinian Water Authority “PWA” (Regulatory Level)

2.2.1 Overall Development Goals of PWA

In addition to the main challenge of securing the future water rights of the Palestinian society the overall development goal of PWA includes achievement of economic growth through securing the water rights of the Palestinians and enforcement of equitable allocation of water resources among sectors and achieving environmental aims through the effective conservation and protection of these same scarce resources. In other words, PWA also has a fundamental responsibility in contributing to

reduction of poverty and to promote water security and prosperity of the Palestinian People. PWA has a major challenge in translating this “development goal” into a realistic and operational “vision”.

2.2.2 PWA's Mandate

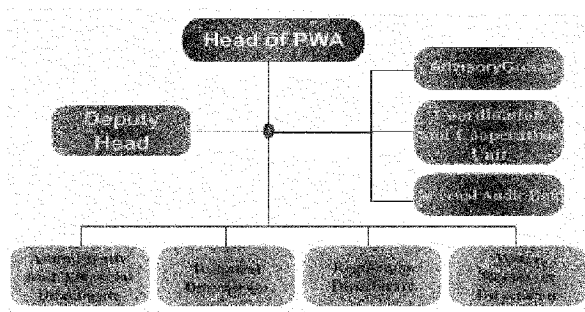
The Palestinian Water Authority (PWA) is a central public authority established under the presidential resolution No. 90 of 1995, acting under the direct responsibility of the President of the Palestinian National Authority. PWA is the main regulatory body for water resources management and development in Palestine with the following primary objectives:

- Execute the National Water Policy as approved by the National Water Council;
- Ensure most efficient management of available water resources in Palestine;
- Seek to achieve and develop water security through optimal planning and management of water resources and explore further resources to ensure balanced management between supply and demand;
- Set standards and establish technical specifications to assure quality control of water works.
- Licensing the exploitation of water resources including the construction of water projects.
- Seek to achieve strong co-operation between PWA and other relevant parties.

2.2.3 PWA Structure

The PWA, as described in the Water Law is a governmental institution with a juridical personality and its budget shall be included within the general budget and follows the President of the Palestinian National Authority and has a commissioner who is appointed by its President. PWA is responsible for the management of the most scarce and vital sources for sustaining life, for promoting development, and for maintaining the environment in Palestine. Water is in focus of the attention in the general public and the media.

The organizational structure of the PWA includes the following directorates and functions:

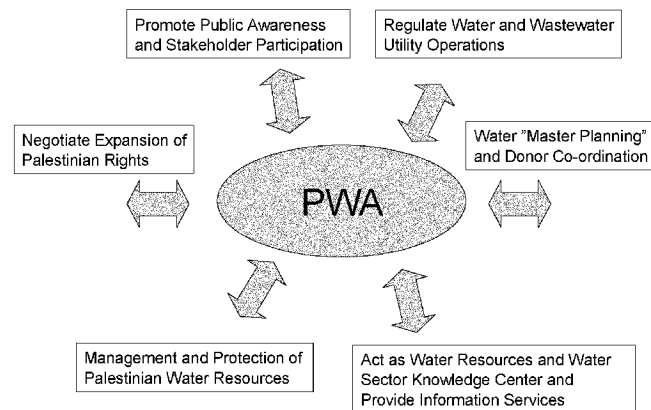


2.2.4 PWA's Core Functions

In brief, the main core functions and challenges associated with PWA in serving the Palestinian society as a statutory water sector regulator are the following:

1. Support negotiations on expansion of Palestinian Water Rights towards gaining control over its equitable share of the region's water resources;
2. Be in charge of management and allocation of water resources including issuing and supervision of water abstraction licenses;
3. Provide water resources and water sector information services;
4. Undertake water "master planning" functions;
5. Take charge of donor co-ordination within the water sector;
6. Be a regulator of water and wastewater utility operations;
7. Promote public awareness, stakeholder participation and mutual trust among interest groups.

PWA's Services to the Palestinian Society



2.2.5 PWA in Transition

Since it was established in 1995, PWA has been through a difficult process of establishment and consolidation and at the same time was involved in resolving urgently needed planning and implementation tasks.

During the interim period, an important task for PWA is to implement all agreed elements of Article 40 of the Oslo II Agreement. This requires a lot of physical planning, engineering and project implementation skills. When the new water utilities gradually take over more of the planning, design and construction supervision tasks, PWA will have to dedicate more resources to its primary functions as a strategic and regulatory body. In due time the focus will turn to representation of Palestinian interests and rights in bi-lateral and regional contexts, and it is necessary to continuously build capacity to meet these important challenges. The capacity building program will have to include training for existing staff in water resources and project management.

One important factor which will need specific attention is motivation and dedication of the staff to play as a team with the common goal of enabling PWA to resolve important water resource challenges facing Palestine. The latter is highly dependent on the attitude and capability of the leaders and their ability to identify relevant tasks and appropriate training and career opportunities for PWA's staff. It should be noted that the development of the regulatory and water right negotiation capacity is a time-consuming process, which has to be considered in planning the recruitment and training programs currently under preparation.

2.3 Service Delivery level

The main elements of the water and the wastewater sector policy adopted by the PNA are based upon the principles of sustainable development. The adoption and implementation of discreet national water policy endeavored to insure that domestic, industrial and agricultural capital investments are compatible with the availability, development, and conservation of the Nation's water resources.

2.3.1 Bulk Water Supply Utility:

The Palestinian Authority is considering the implementation of a new water policy framework, aiming at setting up an autonomous Palestinian Bulk Water Supply Utility, which would take over the management of Trans-regional bulk water supply systems, comprising:

- existing transmission lines, currently operated by WBWD, providing bulk water supply to Palestinian communities,
- water projects, which are currently developed by the Palestinian Water Authority (PWA),
- other water sources envisaged in the National Water Plan (NWP),

The Bulk Water Supply Utility would be licensed by PWA to operate water production facilities, purchase drinkable water from national and international suppliers, convey the water to local Municipal and Industrial water distribution systems; the operation, maintenance and management of those local water distribution facilities will be progressively taken over by four Regional Water Supply Utilities that are established by the new Water Law.

Based on the Norwegian study (1997) and the updated PWA study in 1999 on WBWD, which recommended the needs for its institutional development. Therefore, PWA Signed an agreement with

the French Government to support the development and restructuring of the WBWD. French Company has been selected to conduct a study for Institutional Evolution and Action Plan Outline including a Request For Proposal (RFP) for Management Contract to create the Bulk Water Supply Utility, improve its management and develop its technical efficiency.

2.3.2 Regional Utilities

The water industry can be characterized as being "fragmented". Water departments within the municipalities and village councils operate and maintain the water systems within their service areas. The customers are found to be complaining from an insufficient water supply, deterioration of water quality and inadequate level of services. Therefore, and in order to create a more efficient and sustainable sector, the PWA has adopted the strategy of creating four Regional Utilities in the service delivery level. They are divided geographically;

- Northern Utility (Nablus, Jenin, Tulkarem, Qalqilia, Salfit and Tubas Governorates),
- Central Utility (Jerusalem, Ramallah and Al-Bireh and Jericho Governorates)
- Southern Utility (Hebron and Bethlehem Governorates)
- Coastal Utility (Gaza Strip Governorates)

3. WATER RESOURCES MANAGEMENT STRATEGY

Strategy Statement

To secure an environmentally sound and sustainable development of water resources, through efficient and equitable water management

Key Elements of the Water Management Strategy

- 1- Secure Palestinian Water Rights.
- 2- Strengthen National Policies and Regulations.
- 3- Build Institutional Capacity and Develop Human Resources .
- 4- Improve Information Services and Assessment of Water Resources.
- 5- Regulate and Co-ordinate Integrated Water and Wastewater Investments and Operations.
- 6- Enforce Water Pollution Control and Production of Water Resources.
- 7- Build Public Awareness and Participatton .
- 8- Promote Regional and International Co-operation

3.1. Background and Introduction

The increasing unavailability of water resources to the Palestinians, combined with the associated political complexity related to this valuable resource, have urged the Palestinian Authority to formulate the main principles of the national water policy which lay down the basis for efficient and equitable water management in Palestine. The Palestinian Water Authority (PWA) has been authorized through By-Law No. 2 (1996) to execute this policy and to prepare an overall water Management Strategy. The ultimate goal of strategy formulation is to provide measures to manage this vital resources in accordance with the adopted goals and policies.

The PWA initiated and has produced the draft strategy document. A Task force with members from the PWA staff has been established to assist in the work. The views of the main stakeholders in the water sector were also incorporated in order to create involvement and commitment for the implementation of strategy. The PWA has also consulted with a wide range of Palestinian NGOs, other international organizations in addition to individuals and the private sector.

3.1.1 Water Resources Availability

The sources of the water in the West Bank are those renewable fresh waters of the mountain aquifer which are estimated to be 650 mcm/year, in addition to the surface runoff in the Wadis, estimated to be 70 mcm/year.

The Gaza Coastal Aquifer is essentially the sole sources for water in the Gaza Governorates, a shallow aquifer that underlies the entire Gaza Governorates and extends northward into Israel. The natural renewable recharge is in the order of 45 mcm/year.

The Jordan River system has a natural capacity to deliver an average annual flow of 1311 mill.m³/year. The riparian of the Jordan River are Lebanon, Syria, Palestine and "Israel" and Jordan Palestine's annual share from the Jordan River Basin has been estimated to be 20% of the total annual flow. As a result of water diversion of the upper Jordan River tributaries by the Israelis there is no fresh water down stream of Lake Tiberias, and the negligible quantity that reaches the Palestinian Riparian in the West Bank is of a deteriorated quality.

3.1.2 Water Uses and Consumption

Palestinian total use from the groundwater resources in the West Bank has been estimated to be 120 mill.m³/year. About 86 mill m³/yr. (71%) is used to irrigate 90,000 dunms. The remaining 34 mill.m³/yr. are used for domestic and industrial consumption (industry's share about 3%) with more than 40% of unaccounted for water.

In Gaza, Palestinians total use of water is about 125 mill.m³/yr. is used to irrigate 120,000 dunums. The remaining 45 millm³/yr are used for domestic and industrial consumption (industry's share about 3% with more than 50% unaccounted for water. The water crises in Gaza is not limited to the deficit in quantity. However, the water quality is deteriorating and subject to continuous increase in salinity due to over-abstraction and to the percolation of sewage in the area.

At present, Israel is currently controlling 85% of the water from the Palestinian groundwater aquifers, and Palestinians are denied from their rights to the water of the Jordan River and Gaza Wadis. This policy has led to a severe water crises in Palestine in general and the Gaza Governorates in particular.

3.1.3 Water Demand

The Unique historical water situation in the West Bank and Gaza Governorates has resulted in suppressed water demands. Water Supplies are generally constrained due to technical, institutional and political limitations. In addition to that, approximately 30% of Palestinian Communities are not served while 66% of the served communities suffer from water shortage especially in summer. Thus the current water demands cannot be used for predicting future demands.

Future demand projections should take into account the aforementioned facts in addition to normal assumptions used in predicting demands, like population growth and socio-economic development requirements.

Many studies conducted recently have indicated that the gap between supply and demand will increase dramatically in the coming few years, thus making the Palestinian's water right issue both a necessity seek feasible alternatives and options in order to fill this gap.

a. Domestic Water Demand

The target rates for domestics water consumption in order to bridge the gap between supply and demand falls within a range of 100 l/c/d. These rates will be hopefully met after 10 and 20 years respectively with a target loss rate to 25% over a 20 year period.

b. Agricultural Water Demand

Agriculture is considered one of the major economic sectors in Palestine. Its production contribute more than 30% to national income. Accordingly, there will be much emphasis regarding the development of irrigated agriculture in Palestine. The potential area for irrigation is estimated to be 500,000 dunums. The projection of potential agricultural water demand is estimated to be 200 mcm over the coming 20 years. Treated wastewater is enlisted to be a support resource to irrigated agriculture .

c. Commercial and Industrial Water Demand

Due to lack of detailed economic industrial development plans for Palestine, it is not possible to base estimates of future commercial and industrial demand on economic projections. As a result, projected industrial and commercial water demands have been calculated as assumed percentage of the total water consumption in Palestine. These future demands are estimated to be 9% of the total consumption over a 20 year period .

3.2. Opportunities and Challenges

3.2.1 Political Framework and Challenges

a. Declaration of Principles

This is the first Bi-lateral Agreement between Palestine and Israel signed on 13 September 1993. According to this agreement, water issues will be discussed by the Permanent Palestinian Israeli Committee for Economic Co-operation. It was agreed to prepare plans for water rights, and equitable use of water for the shared resources. However, this agreement did not identify the water right for each party.

b. Gaza Jericho First Agreement

Which is the temporary Agreement regarding autonomous rule of the Palestinian Authority in Jericho and the Gaza Strip, signed on 4 May, 1994. Article 2 paragraph 31 deals with the water issues in the two regions. A limited authority on water uses was transferred to the Palestinian Authority. The Palestinian Authority has control over the water resources, infrastructure in the two regions, and it can operate and manage the water systems. New wells can be drilled on condition that the water resources are not harmed. Nothing in this agreement has been mentioned on the water rights issue, equitable use or the allocation of shared water resources.

c. Article 40 of the Oslo 2 Agreement regarding Water and Sewage

The interim water and wastewater Agreement "Article 40" of Oslo 2 will be used as the basis for water sector planning and project implementation during the "interim period" and until a final status agreement is reached. These will be negotiated and settled in the Permanent Status Agreement relating to the various water resources "

The main challenge facing the Palestinian is to achieve sovereignty and full control over their water resources. It is most urgent to resolve the Palestinian water right issue, which comprises securing comprehensive control and management of their water resources, including the ground and surface water totally originating inside the West Bank and Gaza Governorates, in addition to the riparian rights in the Jordan River Basin and Gaza Wadis. The Control over the water resources is the basis for the development and management of these water resources in order to meet the needs for water for further economic development

d. Palestinian Position from the Final Status Negotiations

The requirements of the Palestinians from the final status negotiations are based on the following aspects:

1. Full sovereignty and control over their own water resources which includes the ground and surface water originating within their area of jurisdiction and their riparian rights of the Jordan Valley Basin.
2. Continue the co-operative efforts in all regional activities and plans in order to guarantee in order to ensure that resources between the neighbour countries are optimally shared.

3. To establish a joint resolve among their neighbors in the development of New and Additional Water Resources.

Going to negotiations with a solid legal (negotiation) position that is based on international legitimacy. This approach will definitely provide us with support from the international community and will, consequently, constitute an advanced negotiation position at the outset of negotiations.

First: Political Aspects :

- Examination of the willingness of the Israeli side to acknowledge the Palestinian permanent and actual sovereignty over water resources, which will be determined and agreed upon within the framework of the permanent agreement .
- Checking the Israelis' intention towards compensation for damages incurred by the Palestinian side during occupation and as a result of the Israeli procedures taken in the field of water.
- Israeli's acceptance of the Palestinian demands, concerning refusal of the existing utilization of ground water resources in the West Bank .

Second: Technical Aspects:

- Concerning our water rights to water resources within the borders of the West Bank and Gaza Strip :
 - **Easter aquifer system wholly located within the borders of the West Bank.**
Our demands: total and permanent Palestinian sovereignty coupled with actual control over all resources of the aquifer, whether ground or surface.
 - **Western and northeastern aquifers system - The geographic and hydraulic borders of these aquifers extend into the Green Line with Israel.**
Our demands: re-distribution of the water resources of these aquifers, on the basis of equitable and reasonable distribution principle, without any precedent conditions, and to dismiss the statement which says it is necessary to honor the Israeli's current utilization .
 - **Water aquifers within Gaza Strip:**
Our demands: total & permanent Palestinian sovereignty and actual control over watercourses inside Gaza Strip .
-Jordan River System:
Our demands :
 - A- To benefit from the aquifer's surface water resources, in accordance with the equitable utilization principle, and not to recognize the existing utilization by the Israeli side.

- B- Complete participation in the aquifer management, and at the same level with other countries riparian in this aquifer .
- C- To get a commitment from the Israeli side to pump the Palestinians' share of water from the aquifer through Lake Tiberias, by a pipeline or canal connecting between Lake Tiberias and the Valley area at the starting point of the northern borders of the West Bank along the Jordan River.

Third: Coordination & Cooperation:

- To develop the work of Joint Water Committee/JWC ,in order to perform control, inspection and supervision over implementation of the final agreement. This shall be in accordance with an agreed upon work mechanism forming an integral part of the final agreement .
- To Cooperate in the field of water in order to develop the available local water resources, and to search for new water resources for the interest of both sides .

3.2.2 Socio-economic Aspects and Challenges

Economic development is to a large extent dependent on adequate water supply. Both Agriculture and wide range of industries depend on water. However, the current pricing system in both the West Bank and Gaza Strip does not reflect the real value of water, since it is not based on an economic analysis to estimate this value.

In the national Water Policy, water has a high social , environmental and economic values. Accordingly this resource has to be managed in terms of both quality and quantity in an economically effective manner. A tariff policy has to be adopted in order to ensure both the efficient use and conservation of water. This Tariff policy also has to take into consideration the social conditions of the people including affordability , i.e. the ability to pay .

3.2.3 Institutional Aspects and Challenges

The PWA has been given the mandate through By-Law No. 2 (1996) and has been stressed on in its amendments Law no.7 for 2002 to manage the water resources, execute the water policy, establish supervise and monitor water projects, and to initiate co-ordination and co-operation between the parties affected by water management.

In the same jurisprudence, the " National Water Council" was also established. The council consists of the president of the National Authority as Chairman and members from the ministries involved in water issues, with the PWA as Secretariat. The main objective of the Water council are to approve the National Water Policy and to support the work of the Palestinian Water Authority .

It is a major challenge to develop PWA rapidly into a well functioning authority and at the same time to follow-up and coordinated the projects that are restructuring the water sector institutions. In that context the PWA has been authorized to oversee the work of the West Bank Department as a bulk utility in order to ensure that technical and managerial performance is improved .

The PWA will also establish regional utilities in the West Bank and Gaza Strip. These utilities will have an autonomous status both administratively and financially, and will have to operate on the basis of cost recovery principles. The strategy will in the long term encourage the involvement of the private sector in the implementation of certain projects and possibly the management of services that could be contracted out by the utilities.

3.2.4 Environmental and Health Aspects and Challenges

Water has a high environmental value. It is essential for life and necessary for an acceptable hygienic standard, but can also be the carrier of serious diseases. A secure and adequate water supply is thus a necessary condition both for the personal well being of people and for a proper level of public health.

A deficient domestic water supply (in quantity as well as quality) is not only detrimental to general welfare, but also a direct economic liability to society, through increased load on the health and social services, and through increased absence from work.

Generally, it is not possible to achieve high quality and secure water supply without proper handling of sewage. Therefore, concept integrated management for water and sewerage will be the ideal solution for efficient management in the water and wastewater sectors.

3.3. National Water Policy

Palestine must develop and manage its water resources efficiently in order to meet present and future water needs in an environmentally sustainable way. The main elements of the Palestinian Water Policy, based on the principle of a sustainable development, have been established as a basis for decisions on the structure and tasks of water sector institutions and water sector legislation. This policy lays down the principle of integrated water resources management and stresses an economic sustainable development of all available water resources.

The development and the management of the water resources in Palestine must be coordinated on a national level and carried out on the appropriate local level. This should ensure that domestic, industrial and agricultural development and investments will be compatible with the quantity of water resources available and economically feasible.

The Palestinian Water Policy, as set out in the following principles, will be the basis for decisions on the structure and tasks of water sector institutions, the water sector legislation and the management strategy:

- All sources of water should be a public property.
- Water has a unique value for human survival and health, and all citizens have a right to water of good quality for personal consumption's at costs they can afford.
- Water supply and domestics, industrial and agricultural development must be compatible with the available water resources and based on a sustainable development.
- Water has social environmental and economic values. Therefore, the damage resulting from the destruction of its usefulness (pollution) should be paid by the party causing the damage (polluter), polluter pays principle.

- The development of the Palestinian water resources must be coordinated on the national level, and carried out on the appropriate local level.
- The national water sector management should be carried out by one responsible body; with the separation of institutional responsibility for policy and regulatory functions from the service delivery functions.
- Public participation in water sector management should be ensured.
- Water management at all levels should integrate water quality and quantity.
- Water supply and wastewater management should be integrated at all administrative levels.
- The optimal development of water supply must be complemented by a consistent water demand management.
- Protection and pollution control of water resources should be ensured.
- Conservation and optimum utilization of water resources should be promoted and enhanced.
- Pursue the Palestinians interests in connections with obtaining the right of water resources shared by other countries.
- The Government will co-operate with regional and extra-regional parties to promote the optimum utilization of water resources, to identify and develop new and additional supplies, and to collect and share relevant information and data.

3.4 Key Elements of the Water Management Strategy

The overall development objective of the Water Management Strategy is to translate the messages of the National Water Policy into strategic imperatives the strategy emphasizes the necessary aspects water development as the establishment of a comprehensive framework for sustainable management of Palestine's water resources. In addition to development of appropriate institutional set-up for reforming and strengthening the water sector in co-ordination with relevant stakeholders. This long term and coordinated strategy for the water sector will be used as an overall basis for the further planning of the activities and tasks in the water sector.

The overall objective for Palestine in the water sector is to secure an environmentally sound and sustainable development of the water resources through efficient and equitable water management. The multi-objective water resources management strategy builds upon the eight key elements which intend to meet this objective and the challenges outlined previously. The key elements of the strategy are:-

3.4.1. Secure Palestinian Water Rights

This strategy emphasizes the Palestinian right for sovereignty and full control over their own water resources. The strategy for the short term is to define and pursue Palestinian water rights. A first step will be the implementation and full utilization of the water allocations committed in Article 40 of the Oslo 2 Agreement. The next step will be to prepare the negotiation strategies for the final status negotiations and finally to agree upon a final water agreement between Palestine and Israel .

3.4.2 Strengthen National Policies and Regulations

This strategic component responds to the need for improving the existing policy and the legal framework in the water sector by introducing new rules and regulations that provide incentives and enforcement mechanisms for sustainable water resources management and development

3.4.3 Build Institutional Capacity and Develop Human Resources

The long term strategy regarding the water sector institutions, is to achieve the most appropriate Institutional arrangement in the water sector based on the principles of sustainability. This includes the establishment of autonomous regional/local water utilities. For the Human Resources Development and executive capacity that is necessary for the water sector.

3.4.4 Improve Information Services and Assessment of Water Resources

The information manager resources with the required makers, planners, developme o develop a comprehensive information system on water acity to deliver relevant information products to the decision nd the public.

3.4.5 Regulate and Co-ordinate Integrated Water and Wastewater Investments and Operations

The overall strategy is to provide and co-ordinate the framework and strategic interventions and investments to ensure long-term water supply with sufficient quantity and quality for the water users, including the integration of wastewater services as a key element for improving socio-economic conditions in the country.

3.4.6 Enforce Water Pollution Control and Protection of Water Resources

The strategy is to develop the appropriate efficient legal regulatory and institutional instruments to enforce pollution control and protection of the water resources through coordinated efforts with relevant institutions.

3.4.7 Build Public Awareness and Participation

The strategy is to enhance public awareness and understanding about the particular importance of the scarce water resources, as well as to raise their knowledge on the management decisions taken in the sector. In addition to that to create the proper mechanisms and incentives for public participation in all stages of the project cycle.

3.4.8 Promote Regional and International Co-operation

As one of the core parties in the Peace Process, and as water is scarce in the region, Palestine commits itself to co-operate regionally and internationally to develop new and additional water resources and any other water related matters.

3.5 Scope of Work and Objectives

The overall objective for Palestine on the water sector is to secure the basic needs for water for all Palestinians on a short term and to meet the additional requests for water necessary for the development of the society and economic growth on a longer term, based on an equitable and sustainable water

management. In order to meet this objective and the challenges outlined in the previous chapters it is necessary to identify how to follow up the main elements of the water management strategy. PWA has therefore, for each of the seven strategic elements, identified the following strategies that will constitute the basis for the identification of the necessary actions, work tasks and day to day work.

3.5.1 Secure Palestinian Water Rights

Background

The increasing demands for water and the scarce water resources that will create tension and conflict within countries and among riparian states. This potentially serious problem needs to be addressed by Palestine through improved mechanisms to resolve conflicts and promote co-operation. Currently PWA is seeking to develop additional amounts of water for prioritized areas. A key issue in this context is the results of the final status negotiations on water rights.

Objectives

The objective is to develop strategic options, and mobilize a team of experts to support and participate in the negotiations of the final water rights and eventually to achieve and secure water rights.

Scope of work

The scope of work for the Palestinian Water Right Issues will include the establishment of an appropriate knowledge base require the development of consistent negotiation strategies and plans. It will be necessary to identify water rights and the activity should identify domestic expertise and need for short term international supplementary expertise to be assigned to this activity and to establish and strengthen a negotiation team. The work of this group would include, but not be limited to:

a. Mobilization of Water Rights Expertise

- Develop well defined objectives for the water resources which Palestine shares with Israel and other regional shared water resources.
- Evaluate possible benefits from existing treaties, agreements and international water right practices.
- Consultation with international water rights experts and elaboration on relevant principles for the Israeli Palestinian situation.
- Prediction of future water demands for the Palestinian people and for the economic activities.
- Reassessment of total/available water resources and data about the overall water balance.
- Propose appropriate mechanisms and measures for developing and/or strengthening legal instruments for the management of shared water resources.
- Carry out case studies by experts from the Palestinian Authority on other countries to learn about relevant experiences on different aspects of shared international water resources.
- Assess possibilities and constraints regarding non-conventional water resources including the option of re-use of wastewater and desalination of brackish or saline water.

1.2 Negotiation of Final Agreement

- Establish professional and competent negotiation team.
- Develop strategic options for the forthcoming water rights negotiations based on activity 1.1.
- Fulfillment of the negotiations.
- Evaluate and negotiate long term options for “import” or exchange of water resources to address anticipated future gaps in available water resources.

3.5.2 Strengthen National Policies and Regulation

Background

Adequate and effective water policies, legislation and regulations are important elements in enabling an environment for efficient water resources management. Even if the Palestinian Authority has made significant progress in formulating and implementing its water policy and water laws, there is still much to do to further develop and settle these reforms and to secure their implementation and long-term viability.

Objectives

The overall objective is to clarify the implications of the current laws and regulations, and to develop a complete and enforceable set of rules and regulations for the water sector which will serve as an appropriate basis for PWA to undertake its regulatory and development functions. The specific objectives of the water policy and regulation activity are to: (i) review existing laws, legislation and regulations affecting water management and to recommend measures for modifying and strengthening them and proposing new laws for effective management of the water resources; and (ii) develop the necessary regulatory tools and to perform the regulatory functions of PWA.

Scope of Work

The legal and regulation framework for the water sector will be upgraded through the Water Rules under preparation. The set of rules will be enacted by the Palestinian Authority and applied by PWA in carrying out regulatory functions in the water sector. These rules are meant to satisfy the need of PWA in an intermediate period, pending full and comprehensive legislation for the sector, which needs to be developed over time. PWA will furthermore need to develop and implement the necessary tools for its functions as regulator.

In order to reach these objectives, the work will include inter alia:

a. Water Policy Amendments

- The process of formulating a comprehensive water sector policy will continue, in close co-operation with the development Water Resources Management Strategy implementation process. The activity will be a continuation of the first step towards a water policy: "Elements of the National Water Policy"

b. Water Rules and Regulations

- Prepare and submit a Draft Water Law for final approval and adoption.
- Empower PWA for performing the regulatory role in the water sector.
- Establish regulations for water resources protection and ensure enforcement.
- Activate PWA's functions for managing Palestine's water resources.
- Finalize the development of the institutional framework for the water sector, including the legal regulations, and pursue their endorsement by the Palestinian Authority.
- Empower rules and regulations for enabling integrated water resources management in Palestine.
- Resolve the legal, political and cultural complications concerning PWA taking over the established "private" water rights.
- Strengthen and start enforcement of the regulatory framework required to develop incentives to enforce and monitor compliance of water rights.
- Establish directives for addressing the issues of illegal wells and water connections and develop guidelines for appropriate resolution of these issues.
- Develop a consistent and integrated water legislation which will mandate that all relevant projects and proposals follow a consultative and transparent process with other key authorities

and stakeholders before endorsement, with the intention to avoid unnecessary gaps and contradictions in the legal framework;

- Develop the regulatory framework for restructuring and private sector participation in water and wastewater utilities, and complete the statutes for the national bulk water supply authority.

3.5.3 Build Institutional Capacity and Develop Human Resources

* Institutional Building

Background

Recognizing some exceptions, the different bodies and institutions, responsible for the service delivery functions either at the bulk or local levels in Palestine suffer from overall inefficient management, poor financial records. This critical situation necessitates the importance of strengthening the institutional capacities in order to raise their managerial and technical performance up to certain acceptable standards.

As stipulated from the National Water Policy the water sector should be regulated by one responsible body, with the separation of the institutional responsibility for policy and regulatory functions from those of service delivery. It is intended to establish three regional utilities in the West Bank and one in Gaza and one utility for the bulk water supply; and encourage involvement of the private sector in the funding and implementation of projects.

Objectives

The objectives of this strategic element will be to achieve the most appropriate Institutional arrangement in the water sector in the context of meeting sector sustainability.

Scope of Work

a. Water Sector Institutional Reform

- Identify challenges facing institutions within the new policy framework.
- Improve the management of water and wastewater services initially by building on existing water utilities, and then determine the appropriate water utility institutional arrangement for future development of the sector in consultation with other stakeholders;
- Continue the implementation of the water sector institutional reorganization including a detailed analysis of the roles and interactions between the institutions and stakeholders.
- Maintain the good working relationships with the National Water Council;
- Encourage the involvement of the private sector in the implementation of investment projects;
- Provide technical guidance for developing institutional capacity, planning and preparation of future water supply and sanitation service improvements.
- Ensure independent auditing, monitoring and reporting of the performance of the utility operators.

b. Economic Sustainability of PWA

- Strengthen the operational capacity and economic performance of PWA to undertake water management.
- Make an analysis of PWA's economic situation and future financing demands and sources of income.
- Develop an action plan and mechanisms for implementation.

"Human Resources Development

Objectives

To develop the human resources base especially the technical, managerial and executive capacity that is necessary to meet the demand of the water sector institutions.

a. Capacity Building and Training

- Implement strengthening of the new institutional structure.
- Analyze the actual training needs of the sector and guide the planning and implementation of an appropriate Water Sector Training Center. The training programs will need to be better and more specifically designed for the local situation and be more systematic and interactive than the recently offered training programs.
- Continuously train and develop the staff, including promotion of good staff motivation.
- Emphasize the role of local consultants as a strong domestic resources base.

3.5.4 Improve Information Services and Assessment of Water Resources

Background

The identification and evaluation of the potentials of the water resources in Palestine has been a continuous dilemma especially over the last 30 years. Only a few comprehensive hydrological studies have been carried out on the assessment of these water resources, and the available data on the magnitude of available water resources are both scattered and incompatible.

The exceptional complexity of the hydrological pattern in Palestine through which the resources are recharged and discharged, adds to the difficulties for the exact identification and evaluation of the availability of water resources.

Objectives

The overall objective of this strategy is to present reliable water resources information to decision makers and stakeholders and to ensure that the data and analysis are used effectively in both political dialogue and development activities. The immediate activities would be: (i) compilation and characterization of Palestine's water resources base by groundwater basin; (ii) overlaying of socio-economic data on the aquifer framework, assessment of the monitoring network, data management and information services; (iii) diagnosis of critical gaps and water resource limitations in relation to development needs and water rights negotiations.

Scope of Work

a. Monitoring Networks and Information Services

- Carry out a compilation, assessment and diagnosis of available hydrological/hydro geological data in relation to development objectives and water rights negotiation.
- Identify critical gaps in hydrological/hydro geological monitoring network design, operation and ownership and initiate measures to upgrade the networks to a suitable level.
- Summarize existing hydrological/hydro-geological and water use data.
- Identify critical gaps in information processing and dissemination and initiate solutions to address them - to include packaging for use at district and community level.
- Collate available socio-economic, environmental, and land-use data on the basis of the existing framework and assemble them and in the GIS system of the Palestinian Authority.
- Identify priority programs and projects for future capital or technical assistance related to water information services.

b. Water Laboratory Services

- Support and participate in ongoing projects aimed at strengthening of water analysis services in the West Bank and Gaza.
- Establish and operate a central water quality laboratory to carry out chemical and biological analyses.
- Identify accredited laboratories in Palestine to carry out more specialized analyses
- Developing guidelines for water sampling and analyses, and upgrading the water laboratory services.

c. Water Balance Assessment

- Enhance the knowledge and information base with regard to water balance and determination of safe yields, taking full account of linkages between precipitation, surface water and groundwater in the hydrological cycle. This assessment will be of great importance as a background for the water rights issues and evaluation of alternative combinations of options of available water resources.
- Evaluate projects related to water resource availability prior to issuing of licenses to water sector investments.
- Centralizing the responsibility of hydrological services including operation and maintenance of the hydrometric stations, data collection, quality assurance, data handling, and publication of all resources data and information.
- Developing appropriate data monitoring networks for water resources .
- Building capacity for data analysis and water resources assessment and provide rational information regarding water resources and “safe yield” of aquifers for the water right issues in the negotiation of the final agreement.

3.5.5 Regulate and Co-ordinate Integrated Water Supply and Wastewater Investments and OperationsBackground

Adequate and reliable water supply and wastewater infrastructure is one of the key elements needed for improving the socio-economic situation of Palestine. The investments needed for new water supply and wastewater infrastructure are estimated to be high.

Objectives

The objectives of the water supply and wastewater component is to develop regulatory and supervision tools for water and wastewater sector development, and initiate the implementation of these controlling and facilitating measures.

Scope of Worka. Regulatory Framework and Monitoring of Utilities

- Operationalize the regulatory framework for restructuring and private sector participation in water and wastewater utilities that has been developed under strategy 2 “Policies and Regulations”.
- Determine appropriate water utility institutional arrangements in order to improve management of water and wastewater services.
- Provide technical guidance, undertake project monitoring and ensure compliance with the management contract by the regional utility operators.

b. Water Tariff Structure

- The overall water and wastewater services shall be economically sustainable covering both operational and investment costs.
- The sewerage fee shall be integrated in the water charge.
- The tariff structure shall encourage water conservation.
- Cross-subsidization will be considered a measure to provide water for basic needs at affordable prices.
- The tariff system shall be practical to implement and enforce.
- Approve and introduce the new progressing water tariff structure for the water utilities and municipalities, including fees for sewerage and for untreated industrial wastewater.
- A pollution charge shall be considered added on for industrial pollution.

c. Water Resources Master Plans

- Continue development and co-ordination of Water Resources Master Plans, and Integrated Water Resources Management Plans for all Districts and Service Areas in Palestine.
- Prioritise and prepare water and wastewater sector investment plans and associated funding requirements.
- Estimate short, medium and long term investment needs.
- Establish investment “packages” identified in the Master Plans, and promote financing of the projects through international funding institutions.
- Identify and guide urban and rural investment projects.
- Promote and supervise rehabilitation and extension projects in areas where they are most urgently required, to improve the sufficiency and efficiency of water and wastewater services to customers.
- Identify and activate funding and financing resources and mechanisms.
- Enforce consistent water demand management and enable local governments to take over this responsibility

3.5.6 Enforce Pollution Control and Protection of Water Resources

Background

Emphasis on environmental objectives through the protection of catchment areas must increase significantly to avoid further water scarcity and quality problems:

- ◊ Environmental impact assessment (EIA), including public display and hearing, should be carried out for each project with anticipated environmental effects.
- ◊ Consider the need for preparation of national EIA Guidelines in cooperation with other relevant institutions.

Objectives

The objective is to develop the appropriate and efficient legal, regulatory and institutional instruments to enforce pollution control and protection of water resources through coordinated efforts between relevant institutions.

Scope of Work

a. Pollution Control regulations

- Establish water quality and effluent discharge standards according to pollutant type and sector.
- Develop and introduce enforceable penalties and regulatory techniques.
- Prepare Guidelines and commence the operationalization of the regulations developed under strategy 2: “Policies and Regulations

- Clarify responsibilities between authorities involved in monitoring and compliance of pollution control and land use, and implement necessary re-structuring of institutional functions.
- Ensure that the water/wastewater laboratory and data processing services are operational.

b. Licenses and Pollution Abatement in High Priority Areas

- Carry out rapid identification and assessment of high priority pollution problems ("hot spots").
- Issue discharge licenses and impose pollution control measures on the polluters in these areas.
- Follow up by implementation of water quality and pollution monitoring program.
- Prepare guidelines for customers fees and carry out billing and collection of sewerage fees and pollution charges for specific industrial discharges and large municipal plants.
- Enforce pollution control measures (construction of treatment plants, internal measures in the quarries, factories, etc.) and impose special charges on violators.
- Follow up by implementation of regular water quality and pollution monitoring programs.
- Initiate cooperation with relevant authorities and ministries in order to take the necessary and most efficient measures to protect vulnerable water resources.
- Evaluate and approve environmental impact assessment (EIA) for projects with potential environmental impacts.

3.5.7 Promote Public Awareness and Participation

Background

It is important to link the policies to people, keeping in mind that policy formulation and the setting of national priorities should occur with the involvement of all major water stakeholders (both users and managers). Stakeholders can be linked to policy-makers through existing organizations and forums at national, district and community level. The decentralization of responsibility and increasing accounting to primary stakeholders is an important success factor. As popular participation increases with an effective, two-way flow of information existing policies may need to be revised.

Awareness of water resources challenges, issues, and opportunities is an essential activity for improving water resources management in Palestine and needs to be enhanced:

- ◊ at the political level, to create understanding and commitment;
- ◊ at the executive level in PWA, as part of building capacity; and among the public, to create society-wide commitment;
- ◊ growing awareness will encourage public support of policy initiatives, such as tariff reforms, good governance, and decentralization of public decision-making;
- ◊ promoting and enabling local participation in planning, operation and management of water resources is a fundamental strategy for achieving sustainable development. Local involvement is a key to ensuring water demand management to monitor the performance of public and private institutions;
- ◊ local participation and unity is a cultural tradition in Palestine, rooted perhaps in coping strategies for collective survival under difficult conditions. It would be possible to benefit from this tradition to promote public involvement and enhance water resources responsibility and management in society at large. PWA should also consider to incorporate community members in the preparation and implementation of projects.

Objectives

The main objective of this strategy is to create incentives for a broad public commitment in order to enhancing participation of stakeholders in water management, and establish immediate and long term institutional and financing solutions for promotion of public awareness and participation .

Scope of Work**a. Public Awareness**

- Inform systematically about projects in mass media, Internet, pamphlets, etc.
- Implement a campaign to enhance the understanding of the need for water conservation and to prioritise the water allocation to economic sectors, such as agriculture and industry.
- Make public display and hear a mandatory part of the project preparation procedure.
- Encourage the Ministry of Education to include education in the understanding of the need for conservation and protection of water in the curriculum for all levels.

7.2 Stakeholder Involvement

- Create understanding and commitment at the political level.
- Identify constraints and opportunities to promoting a participatory approach to water management.
- Ensure widespread consultation in the process of completing and implementing the strategy through a "water forum" or similar instruments.
- Make public hearing a mandatory part of the procedure for preparation of new projects.

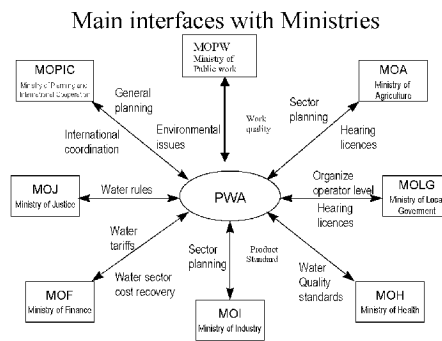
3.6. Implementation of the Strategy**3.6.1 Approach**

The institutional and regulatory framework for water resources management in Palestine will have to cope with a situation of growing water demand, deteriorating quality and conflict between different user categories as well as issues of water rights between neighboring countries. The needed approach to completion and implementation of the Water Management Strategy is the one that builds and utilizes local capacity and strengthens ownership, commitment and awareness among local institutions - public, private, non-governmental - and more broadly with civil society.

3.6.2 Institutional Arrangement

The implementation of the Water Management Strategy will entail specific analysis and actions related to a range of physical, hydrological, water use, institutional, human resources, economic, and environmental issues affecting the sector. An important aim of the implementation process is to strengthen national capacity for carrying out complex, multi-sectorial management and regulations in the water sector. The implementation of the Water Management Strategy will be a participatory process involving PWA staff and other key institutions and stakeholders such as the national water council, water related ministries, municipalities, and organizations in conjunction with limited outside experts if necessary, to carry out specific tasks.

There are a large number of stakeholders and in figure 6.1 some of the main connection with the ministries are identified. After the adoption of the Water Strategy one important step for PWA will be to invite the involved ministries and authorities to take part in the implementation and to establish a framework for the cooperation.



*Framework for
PWA Cooperation
with Main
Ministries*

The implementation will be organized by PWA, being the focal water resources management authority in cooperation with relevant stakeholders. The responsibility for elaborating each of the seven key elements of the strategy should be shared between the departments according to their main areas of responsibility as presented in Figure 6.1. It is, however, important to keep enough flexibility and cooperation in the system to allow the best possible staff teams for the respective tasks, and to facilitate future adjustments and required redistribution of responsibilities.

An implementation Task Force within PWA has been formed in order to achieve this flexibility and cooperation.

Strategic Element	Responsible Unit				
	Co-ordination and Public Relations Unit	Water Resources & Planning & Strategy Directorate	Regulatory Directorate	Technical Directorate	Administrative Directorate
1. Palestinians' Water Rights	■	■	■		
2. Policies and Regulations	■	■	■	■	
3. Institutional and Human Resources	■	■	■	■	■
4. Information and Water Resources Assessment	■	■	■	■	
5. Water Supply and Sanitation Regulation	■	■	■	■	
6. Pollution Control and Resources Protection	■	■	■	■	
7. Public Awareness and Participation	■	■	■	■	■
Primary Responsibility	■				
Participation	■				

indicative Sharing of Responsibilities for Strategy Implementation with PWA

3.6.3 Phasing

The figure below gives an overview of the time schedule for the implementation. The implementation of additional studies and accomplishment of water management actions according to agreed task descriptions. The periods of intensive activity versus periods of more routine-like work varies for each implementation block.

The West Bank has an average population density of approximately 250 persons per km², while the Gaza Strip has an average population of approximately 2,297 persons per km².

4.2 Land Use

Table 4.1 shows the land use classification for the year 1993.

Classification	West Bank		Gaza Strip	
	Area(km ²)	Percentage from total	Area (km ²)	Percentage from total
Various Forms of Agriculture	1783	32	179	49
- Irrigated by Palestinians	100			
- Irrigated by Israeli Settlers	40			
Built-up areas and public infrastructure	334	6	69.7	19
Forests, pastures and grazing lands	1783	32	12	3
Unusable land	1672	30	106	29
Total areas	5572	100	367	100

Table 4.1 Land use in Palestine (1993)

4.3 Climate

The climate of Palestine is of the Mediterranean type. There are two distinct climatic seasons, a wet winter and a dry hot summer. The rainy season extended from mid- November to the end of April with the lowest temperatures occurring in January and February, with maximum rainfall in January.

There is an abundance of sunshine in Palestine with an average radiation of 5000- 7500 kcal/square meter per day in the summer.

4.3.1. Temperature.

The average annual temperature for the western plains of the West Bank is 19degree C, while it is 17 degree for the mountainous region and 25 degree for the Jordan Valley. The average annual temperature in the Gaza Strip is about 21 degree C.

The average relative humidity in the West Bank varies from 50% to 70%. The minimum humidity occurs in June, while the maximum occurs in January. Because of its proximity to the Mediterranean Sea, the relative humidity in the Gaza Strip is higher than that in the West Bank, and ranging from 70% to 85%.

4.3.2 Evapotranspiration.

No direct evapotranspiration measurements are available for Palestine. Annual pan evaporation rates for the western parts of the West Bank are 1,900 mm/yr, while for the Jordan Valley around Jericho pan evaporation rates reach 2,600 mm/yr.

Typical pan evaporation rates for the Gaza Strip range from 2.1 mm/day in winter to 6,3mm/day in summer. Annual average pan evaporation rates in Gaza are about 1,900 mm/a. throughout the warm

season in the GS there is a soil moisture deficit which requires irrigation for cultivating crops. Only a few crop varieties with the ability to withstand water stress area able to survive the summer in the Gaza Strip.

4.3.3 Population.

The last census in Palestine was carried out by the Palestinian Bureau of Statistics in 1997. The total population (excluding East Jerusalem) is estimated at approximately 2.6 million. 62% live in the West Bank while the remaining 38% live in the Gaza Strip, while it is estimated that about 300000 inhabitant live in eastern Jerusalem. The West Bank has an average population density of approximately 287 persons per km², while the Gaza Strip has an average population density of approximately 2,724 persons per km².

The population growth rate in Palestine for the last five years ranged from 3.2% to 3.5% Demographic trends in Palestine have been related to the political development in the region.

The population is generally young. About 80% of the West Bank population and 75% of the Gaza Strip population are below 35 years of age. Israeli imposed restrictions on economic development and land and water use during the last 30 years coupled with the absence of major local investment, resulted in a noncompliance between population and resources, especially water resources.

4.3.4 Population Projections.

When considering or estimating the future population in Palestine, many factors have been taken into consideration such as the future population policies, population growth rates, immigration and the density of communities in Palestine. the situation of uncertainty regarding the mentioned factors requires proposing different scenarios namely low medium and high population estimates. Figure 1.2 illustrates the base scenario for population projections assuming that 0.5 million of Palestinian will return gradually to Palestine by year 2000. Population projections will be affected by the percentage natural growths which were estimated to range between 2-3% over 40 years (Middle East Regional Study on Water Supply and Demand Development,1996).

4.4 Water Resources in Palestine: Potentialities and Utilization.

4.4.1 West Bank

Before 1967, a total number of 774 wells had been drilled for irrigation purposes and domestic use in the West Bank. Currently (year 2000/2001) only 321 wells are still operating, and the rest have been abandoned, either because they were dried up due to their shallow depths, or were located in a military restricted area such as in the Jordan Valley. Others were not economically feasible to be operated due to their quantity of discharge and the high cost of operational or due to old age need to be rehabilitated. In 1976, the Israeli administration imposed and enforced regulatory measures (Military Orders No. 158 and No.92, 1976/77) restricting the quantities of water to be abstracted from the operating wells for agricultural usage, which consequently limited the irrigated areas. Through the period 1976-1994 the Israeli administration also did not allow any new drilling for agricultural purposes, except for a few substitute wells.

A major source for agriculture is springs water, which yields a mean annual flow of 56 MCM. However, no spring development whatsoever has taken place, which is a factor hindering the expansion of the cultivated area.

Even though between 1967 and 1994, the Israeli administration allowed the drilling of only 29 new wells to be operated solely for domestic use, the supply from these wells did not meet the minimum demand for the existing Palestinian community.

4.4.2 Gaza Strip.

In the Gaza Strip groundwater, the major source for water supply, is confined in the coastal aquifer and it is already being exploited beyond the level of natural recharge. Approximately 70% of the water is used for irrigation. It is estimated that there are 2000 registered agricultural wells in addition to 1000 unlicensed wells. The quality of the groundwater water is the main available fresh water in the aquifer.

4.5 Hydrologic Cycle.

4.5.1 Rainfall.

The water sources in Palestine come from the rainwater and sometimes from the snow, which falls during the winter season. The total annual rainfall has a large of variation from year to year and from location to location. Rainfall ranges from 150 mm/yr. in the Jordan valley to 700-1100 mm/yr. in the mountainous part of the West Bank. The mean number of rainy days per year ranges from 55 in the western part to 25 days in the eastern part.

The total annual rainfall in the winter season (October-May) determines the volume of recharge to the groundwater. Water is lost mainly by evapotranspiration, which constitutes the largest factor. Water is also lost by surface runoff, which constitutes a very small portion of potential losses. The nature of surface runoff, which constitutes a very small portion of potential losses is affected by the nature of the fractured and karstic limestone formations that outcrop in most of the West Bank. The long-term average annual rainfall for the West Bank has been estimated at 425mm.

Annual rainfall in the Gaza Strip, although the area is small, varies from about 400mm in the northern part 300mm in the middle area, to about 200mm in the southern part, with an overall annual average of 275mm.

4.5.2 Surface Water Resources.

Table 4.2 summarizes the available surface water (rivers and wadis) resource in Palestine

A- Jordan River Basin	(MCM/Yr.)
Average Surface Flow	1311
Palestinian Share	257
B – Seasonal Wadis	(MCM/Yr.)
Eastern Wadis of the West Bank (Jordan Valley)*	31.4
Western Wadis of the West Bank (Mediterranean Sea)*	63.7
Wadi Gaza	2
Total	97.1

- Table 4.2: Available surface water in Palestine (West Bank Integrated Water Resources management Plan, 2002)

4.5.3 Groundwater Resources.

The available groundwater is all renewable and is replenished by the rains and sometimes snow that falls during the winter season. The groundwater is found in shallow, intermediate, and deep seated aquifers ranging in depths from tens of meters to several hundreds of meters (from the Pleistocene gravels to the Lower Cenomanian lime stones).

There are six known aquifers in Palestine namely the Pleistocene, Neogene, Eocene, Turonian, Upper Cenomanian and Lower Cenomanian.

Table 4.3: Available Groundwater in Palestine.

Basin	Yield (MCM/yr).
a- West Bank Basins	
Eastern	172
North-Eastern	145
Western	362
Total West Bank	679
b- Total Gaza Strip	55
Total/Palestine	734

Source: Article 40 of the Oslo 2 Agreement

i. Springs

There are more than 500 springs and seeps distributed all over the West Bank, 303 springs had historical measurements with a total reported discharge about 56 mcm. Most of springs and seeps supply fresh water of excellent quality, and other springs supply brackish water, especially Dead Sea springs. The flow of the fresh water springs is used mainly for irrigation with only 16 springs for domestic purposes used to supply Palestinian communities with water through public water network. The brackish water springs which are located along the northern and western shores of the Dead Sea, are partially utilized at present by the Israelis for irrigation of palm trees and for recreation purposes.

In the West Bank, natural and structural springs and seeps issue their water from the limestone or dolomitic limestone water-bearing formations where the water intersects the land surface or by deep-seated faults and joints.

4.5.4 Flood Water

i. Natural Runoff.

Surface runoff in Palestine is intermittent and it occurs only in the event of high rainfall intensity. In the West Bank there were only three flood monitoring stations, namely Wadi Qilt/Jericho, Wadi Fari'/Jiftlik, and Wadi Maleh/Hammam Maleh. However, these monitoring stations have been destroyed during the first Intifada. Thus, small amount of accurate data for surface runoff through these wadis is available. There are other wadis in the West Bank that do not have any measuring monitoring stations. Of the surface drainage basins in the West Bank that do for runoff along wadis, there is an estimated 70 MCM/yr, of rainfall water lost through surface runoff. Some of this runoff could be utilized through water storage projects.

In the Gaza Strip, there are only three dry wadis: Wadi Gaza in the central part, Wadi Halib draining the depression of Beit Hanoun, and Wadi Salkaa fossil river. The Ministry of agriculture has estimated the temporary runoff in Gaza Strip to be about 25 MCM/yr.

ii. Urban Runoff.

Ten of the West Bank municipalities have storm-water collection systems. Nine of these have combined sewer systems and only one has a separate storm-water draining system. Estimated urban annual runoff is about 14 MCM. However, most of this runoff is lost. Only minimum amounts are utilized in rainfed cisterns to supply needed domestic water. Utilization of urban runoff could be done through expanding the use of rainfed cisterns. However, such systems are difficult to monitor for water quality and thus there might be a negative health impact. The other possibility is constructing small earth dams on the wadis draining from the cities to utilize urban and runoff for agricultural purposes or to enhance groundwater recharge.

4.5.5 Water Balance.

The groundwater recharge in Palestine is the direct infiltration of rainwater through fractured, karstic rocks and porous soils. The overall estimated natural recharge in Palestine is about 703 MCM/yr (see table 4.4 below).

Hydrologic Parameter	West Bank		Gaza Strip		Total
	Contribution to Water Balance		Contribution to Water Balance		
	Percentage	MCM/yr	Percentage	MCM/yr	MCM/yr.
Annual Rainfall	100	2248	100	101	2349
Evapotranspiration	- 68	-1529	-52.5	-53	-1582
Surface Runoff	-3.2	-71	-1.98	-2	-72
Natural recharge	28.8	648	45.5	46	694
Return Flow		RFWB	8.9	9	9+RFWB
Overall Balance		648+RFWB		55	703+RFWB

Table 4.4: Water Balance in Palestine.

4.5.6 Quality of Water Resources.

Water qualities from springs and wells in the West Bank are reported to be good, except in the Jordan River Valley where the groundwater (Pleistocene aquifer) is poor and salinity is high. In addition, there is a high potential for biological and other contaminant pollution, since untreated domestic wastewater continues to be discharged into the wadis as well as on agricultural land. New studies indicated some anthropological pollution in some wells.

In the Gaza Strip, the quality of groundwater is very poor. Water quality has deteriorated severely for a number of reasons. The most important is that sea water has intruded into the coastal aquifer due to over pumping. In addition, the fertilizers, pesticides and raw sewage water used in agriculture add to the pollution problem.

4.4.7 Water Consumption.

During the recent surveys on present water consumption in Palestine (1995), the industrial consumption could not be separated from domestic water consumption, therefore it is included in the figures of domestic water consumption.

Palestinian consumption from the groundwater resources (springs and wells) in the West Bank has been estimated at about 127.4 mcm for irrigation, domestic and industrial uses. The distribution of these quantities is shown in Table 2.2.

In Gaza, Palestinians are using about 103 mcm/yr, from groundwater. With a safe yield of only 55 mcm/yr, there is an over pumping of about 87%, and it is for this reason that groundwater quality is deteriorating.

The total water consumption in Palestine was estimated at 235.45 mcm/yr. In addition to that amount, 60 mcm/yr, are used by the Israeli settlements in both Gaza and the West Bank.

Location	Water Supply to the Palestinians MCM/yr				Water Consumption MCM/yr.			
	Wells	Springs	Improted	Total	Domestic and Industry	Agric	Israeli settlements	Total
West Bank	64.7	56.6	6.1	127.4	37.45	90.0	50.0	177.45
Gaza strip	103	0	5.0	108.0	48.0	60.0	10.0	118.0
Total	167.7	56.6	11.1	235.4	85.45	150.0	60.0	295.45

Table 4.5: Summary of Water Supply and Consumption in Palestine.

4.4.8 Current Demand.

The historic water consumption in the West Bank and Gaza Strip has been severely constrained due to the scarcity of the resource, high losses in the distribution networks and poor services. Accordingly, current water consumption does not reflect the actual current demand and cannot be used to predict future demands.

In general the per capita water consumption is maximum when the below listed criteria are met:

- The ability of water resources to meet the consumers' water demand.
- The ability of water resources to accommodate the optimum capacity of the water distribution system.
- The ability of water distribution network and conveyance system to meet consumers' demand
- Consumers ability to pay for the services.
- The community's financial ability and political inclination to subsidize water tariffs to fulfill water consumption needs.

Such conditions are only valid when the resource is relatively unlimited and where the consumers are paying for water supply and sewage treatment according to water consumption

4.6 Water Resources Requirements.

4.6.1 Demand Scenarios.

Based on the estimated demand projections, there will be a growing disparity between water demand and existing resources unless additional water resources are mobilized and developed immediately. Before this growing disparity between the demand and the available sources is discussed, water resources availability needs to be assessed. Due to the difficulties in predicting future demand from the current per capita consumption, it is vitally important to develop scenarios that can help make these forecasts. The Middle East Regional Study on Supply and Demand 1995, had developed three scenarios for the estimation of future per capita consumption. Table 3.1 shows the total demand for the base scenario which comprises demands for municipal, industrial and irrigation water.

	2001		2005		2010		2015		2020	
	WB	GS	WB	GS	WB	GS	WB	GS	WB	GS
Domestic & industry	70	63.5	88.4	99.6	127.7	124.2	178.8	151.2	239.3	182
Agriculture	146	91.5	149.6	92.2	167.3	88.3	205.9	83.7	316.1	79.7
Subtotal	216.9	155	238	191.8	295	212.5	384.8	234.9	503.3	261.7
Total	371.9		429.8		507.8		619.7		720	

Table 4.6 Project Demand, (mem) for Palestine (Bas Scenario).
Source: West Bank integrated water resources management plan 2002, and CAMP Report

4.6.2 Per Capita Consumption

The present domestic per capita consumption in the West Bank is estimated at 29.5m³/yr, including 41.1% unaccounted-for water. In the Gaza Strip this figure is around 39 m³/yr. As mentioned earlier, the current consumption is not the actual demand due to many political, and technical constraints accordingly the figures of per capita not be used for predicting future consumption in the various sectors. For comparison, the per capita consumption for domestic water use in Jordan is 53m³/yr, and in Israeli this figure reaches 100 m³/yr. Three scenarios were developed for the estimation of the future per capita water consumption. These are referred to as low, base and high scenarios.

In the base scenario, it is assumed that a rapid development and growth stage after the year 2000 will take place. This will lead to an increase in the living standards and perhaps will reach to a semi-sustainable economic growth that will allow for an increase in the per capita income. Based on this scenario, it was assumed the increase in the per capita consumption is 2.5%. table 3.2 shows these projections for the years 2000, 2010,2020 and 2040.

Year	Palestine m ³ /yr	Jordan m ³ /yr	Israel m ³ /yr
2000	50	74	105
2010	57	72	115
2040	83	86	145

Table 4.7 Per Capita Annual Water Demand for the Base Scenario

4.6 Wastewater

4.7.1 Reclaimed Wastewater in the West Bank.

Reclaiming wastewater for reuse requires collection, treatment and reuse systems. However, rural areas in the West Bank either don't have running water at all or don't have wastewater collection systems, even if they have running water. In villages, wastewater is collected in individual waste pits or cisterns where it infiltrates into the ground. Thus, there is in reality no wastewater to be reclaimed in the rural areas of the West Bank.

In urban areas, water is distributed in water networks. However, not all urban areas have collection systems for wastewater. Thus, only some urban areas can be considered for potential wastewater reuse, i.e. the ten cities with collection systems for wastewater and/or urban storm water. Thus, reclaiming wastewater in these cities will also include urban storm runoff.

At times, untreated wastewater is utilized for irrigating some vegetables, in both Nablus and Bethlehem. Such utilization is causing severe health effects on the public. There is no one single complete and safe wastewater reuse project in the West Bank.

The houses connected to wastewater collection systems consume about 12 MCM/yr., in the West Bank. Assuming that 80% of that amount is collected into a wastewater collection system, then the total amount of wastewater that could be utilized for reuse after constructing efficient treatment plants will be about 10 mcm/yr, or about 27% of the total water consumed in the West Bank. It was assumed that 80% of water will return to the wastewater collection system (when a house is connected to one) because most of the water usually returns to the system as minimal amounts are used in gardening (lawns are minimal in West Bank urban areas). Constructing efficient treatment plants in the nine municipalities could be done by 2010. Thus, by 2010 only 27% of water consumed in the West Bank could be utilized for wastewater reuse in agriculture.

4.7.2 Potential Wastewater Reuse.

To utilize wastewater for reuse in the West Bank, wastewater collection and treatment systems should be established and/or rehabilitated to operate efficiently. Such development requires large investment and gradual or staged timing. Therefore, the amounts of wastewater that could be utilized for reuse will increase gradually with time to correspond with the development of wastewater infrastructures in the West Bank. Timing of this development will depend on available funding for such projects, the size of population and the local government structures in the residential areas of the West Bank. Thus, residential areas are divided into the following three categories according to population:

- i. Urban areas (municipalities) with existing wastewater collection systems: The population of these areas was 514,611 in 1994, or 37% of the total population. Wastewater reuse in these areas requires construction and rehabilitation of wastewater treatment systems. Thus, possible wastewater utilization could be done by 2010.
- ii. Urban areas (municipalities) without existing wastewater collection systems: Population of these areas was 167,419 in 1994 or 12% of the total population. Wastewater treatment and collection systems need to be constructed. Thus, possible wastewater utilization could be done in 2020.

- iii. Villages with population more than 3500 in 1994: the population of these villages was 305733 in 1994, or 22% of the total population. These villages are expected to be recognized as municipalities by 2040. Considering natural growth, it is expected that each one of these villages will have a population of 1000 or more by 2040 wastewater reuse requires construction of wastewater treatment and collection systems. thus, possible wastewater utilization could be done in 2040.

4.9 Present Economic Aspects in the Water Sector.

4.8.1 Present Water Production Cost.

The current responsible institutions for running the drinking water extraction and distribution are regional utilities, municipal departments, village committees, village councils UNRWA offices. The water for agriculture is either operated by individual farmers or families or by collective or cooperative management, such as the Faria project in the Jordan Valley.

These different bodies suffer from overall inefficient management, poor financial records, from high unaccounted -for- water and do not have any sound financial records that one can rely on and use in deciding the present or actual costs for extracting and distributing the water. Thus, it is difficult to get the necessary information or the present cost of water that is needed for documented calculations.

In the Gaza Strip, agriculture is the largest water consumer. It uses about 70% of the total consumption. The cost of supplying irrigation water in the Gaza Strip, according to the World Bank in 1993, was around 12-14 cents per cubic meter, while the agricultural tariff is close to zero. The main reason for the low cost is related to farming on land with a very high groundwater table, or water exploited through private wells. The implication of this is that present costs in the Gaza Strip do not reflect the true value of water, and it does not include the real cost (capital cost, depreciation and services). The high level of losses has made the production cost greater than the price of water and thus no municipal department is balanced financially in both the West Bank and the Gaza Strip.

4.8.2 Present Cost Recovery.

At present, full cost recovery has not been achieved by water suppliers for both domestic and agricultural use. even though some utilities have achieved operation and maintenance (O & M) cost recovery, it should be pointed out that none has achieved the full cost recovery of both the O & M and the capital costs. This situation is not solely due to the existing socio-economic factors or to the affordability of payment of the public, as there are other internal and external factors within the utilities and their surrounding environment.

One of the most important causes of the inability to achieve cost recovery in the Palestinian water authorities is the high percentage of unaccounted -for- water which reaches in certain cases 60%. The small scale of the water networks, the poor management and the inappropriate pricing policies are other main obstacles.

4.8.3 Present Marginal Water Costs.

The marginal cost of water is the cost of producing and distributing the additional quantities needed to cover demand, including covering the needs of localities without piped networks, industry and agriculture.

In Palestine there is lack of elasticity in covering the water demand due to limited financial resources which are needed for investment in the infrastructure, lack of plans, the existing political situation and the institutional and operational short comings of the water institutions.

Therefore, it is assumed that the existing Palestinian needs will take at least 3-4 years to be covered. The outcome of the Palestinian Israeli Peace talks concerning water issues was supposed to be the agreement of both sides on doubling the water quantities the Palestinians can extract in order to cover the immediate Palestinian needs over the coming 3 years. However, the Palestinian water rights in the water resources in the West Bank have not been defined, the whole issue of water rights has been shifted to the final stage talks when dispute issues will be negotiated.

Therefore, when calculating the present marginal cost of water in a simple presentable way, certain assumptions must be made concerning quantities, investment, average depreciation ratio for assets and infrastructure capital and energy cost (according to different scenarios).

Brief Summary Views:

The management of limited water resources in the West Bank is complicated by a political situation in flux. Interim water rights established under the Oslo Accords have not yet been confirmed by final status negotiations. In spite of the uncertain political situation, government agencies established under the Palestinian Authority have continued to plan for development of the water sector.

The Palestinian Water Authority (PWA), established in 1995, serves as the primary regulatory agency governing the Palestinian water sector. By its own definition (PWA, 2000), the roles and responsibilities of the PWA include:

- 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 protection of water resources.
- Build public awareness and participation.
- Promote regional and international cooperation.

In an effort to fulfill these roles and responsibilities, the PWA has successfully developed a visionary National Water Plan, drafted and ratified a comprehensive National Water Law, and organized a National Water Council charged with providing ongoing guidance to water sector development. Figure 1 indicates the role of the PWA in the Palestinian water sector.

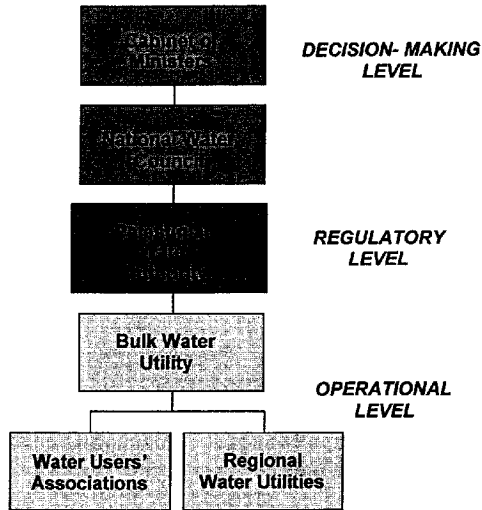


Figure 1
Water Sector Institutional Framework

Furthering their role as the regulator of the water sector, the PWA engaged in an effort to develop an integrated water resources management plan (IWRMP, 2002) for the West Bank which achieves consensus stakeholder objectives, quantifies resources and demands, confirms strategic principles for sector development and identifies specific actions for achieving stated objectives.

Water Supply and Demand

Integrated water resources management planning efforts included extensive study of the present (2001) supply of water to the West Bank as well as present and future demands for water. The study showed that there is a “gap” in the year 2001, between supply and demand of approximately 70 million cubic meters (CH2M HILL, 2001). This existing gap consists primarily of agricultural demand that cannot be met with present supply. Dependent upon the assumptions used in forecasting water demand, the “water gap” in the West Bank is projected to exceed 450 million cubic meters per year by 2025 if new supply is not developed and further demand management is not implemented. Figure 2 illustrates the baseline West Bank water supply in comparison with one suggested projection of future water demand (CH2M HILL 2002). This projected shortfall in supply has driven policy development and planning efforts in the West Bank and helped to define the strategic principles guiding West Bank water management efforts.

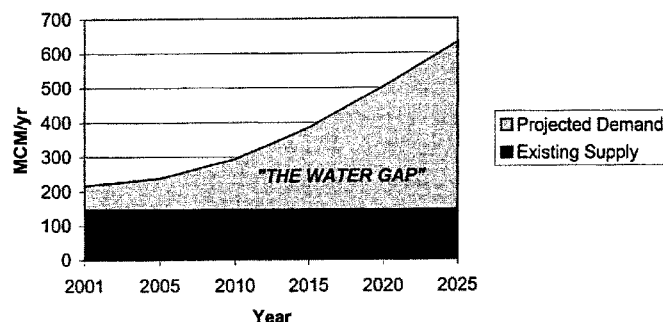


Figure 2
Comparison of Existing Water Supply with Baseline and Forecasted Water Demand in the West Bank

West Bank Water Resources Management Strategy

The goals, objectives, standards, policies, and priorities identified and clarified by the stakeholders during integrated water resources management planning (CH2M HILL, 2001) provide elements of a water management strategy in the West Bank. These principles and their implications toward water management action are described briefly below.

Resource Management

The resource management strategy in the West Bank is defined by the word sustainable. In general, sustainable management of a resource provides for long-term exploitation of the resource up to or below a level at which adverse conditions may occur. The water sector stakeholders have explicitly stated their goal of achieving sustainable management of water resources. This goal is a key principle of the water resources management strategy and has implications toward management actions that must be taken in the development of the water sector. Specifically, aquifer sustainable yields must be well understood and aquifer management plans defining specific well abstraction scenarios must be developed and followed. In addition, water quality must be protected to ensure a sustainable resource.

Conservation

In the West Bank, considerable volumes of water are presently being lost through physical inefficiencies in the water infrastructure. Reduction of these physical losses is an important strategic principle to be achieved through implementation of conservation programs. A target reduction of physical losses to 20 percent of the gross water supply has been established by key stakeholders. This implies water management actions which include improved metering, leak detection, and network rehabilitation.

Water Supply

Scarcity of water resources is perhaps the greatest problem facing the West Bank water sector. The West Bank water management strategy is quite clear in stating that supply should be provided to meet demand. As there is presently a gap between supply and demand in the West Bank, this strategic principle also implies action to either enhance supply and/or reduce demand. The strategy is not explicit with regard to how the gap between supply and demand should be filled.

Distribution

The strategy for water distribution is to improve accessibility to piped water for domestic users. A target of providing piped water to 100 percent of domestic users has been established by the water sector stakeholders. This target emphasizes the importance of developing water distribution; however, it may be difficult to achieve. According to World Bank data, 90 percent of the West Bank population presently has access to an improved water source. While not all of this is piped water (some is by tanker truck), this level of accessibility is comparable to the average (89 percent) for the Middle East and North Africa region. Water management action implications of this strategic principle include expansion of the West Bank distribution network in association with new supply development. The percentage of service connections can certainly be improved in the West Bank; however, the cost of achieving connections to 100 percent of the users may exceed users' ability to pay.

Wastewater Management

The strategy for wastewater management has two objectives: 1) to protect the environment and the quality of water resources and 2) to develop a new resource in reclaimed wastewater. In general, the wastewater management strategy is to eliminate raw wastewater discharge to the

natural environment through implementation of collection and treatment systems in urban West Bank areas and simpler treatment technologies (i.e., septic systems) in rural areas. Where possible, wastewater will be reused for agricultural, industrial, or other non-potable use. This strategy proposes that wastewater be used to replace existing fresh water demand or to meet natural demand growth, as differentiated from creation of additional demand. This strategic principle implies construction of urban collection, treatment, distribution, and reuse systems, as well as rural septic treatment or other small-scale wastewater management technologies.

Financial Management

According to the strategic principles set forth by the water sector stakeholders, all actions taken in the water sector must be financially viable. In other words, projects for which costs exceed the ability to pay may not be considered. A target of full cost recovery for water sector projects has been set. Stakeholders recognize that in the short term it may only be possible to recover O&M costs; nevertheless, it is recognized that both capital and O&M recovery is required for long-term sustainability of an independent (non-donor reliant) water sector. This principle of financial viability implies development of a sound tariff structure and continued development of bulk and local service utilities.

Institutional, Administrative and Legislative Development

The West Bank water sector strategy calls for adequate institutional capability to manage resources and water-related infrastructure and to regulate water sector activities. This necessarily implies capacity building actions in the areas of water resources management and O&M, and development of service utilities. Specific administrative and legislative actions are also implicitly implied to support the regulation of the water sector by the sector institutions. Specific institutional, administrative, and legislative actions will vary according to the selected water management scenario.

Mr. SMITH OF MICHIGAN. Thank you very much, Mr. Barghothi. The AID mission in Tel Aviv, our next witness will be Dr. Uri Shamir. Dr. Shamir.

STATEMENT OF URI SHAMIR, PH.D., DIRECTOR OF THE GWIRI, FACULTY OF CIVIL ENGINEERING, LAWRENCE AND MARIE FELDMAN CHAIR IN ENGINEERING, STEPHEN & NANCY GRAND WATER RESEARCH INSTITUTE

Mr. SHAMIR. Thank you, Mr. Chairman. Thank you very much. I am glad to appear here in front of the Committee together with my colleague Ihab Barghothi. Let me begin with some background on water and sewage in the region. It has been mentioned before by Committee Members that the whole area is arid or semi-arid and experiences large annual hydrological variability, has suffered periodically sequences of dry years and consequently severe water shortages. I propose to discuss water demand and supply in Israel, a situation that is paralleled in Jordan and the Palestinian areas, and then describe Israel's plans, going finally to the regional picture and to water as a means for regional cooperation.

Agriculture in Israel used to be a major user of water. More than 70 percent of the potable water was used in agriculture. During droughts the allocation for irrigation could be curtailed and this provided the necessary flexibility for management under conditions of hydrological variability. Water use efficiency in agriculture grew dramatically, greater value of product per unit of water, sometimes also referred to as more crop per drop.

As you know, Israel is the world leader in water use efficiency. Recycling and water conservation in industry has also been very successful. In the urban area, consumption per capita is relatively low, as compared to European and United States standards, and conservation efforts are continuing. However, urban demands are growing with the rising population. Today over half of the potable water in Israel goes to the urban areas, and it will grow by 2020 to over 70 percent of the available average natural potential. To meet the rising urban demands potable water allocation in agriculture has been reduced in Israel in the last few years by a factor of more than two. Many field crops have been discontinued, and the remaining crops are high investments and high value, such as orchards and greenhouses. These crops are much less flexible to water use restrictions under conditions of drought. Thus, all potable water consumption for the urban, agricultural and industrial uses is practically inflexible, cannot be used as a buffer for reduction during sequences of dry years. Thus, the only option in parallel with continued conservation and efficient use is to augment the supply of potable water.

In 2001, the Israeli National Water Development Plan was adopted, and it contains the following components: Continued strict protection and careful management of the natural resources, including replenishment of the depleted aquifers to sustainable long term levels; desalination of seawater, 500 million cubic meters a year, about $\frac{1}{3}$ of the natural water potential in five to six plants along the Mediterranean coast. The immediate plan has been set to 315 million cubic meters a year. In addition, desalination of brackish groundwater and advance treatment of polluted ground

waters, and import of 50 million cubic meters a year from Turkey. This is a political project, the component of the strategic relation with Turkey, even though it cannot compete successfully economically with desalination. And this brings me to the regional picture.

Large-scale desalination of seawater is the only viable long-term solution for water shortage in the region. Israel has suggested that a desalination plant be constructed for the West Bank on the Israeli coast. The plant would be constructed and operated by donor countries for the Palestinians. The space for the plant and the pipeline access to the West Bank will be provided by Israel. The West Bank would then be fed partially from local groundwater sources, augmented by desalination from a plant that can be increased over time as the demands rise.

I would like to contrast this with the Red Sea-Dead Sea Project that has been discussed. There you have to construct the entire project and invest all of the 4- to 5 billion dollars estimated today before you get the first benefit. Desalination on the coast can be done incrementally at lower cost, in my opinion.

Getting back to agriculture in Israel, as in Jordan and the Palestinian areas is not merely an economic activity. It provides other important national benefits, keeping open and green spaces, providing basic food supply, maintaining the social fabric of the agricultural community and keeping the population distributed throughout the land. To sustain this agriculture, the reduced fresh-water supply is augmented with treated sewage effluent. The quantity in Israel will be doubled in the coming years. Sewage poses a danger to human health, as Mr. Bromberg has said, to the environment and to water resources. If it is treated properly to high quality standards, it can be used for irrigation, for stream flow augmentation, for wetlands and nature preservation. As urban water use rises with the population, so does the amount of sewage that can be treated and returned for use. About $\frac{2}{3}$ of the water supply to the urban area can be recycled. There is therefore a very strong link between water and sewage. There can be no development of water supplies, especially for the Palestinians, without proper treatment of the sewage for reuse or safe disposal.

Sewage in the West Bank, as has been pointed before, poses a severe threat to Israel, as it flows downhill into Israeli territory as well as into the aquifer and is currently not treated at all or at best poorly treated. There is therefore urgent need to complete the planning, construction and continuous operation of about 16 sewage treatment projects on the West Bank, from the collection networks all the way to the effluent.

What is the current cooperation in the region on water? Jordan and Israel signed in 1994 a Peace Treaty in which water is a major component. Cooperation between the parties since then is excellent and no major problems have arisen that could not be settled amicably. The Palestinian Authority and Israel signed in September 1995 the interim Oslo II agreement in which water and sewage are prominent elements. The parties have made every effort to adhere to the agreement in spite of difficulties due to the current security problems. Regular meetings take place at all levels—policy, technical and field, and there have been joint declarations, “to keep water out of the cycle of violence.”

Water is practically the only domain in which the Palestinian Authority and Israel continue to cooperate effectively, even though this is hampered by the prevailing circumstances. The U.S. continues to play a vital role in helping the parties to work together and in resolving difficult issues. The United States chairs regular trilateral meetings with the Palestinian and Israeli delegations, at which both general and specific problems are resolved.

USAID has been an important force on the ground helping the Palestinians in addressing their water and sewage problems, especially planning, funding and responsibility for construction of water and sewage work. These activities of the USAID are currently hampered by security problems, but should be sustained nevertheless and resumed once conditions allow.

Another area of cooperation is joint research projects. They should be encouraged and funded, as it creates solid bridges of personal and institutional cooperation and enhances mutual understanding for joint problem solving.

What elements can we see for long-term solution? Elements of regional cooperation or management of the shared water resources is the mechanism for building peace in the region, as was stated in the call for us to testify. I believe Gaza is largely self contained. It will continue to get its water from local groundwater, augmented by local desalination and some import from the Israeli system as per the Oslo II agreement. The Mountain Aquifer will be managed jointly by Israel and the Palestinians based on the premises and principles of the Oslo II agreement. Major desalination on the Mediterranean coast and delivery directly to the West Bank funded by donors for the Palestinians, this is the only viable long-term solution for the West Bank.

The Palestinian-Israeli Joint Water Commission will continue to operate along the principles of the Oslo II agreement. The United States and other donors will help the Palestinians to develop their water systems and especially to construct and operate in a reliable fashion sewage treatment plants in the West Bank. Israel and Jordan will continue to seek jointly additional sources in both their territories, and the Jordan-Israeli Joint Water Commission will continue to operate as per the peace treaty. Israel will continue to control and carefully manage its natural resources and maintain full control of the sources in the north. The parties will continue to collaborate on conservation and efficient water use, protection of the quantity and quality of the natural resources, treatment of sewage and reuse of the effluent.

In a broader regional perspective, water from the great rivers in the north could become a component in the regional water and peace scheme. This would engage Lebanon and Syria in regional water management schemes for the benefit of all.

And, finally, joint projects of applied research, development, and application in desalination, hydrology, water treatment, sewage treatment and reuse should be promoted as valuable components of regional cooperation. Thank you.

Mr. SMITH OF MICHIGAN. Dr. Shamir, thank you.

[The prepared statement of Mr. Shamir follows:]

PREPARED STATEMENT OF URI SHAMIR, PH.D., DIRECTOR OF THE GWIRI, FACULTY OF CIVIL ENGINEERING, LAWRENCE AND MARIE FELDMAN CHAIR IN ENGINEERING, STEPHEN & NANCY GRAND WATER RESEARCH INSTITUTE

BACKGROUND: WATER AVAILABILITY AND USE

1. Israel has been using the full potential of its natural water resources for several decades, and has drawn down the sources below dangerous levels during sequences of drought years (e.g., 2001–2002).
2. Large hydrological variability is typical in the region. The average annual natural recharge in Israel's three main sources—the Coastal Aquifer, the Mountain Aquifer and Lake Kinneret (Sea of Galilee)—for the 70 year period 1932–2002 is 1457 mcm¹ (1.18 million acre-feet/year; 1,055 mgd;) with a standard deviation of 458 mcm/year. Over this period it has been as low as 657 mcm/year (less than half the average) and as high as 3563 mcm/year (2.45 times the average).
3. Water quality in the sources has deteriorated due to over-exploitation and to human activity above the aquifers. For example, over the 33 year period 1970–2003 average Chlorides concentration in the Coastal Aquifer rose from 160 to 260 mg/liter and Nitrates from 34 to 57 mg/liter.
4. The situation of the sources in Jordan and in the Gaza Strip is the same or worse.
5. On the demand side, Israel is a world-pioneer in conservation and efficient water use in agriculture and industry. Water productivity in agriculture grew by a factor of 5–10 over the last several decades.
6. Substantial conservation has also been achieved in the urban sector, and more is being done to constrain the rise in per-capita consumption.
For comparison: residential per capita water use (in litres per capita per day): Jordan—94; Israel—170; Italy—250; Canada—326; US single dwellings—382. Residential (home and yard) is about 2/3 of total urban use.
7. Urban demand keeps rising with growth of the population—from the current 6.7 million to 8.6 million forecasted in 2020. Even with a constant per-capita consumption, this will bring the urban use to about 960 mcm/year, over 70% of the natural potential.
8. Fresh water allocation to agriculture has been curtailed drastically—from a former consumption of 1,200 mcm/year to 530 mcm/year.
9. Total demand for potable water over the coming decade is forecasted to rise from the current 1350 to 1535 mcm/year, which exceeds the average natural replenishment and is far greater than the low values of replenishment.

CLOSING THE WATER BALANCE GAP: DESALINATION AND REUSE OF SEWAGE EFFLUENTS

10. Repeated occurrence of water-shortage crises due to droughts led to adoption in 2001 of a national plan to augment the supply through a 10-year program of sea-water desalination. It was initially set for desalination of about 500 mcm/year (~360 mgd)—over one-third of the natural potential!—to be produced in 6–7 plants along the Mediterranean coast. Subsequent decisions have reduced the immediate plan to 310 mcm/year.
11. Other sources to be developed: desalination of brackish groundwater in several suitable locations (50–60 mcm/year) and treatment of groundwater that is too polluted to be used directly.
12. Import of 50 mcm/year from Turkey is a “political project”, justified on the basis of the overall relations between the two countries, not on professional considerations or an economic justification.
13. Agriculture has national values beyond the narrow economic, including protection of open spaces and green environments, self-supply of basic foods, and maintaining the social fabric of the agricultural sector.

To sustain the required level of agriculture, the reduction in potable water allocation is compensated by the supply of reclaimed sewage—to be raised from the current level of 270 mcm/year to a projected 530 mcm/year. Soil salination and damage to plants associated with reuse of effluents have to be overcome by advanced (membrane) treatment of the effluents.

¹ 1 million cubic meters (mcm) = 810.7 acre-feet = 264.17 million gallons. 1 mcm/year = 0.724 mgd.

All figures in this report are rounded, for clarity of presentation.

14. The quantities of sewage increase with the rise in urban water use. Untreated or poorly treated sewage creates a serious danger to health, to water resources and to the environment.
15. On the other hand, properly treated sewage can be used for irrigation, flow augmentation in streams, and wetlands. About two-thirds of the urban sewage can be reclaimed for reuse.
16. Where there is no use for the treated effluents, they can be discharged into the environment without detriment—provided they are treated to high quality levels.
17. Similar solutions are relevant for Jordan and the Palestinian areas. Therefore Israeli researchers are cooperating with Palestinian and Jordanian colleagues in refining technologies for treatment and reuse of sewage effluents.
18. Israel faces a very serious threat of sewage from the West Bank percolating into the Mountain Aquifer, a major source of potable water for both Israelis and Palestinians, and flowing downhill into its streams.
There is urgent need to complete the planning, construction and operation of some 16 sewage projects in the West bank—collection, treatment and reuse or safe disposal. Funding for these projects, provided to the Palestinians, is a major concern. The plants must be operated by companies with proven international expertise and experience.

CONCLUSIONS OF THIS PART

19. In spite of great achievements in efficient water use in Israel, there is a negative balance between demands and the availability of natural supplies, a deficit that is growing with time.
20. The shortage is exacerbated by the large hydrological variability that is typical in the region. Sequences of dry years have resulted in serious deterioration of quantities and qualities in the sources.
21. A similar situation exists throughout the Palestinian areas and Jordan. Their situation is even worse, as they are land-locked (except for the Gaza Strip, and an opening for Jordan at Aqaba) and much of the demand is located at high elevations.
22. The entire region is water-short, and subject to large hydrological variability. Dividing the scarce natural water resources is not a viable solution for all Parties in the region. It must lie in production of very large quantities of new water, primarily desalination of sea-water.
23. Treatment and re-use of sewage effluents for irrigation, for nature and for stream flow augmentation is an important component of the solution, provided the sewage is treated to high quality.
24. Proper solution of the sewage problem in the West Bank is a critical element in solving the regional water and environment problem.

EXISTING REGIONAL COOPERATION

25. Jordan and Israel signed a Peace Treaty in October 1994, in which water is a major component. Cooperation between the Parties since then is excellent, and no major problems have arisen that could not be settled amicably.
26. The Palestinian Authority and Israel signed in September 1995 the interim Oslo II Agreement, in which “water and sewage” are an important element. The Parties have made every effort to adhere to the Agreement, in spite of the difficult security problems. Regular meetings take place at the field, technical and policy levels, and there is a mutual agreement “to keep water out of the cycle of violence”.
27. Water is practically the only domain in which the Palestinian Authority and Israel continue to cooperate effectively, even though it is hampered by the difficult security situation.
28. The US has played a critical role in helping the Parties to work together and in resolving difficult issues. The US chairs regular Tri-Lateral meetings with the Palestinian and Israeli delegations, at which both general and specific problems are discussed.
29. The US, through US-AID, has been an important force on the ground, helping the Palestinians in addressing their water and sewage problems. Carrying out studies, and especially funding and responsibility for construction of water and sewage works have a significant impact. These activities of

US-AID are currently hampered by security problems, but should be sustained nevertheless, and resumed fully once conditions allow.

30. Considerable regional cooperation in applied research is ongoing, and should be encouraged and funded. This is creating solid bridges of personal and institutional cooperation, which enhances mutual understanding for joint problem-solving.

ELEMENTS OF A LONG-TERM SOLUTION: REGIONAL COOPERATION IN MANAGEMENT OF SHARED WATER RESOURCES—A MECHANISM TO BUILD PEACE IN THE REGION

31. Gaza gets its water from local groundwater, augmented by desalination and some import from the Israeli system—as per the Oslo II Agreement.
32. Coordinated management of the Mountain Aquifer by Israel and the Palestinians—based on the principles of the Oslo II Agreement.
33. Major desalination on the Mediterranean Coast (proposed at Hadera) and delivery directly to the West Bank, funded by Donors for the Palestinians. This is the only viable long-term solution for the West Bank.
34. The Palestinian-Israeli Joint Water Commission continues to operate along the principles of the Oslo II Agreement.
35. The US and other Donors help the Palestinians to develop their water systems, and especially to construct and operate over time in a reliable fashion sewage treatment plants in the West Bank.
36. Israel and Jordan continue to seek jointly sources in both their territories for additional supply to Jordan, to be paid by Jordan, as per the Jordan-Israel Peace Treaty.
37. The Jordan-Israeli Joint Water Commission continues to operate as per the Peace Treaty.
38. Israel augments its own supplies as described above and maintains full control of its natural water resources in the North.
39. A attractive option would be a larger regional perspective, in which water from the great rivers in the North is a component in a regional “water-and-peace” scheme. This would engage Lebanon and Syria in regional water management schemes for the benefit of all.
40. Joint projects of applied research, development and application in desalination, hydrology, water treatment, sewage treatment and reuse are valuable components of regional cooperation. These activities build bridges and contribute to joint problem-solving.

Mr. SMITH OF MICHIGAN. Dr. Salameh.

**STATEMENT OF ELIAS SALAMEH, PH.D., PROFESSOR,
UNIVERSITY OF JORDAN**

Mr. SALAMEH. Thank you, Mr. Chairman.

The Middle East is an area of water scarcity, and historically agriculture developed when the amount of rain was sufficient to support plant life. Irrigated agriculture was practiced along water courses such as the Rivers Nile, Euphrates, Tigris, Jordan, Yarmouk, and others.

In the past, availability of water and the technologies used for its exploitation not only determined lifestyles and social economics, but also limited the population to the number which the amount of food produced could support. In the last few decades, the population growth rate has been very high, not only due to natural growth, but also as a result of refugees coming into the area.

The whole development of the Jordan River Basin since the early 1950s have been concentrated in agriculture, mainly irrigated agriculture, which created job opportunities for the refugees and also for the indigenous populations.

The development of agriculture has in the Middle East one limiting factor, and that is the availability of food. And the human ac-

tivities aggravated the natural scarcity of food in the area with the following results: Alarming growth rates of population; growing degradation of available water resources; increasing demand due to higher standards of living; and the still prevailing political hostilities and the various intentions and interests of the different countries.

The present situation in the area is that water levels are dropping; fossil water resources are being mined; salinization of aquifers is taking place; saltwater intrusions can hardly be avoided; irrigated agriculture, irrigated soils are showing increasing salinization; water quality degradation is on the increase, and water supplied for domestic users does not satisfy the hygiene and living standard demand. As a conclusion, the area is experiencing escalating water crisis, and water shortages are already chronic.

The challenge facing the Middle East countries is now how to develop the necessary technologies to better make use of the water resources in the area. This is one of the challenges.

The other challenge is subsidizing irrigation water. Irrigation water in the area is still subsidized by the different governments, and that will lead to the inability to satisfy the demands.

Jordan is the first and only country in the world which introduced prices on groundwater extraction for irrigation purposes. Although farmers pay the capital cost and the drilling cost and the running and operation costs of their facilities, they have to pay also for the water extracted for irrigation.

Desalination of seawater could alleviate the problems of coastal urban areas due to its relatively high cost. Desalination could be justified for drinking purposes, but not for irrigational purposes or for areas which lie far away from the coastline like, say, cities lying 320 kilometers from Aqaba and at the height of more than 1,000 meters above sea level.

Curtailling irrigated agriculture will have its ramifications on employment and food production in the area.

The whole problem in the Middle East and the water shortage problem was somehow affected negatively by the population increase of refugees coming from the outside, and the water quality is accordingly continuously degrading in the area. Therefore, now we are in a stage where we say that development in the Middle East area and the water sector of the Middle East area should be basinwide, as taken to basinwide aspects and the framework of sound economies.

I can see that the irrigated agriculture sector in the Middle East is supported by foreign laborers. We deliver the water, we deliver everything, but we don't have the workers for that. Importing workers from other countries or other areas just to support the irrigated agriculture sector is not a wise policy in the area.

The Dead Sea has been declining since the early 1960s, and now the level lies at something like minus 417 meters below mean sea level. And the impacts of the declining Dead Sea is—are, first of all, the decline in the Dead Sea which is accompanied by increasing groundwater flows into the Dead Sea to reach a new equilibrium along the interface, and then along the coastline the damage by the drop in the Dead Sea, and that damage is the formation of sink-holes affecting the whole area, not only in Jordan, but also in

Israel and maybe in Pakistan. Therefore, the Dead Sea level should be somehow reraised, and the Dead Sea canal is a must in the area, not because only to produce energy to desalinate water, but also to somehow stop the damage, environmental damage, of declining Dead Sea level and to return the situation to its former situation of the 1960s.

Jordan has exactly recognized its severe water situation and has accordingly developed its future water strategy with all the necessary programs, action plans, and projects. After that, rigorous planning and investment programs have been developed and have already started to be implemented.

We thank all donor agencies, USAID, GTZ, JAICA, and other donor agencies for the support of our programs, and we hope that the Red-Dead Canal will be somehow supported for the benefits of present and future generations. Thank you very much.

Chairman HYDE [presiding]. Thank you very much, Doctor.

[The prepared statement of Mr. Salameh follows:]

PREPARED STATEMENT OF ELIAS SALAMEH, PH.D., PROFESSOR, UNIVERSITY OF JORDAN

WATER RESOURCES IN THE MIDDLE EAST AND THE IMPORTANCE OF THEIR WISE MANAGEMENT

INTRODUCTION

Although water is the most abundant among the natural resources, the Middle East (ME) is among the least blessed areas of the world with respect to the availability of water resources, Vast areas in the ME are even bedeviled by hyper aridity.

The history of man in the Middle East (ME) throughout the last three to four millennia has been determined and shaped largely by one major infra-structural element, namely water. This essential resource has great influence over human life when it is scarce. In the ME, this basic factor; water determined the lifestyles of people, their socio-economics and their conflicts.

Agriculture developed when the amount of rain was sufficient to support plant life. Irrigated agriculture was practiced along water courses such as the rivers: Nile, Euphrates, Tigris, Jordan, Yarmouk, Farie, Kilt, Auja, Haroud and Zerka, springs and desert oases.

In the past, availability of water and the technologies used for its exploitation not only determined lifestyles and socio-economics but also *limited the population* to the number, which *the amount of food produced could support*. In the last few decades, the population growth rate has been very high, not only due to natural growth but as a result, of the waves of *refugees* coming into the area.

The whole development in the Jordan River basin has, since the early fifties been concentrated in agriculture, mainly irrigated agriculture, which entails developing water resources to be used for irrigation. *Irrigated agriculture has created job opportunities*, through less expensive investments, for both the indigenous and the immigrating population.

The development of irrigated agriculture has different limiting factors such as availability of suitable land, water, laborer etc. In the JR basin the limiting factor proved to be the availability of irrigation water, which in addition to its scarcity was a subject for conflicting interests of the different riparian countries and use sectors; of agriculture, domestic and municipal uses.

Thus, human activities aggravated the natural scarcity of water resources in the area, with the following results:

1. Alarming growth rates of population resulting in doubling the population of the different countries, sharing the JR basin, every 18 to 30 years.
2. Growing degradation of the available resources thus reducing their utility at their original quality.
3. Increasing demand due to higher standards of living, industrialization and irrigation.

4. The still prevailing political hostilities and the various intentions and interests of the different countries are superimposing the above characteristics, in addition to the fact that the different countries still share some of the water resources.

PRESENT SITUATION AND UNDERTAKEN POLICIES

Jordan, Palestine (West Bank and Gaza) and Israel are presently over utilizing their water resources by 20%, 15% and 7% respectively.

Generally, water levels are dropping, fossil water resources are being mined, salinisation of aquifers is taking place, salt water intrusions can hardly be avoided, irrigated soils are showing increasing salinisation, water quality degradation is on the increase and the amount of water supplied for domestic uses does not satisfy the hygiene and living standard demand.

As a conclusion, the area is experiencing escalating water crises and water shortages are already chronic.

The challenge facing the ME countries is to develop and introduce the *necessary technologies* to satisfy water and wastewater systems. The *increase in population* makes this challenge more difficult to achieve. The traditional policy of developing new water resources to satisfy needs, in the area, is almost exhausted. Now is the time to have *new policies* and changes in *management strategies* to fulfill this demand. Investment in leakage detection and maintenance, as an example seems to be a more economic way of increasing the *efficiency of water supply*. Leaking water from pipes and irrigation facilities represent a great loss because its cost is paid, but without any revenues. That water is collected, purified, pumped and distributed but it does not reach the consumer to pay for it.

Therefore, Jordan is implementing a rigorous rehabilitation program for its water supply system, with a cost of hundred millions of dollars.

Subsidizing irrigation water is still a prevalent policy in the area, where governments pay the capital cost of all the large irrigation projects. Although it is expected that farmers would irrigate their crops more efficiently if irrigation water prices would reflect the real cost. Pricing water at a lower cost has led to the *inability to satisfy the demand*.

Users of fossil water resources for irrigation pay only the pumping cost of the water, but not for exhausting the non-renewable water resources. Although these practices will certainly lead to the depletion of these resources and the loss of the future water and food security, yet, paying a certain cost might lead to saving and conserving at least part of the water and may lead to reconsiderations of economic feasibilities of certain projects.

Jordan is the first and only country in the world that has introduced prices on groundwater extracted for irrigation purposes. Although farmers pay, all the capital cost of drilling and the running cost of operation and maintenance, they have also to pay for the extracted amounts of water.

The introduction of prices for the groundwater extracted for agricultural uses (water extracted for industrial and municipal use is also paid for) was not an easy task, but the Ministry of Water and Irrigation insisted on that for the benefits of the present and future generation and the environment.

In the coming decade high cost projects, environmental hazards and tightened budgets will make large water projects unattractive and difficult to implement. Therefore, policy makers should change their strategies to lower the demand for water instead of increasing the supply, especially for irrigation.

The change to an efficient water economy is not an easy task, but such a change should start and continue. The technologies for that are available. Therefore, allocating more funds for improving the efficiency of water supply systems will make some expensive, environmentally unsound projects, unnecessary.

In Jordan, water saving devices are exempted of any tax. Water prices increase with increasing consumption. These policy measures aim at improving efficiency and savings in water use and consumption.

Desalination of seawater could alleviate the problems of coastal urban areas. Due to its relatively high cost, desalination could be justified for drinking purposes, which will also increase the amount of wastewater effluents and hence, the available water for irrigation.

Curtailling irrigated agriculture might increase domestic water supplies and alleviate the shortages, but such a measure would result in declining food production and foodstuff coverage, lower export revenues, higher hard currency expenditures for food imports, and higher unemployment with all its socio-economic ramifications in the different countries. Curtailing irrigated agriculture must therefore, be coupled with a transfer to industrialization, to guarantee jobs and revenues and to stabilize

the social and political systems. Such restructuring, from an agrarian to an industrialized, tourism or trade-dependent economy, would require large investments of time and money, as well as great deal of skilled planning, training and technological expertise.

An increasing problem already causing tremendous concerns to the Middle East countries is *water pollution*, which is not only leading to water pollution but also to diminishing available resources by making these resources less suitable for their present uses, or of no use for any appropriate purpose.

Governments funding for *environmental protection* and for guaranteeing adequate water amounts for *environmental services* is often unavailable or has a very low priority on the agendas.

REFUGEES AND WATER SHORTAGES

As a result of the different refugees waves from Palestine, Jordanian and Palestinian returnees from Gulf States as a result of the Gulf Wars, in addition to hundred thousands of Iraqis, the *population* of the country *increased by many folds*, each time within a few months. This migration put a great deal of pressure on the country's already severe water supply situation, especially during the dry season.

The citizens of the major urban centers in Jordan, has been since the early eighties suffering from a catastrophic water shortage. Water is pumped only once or twice a week through the networks, where it is then collected and stored in roof tanks for use during the following week or so. Almost every one is living at *the hygiene brink, where water use is concerned*.

Israel is also suffering from diminishing water resources, although it obtains around 1/3 of its consumed water from the Jordan River and another 1/3 from the West Bank and Gaza Strip.

For the last few years, *Israel has been rationing water*, mostly affecting the politically sensitive farming sector, which consumes around 75% of the country's water supply.

WATER QUALITY

It is not the *water quantity*, but its *worsening quality* that will bring us to our knees.

One thing is becoming clearer with every passing day; that the quality of our water resources is degrading rapidly, not only because of active pollution introduced by liquid or solid wastes, but also, and in increasing steps, by passive degradation due to salinization as a result of over-pumping and depletion of our groundwater resources base.

Water quality-deterioration problems are exacerbating and sharpening the severe water shortage of the area perceived under the prevailing economic, social, scientific and technological situations.

Regrettably, anti-pollution rules in some of the JR riparian countries are either unavailable or very vague. Even if they exist, they can be, easily circumvented. New rules have to be advanced to account for the prevention and repair of environmental damages.

In Jordan all towns of more than 20.000 inhabitants has been provided with wastewater collection and treatment systems. Each industry has to treat its effluents before discharging it to recipient wadis or water bodies. Additional wastewater treatment plants and reuse schemes are still needed. In addition, some of the existing wastewater treatment plants require improvements to reach at a better effluent quality.

Misuse of water resources, water pollution, over-utilization or not respecting sustainability principles and intergeneration equity indicate unsound water resources management. In this context, the cause of development should never be used as a reason to sacrifice the water resources whether quantitatively or qualitatively. Because doing so will bring the whole issue of development into vicious circles, in which degradation of water resources as a vital element of the environment may in turn, negatively, impact the development itself.

Therefore, development should be compatible with the water resources issues, especially their pollution and sustainability in the concerned countries with scarce or poor water resources. Accordingly, the appropriate management of water resources should be *basin-wide* and, should incorporate the management of their *environmental aspects*, altogether within the framework of *sound economics*.

Therefore, any project generating degradation of water resources without the mechanisms and economic instruments to repair that degradation can be, regarded as a misallocation and misuse of water resources, even if the negative impacts will *only affect other riparian countries*.

This implies that any water development plan whether for urban, industrial or agricultural use should include an economic feasibility aiming at beneficial objectives to the society. But, if the *basin-wide environmental* aspects of water resources development, use, disposal of waste water and reuse are not fully included in that feasibility, the benefits to the society remain partial or even only apparent. In this case the whole development is, in reality, on the long run detrimental to the society and not beneficial.

THE DECLINE OF THE DEAD SEA LEVEL

During the last five decades, water-development projects within the drainage basin of the Dead Sea supported a major part of the increasing agricultural production necessary to meet the food demand of growing population in Jordan, Palestine, Syria and Israel. The projects also created jobs for hundred thousands of refugees moving from one place to another within the area and for migrants coming from other places in the world. Thus, the development of the water resources within the drainage basin of the Dead Sea was very essential for the survival of people and it will continue to be for future generations.

During the early and intermediate stages of development; the 50's, 60's and 70's of the last century, almost no concerns were expressed about the impacts of the water resources development of the Dead Sea drainage basin on the ultimate base level of all the water resources of the surrounding areas, including the enclosed Dead Sea itself. This development deprived the Dead Sea of a major part of its incoming water, due to which its level continued to drop. The Dead Sea left behind its old shoreline and the nearby tourist facilities, hotels, spas, harbors far from the seawater.

One of the severest impacts of development and the lowering of the Dead Sea water level is the resulting seaward migration of the salt water/ freshwater interface. This caused billions of cubic meters of *fresh groundwater to replace saltwater* in the areas between former and present interface positions in order to reach at a new hydrodynamic equilibrium state (*375 million m³/ 1m drop in sea level*).

The unique configuration of the shallow interface between freshwater and Dead Seawater (density of 1.23g/cm³) is only about 1/10 of the equilibrium depth of the interface between freshwater and oceanic water. This makes the underground of the newly exposed shores, especially those composed of friable salty deposits highly vulnerable to flushing due to their instability and because of the fresh groundwater percolation caused by the retreat of the interface.

The freshwater flushing causes salt dissolution and fine particle removal, resulting in the creation of underground cavities, which in turn, caused ground-surface collapses in the form of sinkholes. These collapses endanger not, only people, but also infrastructure, hotels, spas, farms.

These facts have made us recognize that the Dead Sea and its drainage basin as one system requiring a "*comprehensive system analysis*" and an "*integrated program for restoration*".²

The *Dead Sea* is not a possession of one country in the Middle East. It is not only a possession of all the riparian countries of the Middle East, but also a *world heritage site*. Therefore, its use, benefits, problems and protection should bring nations together to make the best of its uniqueness. For that courage, wisdom and goodwill are required in order to avoid its destruction and to reach fruitful conservation schemes.

The *Dead Sea disaster* should worldwide serve to form an example of the results of *piecemeal planning despite the holistic nature of natural systems*.

Now, more than ever before, the Dead Sea level has to be restored to its former elevation of the 60's of the last century. *The Red Sea-Dead Sea conduit* is becoming more vital for all the Dead Sea riparian countries. This project will not only, rescue the Dead Sea itself, restore the depleting groundwater resources of the surrounding areas, *protect* the coastal areas from collapses and bring back the humidity to the surrounding areas, but it will serve as a project of *free cooperation for the benefits of all riparian states and the world community*.

Jordan has exactly recognized its severe water situation and has accordingly developed its future water strategy with all the necessary programs, action plans and projects. After that, rigorous planning and investment programs have been developed and have already started to be implemented.

CONCLUSIONS AND RECOMMENDATIONS

Although water is the most abundant among the natural resources, the Middle East is among the least blessed areas of the world with respect to the availability

of water resources. Vast areas in the Middle East are, even bedeviled by hyper-aridity.

Shared water resources in the JR basin are to allocate to the riparian states in a fair way through negotiations in order not to allow for future conflicts.

The development plans of the water resources should be redesigned to fit in a scheme of *basin-wide development*, in order to avoid conflicts, enhance cooperation and joint management of resources, avoid and alleviate pollution and conserve resources in the context of intergeneration equity.

If water resources are to continue yielding adequate amounts of water with suitable qualities, government interventions in the form of regulation, environmental laws, and pollution control standards become pre-conditional. Therefore, any consideration of water resources pollution should involve a fair judgment about the level of pollution, which can reasonably be tolerated and accepted by the society without compensation. The other important issue in pollution control is the legal acceptance of the principle that an activity could be restricted by governmental actions, if it is presumed (not proven) to be harmful.

This implies that polluters must obtain a "permission to pollute", otherwise they should not be allowed to cause any pollution. The permission should specify the quantity and concentration of the effluents allowed to discharge into the recipient water bodies. In such a case, effects on downstream areas have to be taken into consideration. This implies a basin-wide planning and utilization of water resources. Failing to meet the conditions laid down in the permission or to pollute without permission is, to deal with, as a criminal offence, even of states against each other.

The future of water supply, distribution and uses in the Middle East does not seem to be a continuation of the past. Demand is on the increase, new sources are hardly to find, aquifers are over-exploited and the cost of desalination or imports from water-rich countries is too expensive for the majority of the population.

Unless advanced concepts of water allocation and use such as socio-economic, environment, efficiency and intergeneration equity are introduced and applied in the near future in a wise, scheduled and comprehensive way, the area will certainly face one of its most severe socio-economic and intergeneration equity problems.

Droughts in the JR basin during the last decade resulted in the expressed wish to renegotiate the water sharing agreements. Hence, the basin-wide planning should incorporate drought potentials and risks in order to keep the peace treaties in a positive atmosphere by keeping the parties salient about any potential dispute.

Once the ongoing peace process fades out, the prognosis shows that even the peace accords and treaties have not solved and will not solve the water problems of the area, although, they might put an end to the claims and contra-claims of the different countries sharing the same source of water. If not deeply incorporated in a context of *basin wide planning, sustainability and security* water shortage problems in the area may calumniate and affect people's health, social security and lives.

Water does not recognize political borders. It only deals with hydrologic units, which are trans-boundary systems. Therefore, *sharing and cooperation among riparian countries are imperative*. Lack of cooperation and sharing among riparian countries deprives, first of all, nature of the environmental services of water. An example on that is the story of the Dead Sea declining level caused by diversion of its feeding waters by the different riparian. The drop in the sea level led during the last three decades to migration of its saltwater/fresh water interface in a seawards direction, with an average annual loss of around 375 million cubic meter of fresh water from the Dead Sea surrounding areas to the Dead Sea and to its underground extensions beneath the shores.

The drop in the Dead Sea level resulted also in the creation of new coastal areas, which due to their geologic nature became unstable after the fresh water started percolating through them. Sinkholes and land collapses were the results, damaging roads, farms, houses etc.

Chairman HYDE. Mr. Ackerman.

Mr. ACKERMAN. Thank you, Mr. Chairman.

In part, the scarcity problem, or at least the sense of urgency, stems from several years of drought in the region. Is the dry weather trend of recent years expected to continue? And how much does the prognosis for scarcity change if the dry spell ends? And how far can a change in the weather go toward fixing the water shortage? Mr. Shamir?

Mr. SHAMIR. Congressman, the change in weather or the climate change over time is much less significant than the hydrological var-

iability that we have been experiencing, say, in the last 70 years for which we have records. We have used the historical record to analyze the need in augmenting the natural resources by artificially produced water, namely through desalination. And we are able to overcome the deficits over time if we produce water to the tune of something like 300- to 500 million cubic meters a year.

The cost of desalination today is in the order of 60 cents per cubic meter. The cost of natural water is in the order of 25 cents per cubic meter, to use a round number. So it is something like twice maybe to three times the cost of natural water. And, indeed, as Professor Salameh has indicated, desalinated water is definitely possible for the urban areas releasing more water and producing then more effluence for irrigation.

Mr. ACKERMAN. Thank you.

Mr. Barghothi, do you agree?

Mr. BARGHOTHI. Well, again, I am an economist, but I should agree with Mr. Shamir. Mr. Shamir knows the science of hydrology better than me. I respect his opinion, and I totally agree with him.

Mr. ACKERMAN. Thank you.

Mr. Salameh or Mr. Bromberg, any?

Mr. BROMBERG. I think the dry spell has ended, and we have enjoyed 2 blessed years of heavy rainfall in the region, which has filled the Sea of Galilee, for instance, to the point where they have almost had to release water. And, nevertheless, we are in a semi-arid desert area where droughts will continue.

I want to respond to the question more to the point that I don't think we can see desalination as a comprehensive solution, as the end-all solution to our water problems. I see desalination as being part of a process to overcome drought years. But because we do live in the desert, water will always remain very scarce. If we are constantly going to be seeking to produce more and more water without dealing with demand management, there will be no end to the number of desalination plants we will require. On the other hand, we can conserve a lot more water by introducing water-saving technologies and raising awareness on water-saving issues.

We need to consider that desalination requires the burning of fossil fuels, and over time the price of fossil fuels is going to continue to rise, possibly rise dramatically. I think for the Palestinians and for the Jordanians, relying on desal is very, very expensive.

Mr. ACKERMAN. I thank you for—all of you, for those answers. I can't help but note the excellent cooperation between our two witnesses who are testifying electronically from Tel-Aviv. And it is interesting to note that on the scientific level how well Israelis and Palestinians can get along. And if that can only be transposed to the rest of society throughout the region, we would all be so much better off.

Mr. Bromberg, you say in your written testimony that at the moment both the Israelis and Palestinians do have the political will to move forward on the sewage treatment plants to preserve the quality of the Mountain Aquifer. But you go on to say the United States and Germany are reluctant to make the investment needed. That is a direct quote.

What is the reason for the reluctance? Do they see the situation differently than you do in terms of urgency and the value of such

a project? Are they concerned, as was Ambassador Satterfield, about the safety of the people involved because of the violent political situation?

And I guess you are slightly critical that the United States and Germany are reluctant to go ahead. An overriding question in my mind is, why is this up to only the Americans and the Germans, two very Western countries? Where is the Arab world on this? Where is Iran and Syria and Libya? Where are the Saudis? Where are the other Muslim countries throughout the world? Why does the West have to solve this problem? Not that we don't want to help, but why isn't pressure put on others who profess to be so greatly interested in this region?

Mr. BROMBERG. I really can't answer the question in relation to the other Arab countries. We have not researched that issue, but we have very closely researched the need for building sewage plants above the Mountain Aquifer. As I said earlier, there are 60 million cubic meters of untreated sewage pouring out above the aquifer, which is directly reducing its viability. That aquifer is currently the most important drinking water for Israelis and Palestinians. That sewage pollution will only add to the water scarcity with which we are concerned.

I think we heard for the first time from the Administration that there actually is a decision to suspend projects in Gaza. It wasn't clear to me whether that includes also water projects in the West Bank, but if indeed it does, then I think that is extremely unfortunate, because if we believe that water is an issue that promotes peace, that advances cooperation, then suspending water projects at this time certainly is not going to advance peace.

We certainly condemn the murder, the killing, of the American contractors in Gaza. But I think the point was made earlier that there has been no direct effort to destroy any infrastructure that the U.S. has built or that other donor states have built in the water sector. So I don't think there is the precedent that we can rely on at the moment that would justify a freeze on water projects.

I also think that we need to highlight who the people are who are suffering. The people that will suffer from a desalination plant not being built in Gaza are the Gazan population, whose hearts we want to capture, because they are currently drinking water unfit for human consumption. The water that we will contaminate in the Mountain Aquifer is water that will be less available for the consumption of Israelis and Palestinians. I think that that is the reason we should be so concerned with this decision to suspend water projects.

Mr. ACKERMAN. I appreciate that. And I concur with you 100 percent on the importance of water not just in people's lives, but in the process of making peace and stability and winning the minds and hearts of people in Iraq. I don't know if I mentioned Iraq before today, but in Iraq we might recall that the first thing that the people were asking for was water, fresh water, and that the infrastructure be restored or created so they might have that water.

I do thank the Chairman for calling this hearing. The issue of water is very important. I only wish some more of our Members who thought it was important earlier, I am sure they are all going

to be reading the transcripts, would be able to be here to hear this testimony that we have heard. It is very interesting.

Chairman HYDE. Thank you, Mr. Ackerman.

There are some questions that we would like to put to the witnesses both here and in Tel-Aviv, but we have another panel, and it is getting along. We expect votes soon; and I have great fear that we will not reconstitute our Committee after votes. So we are going to ask, if you will be kind enough, should we submit some questions in writing, to respond at your convenience, and I am sure you will.

[The information referred to follows:]

QUESTIONS SUBMITTED FOR THE RECORD BY THE COMMITTEE ON INTERNATIONAL RELATIONS TO GIDON BROMBERG, ISRAELI DIRECTOR, FRIENDS OF THE EARTH MIDDLE EAST, IHAB BARGHOTI, PH.D., ADVISOR, PALESTINIAN WATER AUTHORITY, URI SHAMIR, PH.D., DIRECTOR OF THE GWIRI, FACULTY OF CIVIL ENGINEERING, LAWRENCE AND MARIE FELDMAN CHAIR IN ENGINEERING, STEPHEN & NANCY GRAND WATER RESEARCH INSTITUTE, AND HAIM SHAKED, PH.D., DIRECTOR, THE MILLER CENTER, UNIVERSITY OF MIAMI

Questions:

Please describe to what extent the Israelis have benefited from regional cooperation in water related matters with Palestinians? Jordanians?

Based on your experience, have discussions in the water sector been going well between Israelis, Palestinians and Jordanians? To what do you attribute this relative stability?

What are Israel's main sources of water? Where are they located?

What is the water consumption of Israeli settlers in the West Bank and Gaza? Where do they get their water from? Do they have adequate sewage treatment plants?

Some high-level Israeli officials have said that importing water from Turkey is more about politics than need. Do you agree? Is importing water an appropriate solution to the problem?

What does it mean when the water level in the Sea of Galilee is below the "red line"? Is the "red line" adjusted to different levels?

How much water is allocated to agricultural use in Israel? What percentage of the agricultural sector is represented in Israel's gross domestic product?

In response to allegations that settlers use a disproportionate use of water in comparison to Palestinians, some assert that all their water, or perhaps all their agricultural water, comes from within the Green Line. Is this accurate? What proportion of the water used for residential or industrial use comes from within the Green Line? Is this from surface water or ground aquifers?

How many desalination plants are in Israel? How much water do they supply and to whom? Are there any plans to build any more? How does the price of desalinated water compare with the price of alternatives (i.e., bringing in new supplies from Turkey, conservation, other water generation technologies)?

In the 1995 Oslo II agreement, Israel recognized Palestinian water rights in the West Bank. Is this agreement a sustainable foundation for enhanced regional cooperation in the future? What about Israel's agreement with Jordan on water-related matters?

RESPONSES FROM GIDON BROMBERG TO QUESTIONS SUBMITTED FOR THE RECORD BY
THE COMMITTEE ON INTERNATIONAL RELATIONS

Question:

Please explain how community partnerships that protect important water resources have influenced the political climate. Have you found that cooperation in the environmental area promoted positive dialogue between Israelis and Palestinians?

Response:

The FoEME program, called Good Water Neighbors has brought together 11 communities; 5 Palestinian, 5 Israeli and 1 Jordanian—that constitute 5 sets of neighboring communities. The communities are on either side of the Green Line or border with Jordan. The communities literally see each other and most importantly share a common watershed. The failure of our national governments to advance peaceful relations and dialogue have led some communities that are on the 'front line' to agree to take the initiative themselves and try to solve their common problems, particularly as regards water and environment.

Our experience not only in the Good Water Neighbors project but in all our joint activities is that once individuals or communities start to dialogue on concrete issues such as environment, where political borders are irrelevant, they begin to understand that we are all dependant on each other and that cooperation is a necessity for the welfare of all our peoples.

Question:

What role do young people play in the "Good Water Makes Good Neighbors" program?

Response:

One of the main features of the program was to create a group of "water trustees" in each community. These are volunteers, mostly young people that meet once or twice a week after or during school hours, depending on the community, to undertake water awareness activities. For the first year of the project, a field researcher focused much of his/her attention on educating this group on their local community water and environment issues. Increasingly, though, these water trustees have served as messengers on water awareness to their communities as a whole. They have undertaken surveys of their own water reality, worked to collect signatures on common water petitions to solve their local water related problems, affixed water saving devices in public buildings, and converted their own schools into water saving buildings. With the start of each new school year, a new group of water trustees has been created in addition to the earlier groups.

Question:

Right now your organization has created eleven existing partnerships. Does your organization have the capacity to increase the communities participating in your programs? How much money and time would it take to accomplish this?

Response:

When we launched the project in 2001 we had to convince communities to join. Today new communities approach us all the time asking if we can work with them but unfortunately we lack the resources to allow them to join. If funding was found we could triple the amount of communities we are working with to 33 within 6 months. We now not only have the interest and the contacts but we have the expertise to bring in new communities effectively.

Question:

What are the major challenges to regional cooperation on water resources?

Response:

The lack of an overall peace agreement between the Israelis and Palestinians is the major obstacle. The Israeli and Palestinian water officials' state off the record that the water allocation issues have for the most part been agreed to. The officials claim however that they cannot be accepted unless part of an overall package. This approach is problematic as it denies us the opportunity to advance on at least one final status issue—water and hence help create the good will that we so badly need to move forward on the other issues.

Water issues should not be used by either side as a bargaining tool. Water for domestic purposes is a basic human right and treatment of sewage is a necessity to protect the fresh water resource itself.

Question:

What percentage of the groundwater in the mountain aquifer in the West Bank is allocated to the Palestinians? Israelis? Is this rate proportion to need and population figures?

Response:

Precise figures are hard to come by and what figures that do exist are disputed. From research undertaken by FoEME however we estimate that at least 80% of the waters of the Mountain Aquifer are utilized by Israel, leaving the Palestinians around 20%. However what constitutes a fair allocation is not simple and cannot be based just on population figures. International law is not clear on water allocation issues but allows much room for interpretation. For some 200 Palestinian villages that are not connected to a water network, the lack of water is great and their need for more water clear. Palestinians must receive a higher proportion of the waters of this aquifer and off the record this is agreed to by some Israeli officials. The tragedy though is the failure to finalize the negotiation on water allocation is preventing cooperation and joint management of the Aquifer which is so badly needed.

Question:

Have the Israeli, Jordanian, and Palestinian governments been receptive to your organization's concerns? Are there areas that require improvement?

Response:

In most cases receptive but not cooperative in actions taken on the ground. There is a general lack of understanding as to what the role of the public and advocacy groups are. Officials generally believe water issues to be national security issues and hence are reluctant to make public, information, that is vital for meaningful public participation to take place.

Question:

What is the impact of use (or overuse) of the aquifers? Who is more responsible for the overuse of aquifers—Israelis within the Green Line, settlers, or Palestinians? Is any remediation possible? Whose water use is most efficient?

Response:

The Mountain Aquifer is managed as a resource by the Israeli Water Commission. It is this Commission that determines who and how much is pumped out of the Aquifer. Prior Commissioners allowed the Aquifer to be over pumped or managed at its red line level which was very dangerous. The present Commissioner thankfully changed this policy.

Question:

Are there sufficient wastewater recycling plants in Israel, the West Bank and Gaza, and Jordan? If not, what is being done to increase the number of plants available?

Response:

In general, in Israel proper there is high-level sewage treatment. Over the Mountain Aquifer however, a recent FoEME report revealed that the sewage of some 2 million people who live above the aquifer is not treated at all or insufficiently to prevent water pollution. Apart from El Bira a medium sized Palestinian city, there exists no other operating sewage treatment plant of the Palestinians in the West Bank. Most Israeli settlements also do not treat their sewage adequately if at all. In Gaza sewage pollution is very serious. In Jordan too there is insufficient sewage treatment and the treatment that exists is often inadequate.

In an area of such water shortage proper treatment of sewage to turn it into a resource at least for agriculture should be a regional priority. The governments need to do much more. Responsibility here lies with the donor countries too. The building of sewage treatment facilities has not received the priority required and projects agreed to have been delayed.

Question:

Do the water-scarce countries of the Jordan River Basin have the appropriate water infrastructure in place to store and distribute large amounts of desalinated water?

Response:

Not my expertise to answer.

RESPONSES FROM IHAB BARGHOTHI, PH.D., TO QUESTIONS SUBMITTED FOR THE
RECORD BY THE COMMITTEE ON INTERNATIONAL RELATIONS

Multi Lateral Working Group on Water Resources has benefited the Palestinians through the implementation of a series of projects that aimed at improving the monitoring of the water quality in the region as well as increasing the awareness to the water related issues. The program was implemented in the region with the cooperation of Palestine, Israel and Jordan.

Meetings with the Israeli experts are done periodically and at different levels. At the Israeli-Palestinian Joint Water Committee, and the Joint Technical Committees. This is done as a co-ordination venue between the two sides on the various projects and programs that would be implemented in the West Bank. Other meetings are being held among the different experts through academic activities and NGOs.

The USAID is considered the main funding program in the water sector in Palestine, and has been considered as the driving force in bringing greater access of water to the Palestinian population. Such programs have been discussed in the Israeli-Palestinian water committee, and are being used to bring both sides to a common understanding to the water issues in the area. It should be noted that the USAID has been active in the Tri-lateral meetings that are held quarterly between the Palestinian side, the Israeli side and the US government. Such meeting has bridged the gap between the two sides.

The Palestinian Ministry of Education has been one of the target groups through which the awareness was raised on the water related issues. This has been done through the multi-lateral working group when a book was published in Palestine, Israel and Jordan under the title "Water" and was distributed in schools.

The agriculture sector uses close to 75 percent of the fresh water when its share in the GDP reaches to less than 30 percent. The Palestinian economy is still an agrarian economy and many Palestinian families depend on the revenue that is generated from the agriculture. Accordingly, the Palestinian Water Authority has the strategy of building wastewater treatment plants, and uses the treated effluent in agriculture. The fresh water would then be reallocated to the domestic.

The Palestinian Water Authority is the Regulator of the water sector. The Bulk utility is in charge of producing water and distributing it to the communities at the Bulk meters. The water department in the municipality and village council would then be responsible for the distribution of water within the communities' boundaries.

The only surface water that the Palestinian population has an access to is the Wadi (valley) runoff. Currently, there is no access to the Jordan River. The Palestinian communities depend on the springs and some Wadi runoffs and the water is distributed through water tanking. The sources are not safe and not monitored. In the other areas, the abstraction from the aquifer is the source, and is distributed through the networks. In the West Bank, there is no over-abstraction from the aquifer since a ground water model was built to be a management tool for the aquifer. In the Gaza Strip, the aquifer is being depleted through the over-abstraction. However, the coastal aquifer has a lower water quality than the mountain aquifer in the West Bank due to the sea water intrusion and the infiltration of herbicides and pesticides.

The average per capita consumption for the Palestinian individual varies from one governorate to another, and hence it gets between 45 l/c/d and 95 l/c/d. But it should be noted that there are more than 300,000 Palestinians living in close to 240 communities that have no distribution networks, and depend on getting their water supply from the water tankers.

In the mountain aquifer, the Palestinian side has control over 25 percent of the aquifer while Israel controls 85 percent. Such has a direct impact on the ability of the PWA to put together and implement an effective water policy. However, the PWA has put together its policy and strategy (included in the materials that was sent earlier in the Background) bearing in mind the limitations that we face.

The PWA has adopted the construction of a series of wastewater treatment plants in the West Bank and Gaza in order to protect the aquifer and find an alternative source of water for agriculture. Such plans have been funded by the German government, and more recently by the USAID. So far, only one operating treatment plant is operational, AL-Bireh treatment, and the efforts are underway to construct 4 more. The main limitation of the construction is permitting in addition of the availability of funds for the capital investment.

There has been some reported cases where the Israeli settlers from Kiryat Arba' would sell water to the Palestinians from the adjacent city of Hebron. The price of the cubic meter reaches as high as 20 Israeli Shekels (4.44 USD) compared to the average price of 4 NIS (0.89 USD). The sale is not illegal, but it should be noted

that the water supply that comes through the Israeli company Mekorot to the Palestinian communities is reduced during the summer times in favor of keeping, if not increasing, the water supply to the Israeli colonies.

The Israeli wall has been used to separate the Palestinian communities from their agriculture wells and agriculture land. There have been cases where the wells are located fully on the wrong side of the wall with no or limited access to the site; and in some cases the well is located on one side where the agriculture land is located on the other side. The access to the sites is controlled through some gates that are manned only twice a day, one time in the morning when people want to cross to the other side to tend their land, and the second time in the afternoon when the people are ready to go back to their homes. During the two times, the gates are shut down. No compensation has been given to Palestinians who lost their main means of living.

RESPONSES FROM URI SHAMIR, PH.D., TO QUESTIONS SUBMITTED FOR THE RECORD
BY THE COMMITTEE ON INTERNATIONAL RELATIONS

June 28, 2004

To: Lara Alameh
Committee on International Relations
Congress of the United States

From: Professor Uri Shamir
Stephen and Nancy Grand Water Research Institute
Technion -- Israel Institute of Technology

Re: **Reply to Additional Questions**

Dear Lara,

Please find below my replies to the points listed in the attachment to your letter of May 26 – numbered in the sequence of the points/questions raised. I expect that you did receive by fax the corrections I made to the transcript.

1. Israel has provided more water to its neighbors under the agreements than before. Thus the Jordanians and Palestinian have benefited from additional water. Israel gained in the broader context of improved relations towards a peaceful settlement, by demonstrating that it intends to deal with water in a cooperative manner, while it protects its own rights.
2. As stated in my written and verbal testimony, Israel's discussion with Jordan and with the Palestinians have proceeded very well, especially in view of the difficulties encountered in the last three and a half years. This is probably due mostly to the fact that the matter has been left to a considerable extent in the hands of professionals, who understand the importance of providing water to the population and for economic activities and can work together, and because the politicians on both sides approve of the policy of "keeping water out of the cycle of violence".
3. Israel's main sources are:
 - a. Kinneret - in the North, from where the National Carrier – the backbone of the Israeli water system - takes its water.
 - b. The Coastal Aquifer and along the Coast of the Mediterranean Sea - some 130 km long and 10-30 km wide, between a few meters and 200 meters thick, over which a major part of the population reside.
 - c. The Mountain Aquifer – under the West Bank, with three sub-basins:
 - i. Western - flowing into Israel, towards the Sea
 - ii. North-Western - flowing into the Israeli Valleys of Yizrael, Harod and Beit-Shean and Harod
 - iii. Eastern - which flows to the Jordan Valley.
4. Settlers in the West Bank and Gaza use similar amounts to the rest of the Israeli population – in the order of 100-110 cubic meters per person per year. In both Gaza and the West Bank the water comes partly from local

groundwater and partly imported from the Israeli system. The wastewater treatment plants of the Israeli settlements in the West Bank are adequate and mostly operate well. Palestinian cities, towns and villages lack proper sewage treatment, except in a few places. The situation in Gaza is poor, and raw sewage is barely contained.

5. Agriculture is allocated 530 million cubic meters a year (mcm/y) of fresh water (about one-third of the total available). This is the allocation to agriculture, and it will not increase. The fresh water is used to irrigate high-value perennial crops. Agriculture uses an additional amount of 270 mcm/y of treated wastewater effluents. The intention is to increase this to about 550 mcm/year, while upgrading the treatment to remove salinity.
 6. Much of the water supply to Israeli settlers in the West Bank comes from the Israeli water system. There is little Israeli agriculture in the West Bank. Israelis use more water per capita than the Palestinians, resulting from: life style and economic standard, better water supply systems. Water supplied to the West Bank from the Israeli system is a blend from the various sources, as it is throughout the entire Israeli system, so it is not possible to identify the proportion of the specific sources.
 7. There is an urgent need in more sewage treatment plants, and – even more important – in making sure that they are operated effectively and reliably. A sewage treatment plant that does not operate properly (or not at all!) is worse than not having one at all, since without a plant there usually is some arrangement for dealing with the sewage, while the construction of a plant may lead to the false sense of security that the problem is solved, and no alternate way for dealing with the sewage is included in the plan. The situation in Israel is far better in this respect, although Israel also needs much greater investments and upgrading of existing plants. Wastewater treatment must include removal of salinity, which has become a major problem to soils, agriculture, the environment, and the water resources. Israel will therefore be moving to membrane treatment of effluents.
 8. This continues the previous answer: much more needs to be spent to collect, convey and treat urban sewage to a high quality level, then deliver the effluents to reuse - irrigation, flow augmentation, nature and wetlands - and/or safe disposal.
 9. Lack of sufficient over-year storage is a major problem. The hydrology is highly variable, so large storage is needed in order to smooth out the variability and provide a reliable long-term supply. Because the total storage is not large enough, and also because the quality of water in sources is constantly under stress, the entire region faces frequent shortages. Israel's large sea-water desalination plants, as well as those planned in the Gaza Strip, will be operated in coordination with the availability of natural water and the need to restore groundwater aquifers to safe storage levels. The distribution system requires expansion, but the most acute problem is the use of groundwater storage.
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RESPONSES FROM HAIM SHAKED, PH.D., TO QUESTIONS SUBMITTED FOR THE RECORD
BY THE COMMITTEE ON INTERNATIONAL RELATIONS

Question:

How much water is allocated to agricultural use in Jordan? What percentage of the agricultural sector is represented in Jordan's economy?

Response:

- a) Water allocated to agricultural use in Jordan amounted to 430 MCM in 2003 coming from groundwater and surface water that equals 54.5% of all the used fresh water. In addition, about 76 MCM/yr of treated water were used for restricted irrigation representing about 8% of all water uses.
- b) The percentage of agricultural sector is represented in Jordan's economy as direct contribution of 3.2% and as indirect contribution of approximately 10%.

Question:

If the status quo remains, when will Jordan completely be out of water?

Response:

Jordan's strategy and policies emphasize the utilization of all water resources. According to the investment plan prepared for the years 2002–2011, which describes the future water projects with a total cost of 3.5 billion US\$, Jordan will have a deficit of 345 MCM/yr by the year 2015. To meet the projected deficit Jordan is exploring the development of non-conventional water sources such as, the Red Sea—Dead Sea water conveyance, multi-purpose project.

Question:

What type of water rationing system takes place in Jordan? Do systems vary from rural to urban areas?

Response:

Water rationing has been taking place in Jordan since the early 1980's, where water is distributed through the water supply network only once a week for 24–48 hours for both rural and urban areas.

Water prices are regulated through increasing block tariffs, where small consumers obtain subsidized water, whereas big consumers pay more the costing prices.

Question:

What is the average working budget for the Ministry of Water and Irrigation?

Response:

The average working budget for the Ministry of Water and Irrigation is around 500 Million US\$ per year, including loans, grants and direct government contribution.

Question:

How would you assess Jordan's concern for the environmental degradation of the Dead Sea Basin? Would you say that Jordan has found an adequate balance between development and environmental concerns?

Response:

Jordan has been at the forefront of raising the issues of the environmental degradation of the Dead Sea Basin through various regulations and schemes. A Master Plan has been developed that clearly defines the planning and environmental impacts of the various development activities such as; tourism, agriculture etc on the Dead Sea Basin. One recent example was shifting the site of the Mujib dam at great expense to help protect one of the ecological sub-systems of the Dead Sea.

Jordan has been working hand in hand with NGOs, environmental organizations and stakeholders to address the raised environmental concerns of any water project. Jordan has developed its vision of the area through the "Protecting the Dead Sea Initiative", which, with the support and backing of region partners, namely Israel aims at saving the environment of the Dead Sea and the surrounding areas through sound policies and long-term vision. Jordan is also exploring the possibility of listing the Dead Sea area as a world Heritage site and/or Man and Biosphere with the UNESCO.

Question:

Are there sufficient wastewater recycling plants in Israel, the West Bank and Gaza, and Jordan? If not, what is being done to increase the number of plants available?

Response:

Jordan has a master plan including studies to expand in building wastewater treatment plants including reuse schemes. At present, the municipal wastewater of the main cities is treated in 19 treatment plants. In addition some universities, hospitals, military camps have their own wastewater treatment plants and reuse schemes. All industries in Jordan have to treat their water before discharging it to the environment. There are plans to construct 16 additional municipal wastewater treatment plants to further expand the service and to reuse the expected effluents. These projects will be implemented after securing the financial support.

Question:

Are the governments of the Jordan River Valley spending enough money on much needed sewerage networks and treatment plants?

Response:

Jordan has developed a wastewater master plan for the Jordan Valley area. Recently, a wastewater treatment plant was constructed in Al'twal area (Middle Jordan Valley) with the assistance of the Canadians. There are also plans to expand in wastewater treatment in the Jordan Valley area upon the availability of necessary finance. Several wastewater treatment plants in the highland areas were constructed in order to improve the quality of water flowing towards the Jordan Valley to help protect its environment.

Question:

Do the water scarce countries of the Jordan River Basin have the appropriate water infrastructure in place to store and distribute large amounts of desalinated water?

Response:

No, Jordan does not have the necessary infrastructure for that, and I believe that neither Israel nor the Palestinian Authority possess such systems.

Chairman HYDE. I want to congratulate our two guests in Tel Aviv. I think the fact that one is a Palestinian and one is an Israeli and they both have a common cause is a sign that this subject has great potential for peacemaking as well as agriculture. So we will excuse you then, and thank you for your marvelous input. And, believe me, your papers will be read. Thank you. And thanks to our friends in Tel-Aviv. Thank you.

Chairman HYDE. Dr. Franklin M. Fisher is the Jane Berkowitz Carlton and Dennis William Carlton Professor of Microeconomics at the Massachusetts Institute of Technology, where he has taught since 1960. Professor Fisher has published 16 books and over 150 articles in the area of economics. He has also served for more than a decade as Chair of the Water Economics Project, and he holds a doctorate from Harvard.

Dr. Haim Shaked is the Founding Director of the Sue and Leonard Miller Center for Contemporary Judaic Studies at the University of Miami. Dr. Shaked is here today representing the Taplin Middle East Peace Project with respect to the Jordan Basin and the restoration of the Dead Sea. Dr. Shaked holds a Doctorate from the University of London School of Oriental and African Studies.

We are honored to have you all appear before the Committee today. We salute your patience as well as your learning.

And, Dr. Fisher, would you proceed with a summary of your statement. If you could confine it and capsule it to 5 minutes, give or take. The rest of your statement will be made a part of the record.

STATEMENT OF FRANKLIN M. FISHER, PH.D., JANE BERKOWITZ CARLTON AND DENNIS WILLIAM CARLTON PROFESSOR OF ECONOMICS, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Mr. FISHER. Thank you, Mr. Chairman. I shall try.

Chairman HYDE. Will you push the button on your mike?

Mr. FISHER. Yes. Is that better? I said, thank you. I will try to keep it down. My usual talk on this subject runs about 8 hours.

But in any event, Mr. Chairman, Members of the Committee, it is a privilege to testify before you today. As the Chairman mentioned, I am the Chair of the Water Economics Project, which is an international project of Israeli, Jordanian, Palestinian experts, some of whom have, in fact, testified here today facilitated by the Government of the Netherlands.

The assertion is often made, and we heard it today, that disputes over water will be a major cause of war, perhaps especially in the Middle East. But there is an outside-the-box way of thinking about water problems and water disputes. That way involves thinking about the economics of water. And when this is done, water disputes and negotiations that appear to be a zero-sum game can be seen to be transformable into win-win situations, with water becoming a source of cooperation rather than of conflict.

I begin with an example. No matter how much one values water, one can't rationally value it beyond the cost of replacing the water. That means the cost of desalination on the Mediterranean coast puts an upper bound on the value of water, and one can compute what that is. As Professor Shamir stated, that cost is about 60 cents per cubic meter and, in fact, is expected to fall. That means that a cubic meter of water can never be worth more than 60 cents in the large cities or the coast.

But water in dispute between Israelis and Palestinians isn't on the coast. A good deal of it is underground in the Mountain Aquifer, and it has its own costs. It would cost roughly 40 cents a cubic meter to extract and convey to the cities of the coast. That calculation, that says that ownership of Mountain Aquifer water can't ever be worth more than about 20 cents per cubic meter per year.

Now, 100 million cubic meters per year is a very large amount of water in the Mountain Aquifer dispute, and what I have just said is that 100 million cubic meters of Mountain Aquifer water per year is never going to be worth more than roughly \$20 million per year, and, in fact, our estimates are that it is going to be worth much less. This is rounding error in the national accounts, particularly for Israel whose pre-intifada GDP was approximately 100 billion per year. To put it more dramatically, even so large an amount of disputed water is not worth the purchase of a fighter plane.

Now, the major lesson to be learned here is not that desalination is the efficient answer to the water dispute problem. It is an answer; it is not, in fact, an efficient answer at least in the short run. The lesson is rather that it is really important to think about water in terms of water values rather than only in terms of water quantities.

Water, despite the fact that it is essential for human life, is not beyond price. In fact, there is no shortage of water for human consumption in the region, at least if you permit desalination. The

problem is rather that there is no cheap water for agriculture. Water can and should be thought of as an economic commodity, although one that has very special attributes. If one does so, the water problem can be monetized, deemotionalized, and put into perspective.

Our project has produced a computer-driven tool for the rational analysis of water systems. That tool is called WAS, W-A-S, for Water Allocation System. It produces a simulated market solution that takes into account the special attributes of water and shows how to allocate the available water to maximize the benefits obtained from it. It permits the user of the tool to impose constraints on the solution that reflects social values of water that are not just private values.

When this is done, WAS, among other things, produces a system of prices called shadow values that can be used to guide decisions just as prices do in actual free-market situations, but that reflect the social value of water. Those shadow values are the efficient prices with which to guide international cooperation in water. For a single country, you can use this tool to evaluate the costs and benefits of proposed infrastructure projects or of new sources of water, and we have done that for all three of the parties under discussion today. But WAS can also be used to facilitate negotiations and in design of a regional system of cooperation.

I shall begin with negotiations. I have already pointed out that you can use WAS to enable water negotiations to be recast in monetary terms rather than in terms of matters of life and death. Further, by using WAS a party can evaluate the effects on it of different water ownership settlements, and the results can be quite surprising. For example, use of WAS for Israel shows that the loss of the water sources on the Golan, which was mentioned earlier today with regard to the Syrian negotiations, or for that matter of the entire flow of the Hasbani River, a river over which the Lebanese proposal to pump generated very heated controversy not very long ago, that in normal times, in nondrought times, this would cost Israel only about \$5 million a year, and even in drought times no more than about \$50 million if it lost either one of those water sources entirely. I am not suggesting that it is appropriate for Israel to give up those water sources; I am simply saying this is not the sort of stuff of which wars ought to be made.

Most important of all, WAS can be used to guide cooperation in water. Such cooperation would take the form of an agreement to trade permits, as it were, to use each other's water at WAS-produced prices. This leads to very large gains to all participants and is a superior solution to the standard water treaty. Project results show that there would be big benefits to both Israel and the Palestinians from such an arrangement; benefits could bring gains to each of them larger than the value of ownership of more or less the disputed water is ever going to be. Beyond that, such an arrangement would bring the gains from a flexible cooperative arrangement in which allocations change for everyone's benefit as populations grow and incomes and technology change. That form of an agreement could turn water from a source of stress into a source of cooperation.

I now present some examples, bringing this down to a more level of greater specificity.

Our results strongly show that it would be beneficial for both Israel and the Palestinians if there were a water recycling plant in Gaza with some of the output sold to Israel for agricultural use in the Negev, where there is effectively no aquifer to be polluted. That means that Israel has a positive economic interest in assisting with the financing of such a plant. That is a fairly inexpensive confidence-building measure in an area that does not impinge on the core issues separating the parties.

Next, without some form of cooperation there is going to have to be desalination in Gaza. Indeed, if the problem is not resolved, they are going to have to pump the desalinated water uphill to the southern West Bank or have Israel propose to do it. That is not an efficient way to supply the West Bank. Under a cooperative agreement, one could avoid this. The Palestinians would use more water on the West Bank; Israel would supply more water to Gaza.

Now, I should mention two more things, and then I will close. One is that in addition to this tool, we have produced another tool specifically used for analyzing the effects of water issues on crop choice and agriculture, a critical issue as to, among other things, the Palestinians in the West Bank, Jordan's rural population, and, if this were expanded to other areas, the fate of the marsh Arabs in Iraq.

The other thing I want to point out is that it should not escape attention that similar progress could be made elsewhere; for example, in the rebuilding of Iraq's water system, in aiding infrastructure development in Saudi Arabia, and in the resolution of water disputes among Iraq, Syria, and Turkey, possibly building a regional cooperative water authority. This may be the moment to start making something like that come true, and I certainly believe it is the moment to start expanding on the cooperation already existing among Israel, Palestine, and Jordan.

The tools are available with which to solve water conflicts and assist the countries of the region in efficiently dealing with water management and infrastructure. And this may be, if I may say so, the time to jump-start an area of agreement between Israelis and Palestinians and actually get moving out of the impasse.

Chairman HYDE. Thank you, Dr. Fisher.

[The prepared statement of Mr. Fisher follows:]

PREPARED STATEMENT OF FRANKLIN M. FISHER, PH.D., JANE BERKOWITZ CARLTON AND DENNIS WILLIAM CARLTON PROFESSOR OF ECONOMICS, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

WATER AND COOPERATION IN THE MIDDLE EAST

1. INTRODUCTION

Mr. Chairman and Members of the Committee, it is a privilege to testify before you today.

My name is Franklin M. Fisher, and I am the Jane Berkowitz Carlton and Dennis William Carlton Professor of Microeconomics at MIT, where I have taught for 44 years. Most relevant to this proceeding, however, is the fact that, for more than a decade, I have been the Chair of what is now named the "Water Economics Project" (WEP), an international cooperative effort of Israeli, Jordanian, and Palestinian experts, facilitated by the government of The Netherlands with the knowledge—and sometimes the assent—of the three regional governments.

The assertion is often made that disputes over water will be a major cause of war in the present century, perhaps especially in the Middle East where water and disputes over water are among the seemingly everlasting problems. In particular, water issues are seen as forming an important part of the Israeli-Palestinian problem and are, of course, very important for Jordan as well.

This comes about because water is usually considered in terms of quantities only. Demands for water are projected, supplies estimated, and a balance struck. Where that balance shows a shortage, alarms are sounded and engineering or political solutions to secure additional sources are sought. Disputes over water are also generally thought of in this way. 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 others, so that one party's gain is seen as the other parties' loss. Water appears to have no substitute, so that it can only be traded for other water.

But there is another way of thinking about water problems and water disputes, a way that can lead to dispute resolution and optimal water management. That way involves thinking about the economics of water and shows, in fact, that water can be traded off for other things. When this is understood, water disputes and negotiations that appear to be a zero-sum game can be transformed into "win-win" situations, with water becoming a source of cooperation rather than of conflict.

In particular, dealing with—and perhaps settling—the Israeli-Palestinian water issue can be done in a way that involves relatively inexpensive confidence-building measures, benefits both parties, and does not impinge on the real core issues of either side.

The methods that can be used to accomplish these ends already have been developed. I now discuss that development and the methods themselves. (More detailed discussion is elsewhere available.¹)

2. THE WATER ECONOMICS PROJECT (WEP): WATER VALUES

To understand the principles used by the WEP, it is convenient to consider the following example—a version of which started the WEP:

Water is a scarce resource, and scarcity can breed conflict. But, no matter how much one values water, that value cannot rationally exceed the cost of replacing the water. Hence, the availability of seawater desalination puts an upper bound on the value of water for any country that has a seacoast. Moreover, that upper bound is not very high, as can be seen in the following rough calculation:

- a. The cost of desalination on the Mediterranean coast of Israel and Gaza is at most 60¢ per cubic meter and is falling as technology improves.² That means that a cubic meter of water can never be worth more than 60¢ in the large cities of the coast.
- b. But the water principally in dispute between Israelis and Palestinians is not on the coast; it is underground in the so-called Mountain Aquifer, much of which lies beneath the hills of the West Bank. That water would cost roughly 40¢ per cubic meter to extract and convey to the coast. *Hence, ownership of Mountain Aquifer water cannot be worth more than 20¢ per cubic meter per year (60¢—40¢).*
- c. 100 million cubic meters (MCM) per year is a very large amount of water in the Mountain Aquifer dispute. It is almost certainly larger than the true distance between the parties' negotiating positions. *But 100 MCM of Mountain Aquifer water per year can never be worth more than roughly \$20 million per year (100 MCM x 20¢), and the WEP's estimates are that it is worth much less. This is rounding error in the national accounts—particularly for Israel, whose pre-intifada GDP was approximately \$100 billion per year.*
- d. To put it more dramatically, *even so large an amount of disputed water is not worth the purchase of a fighter plane.*

¹The most complete published paper is F.M. Fisher, *et al.* "Optimal water management and conflict resolution: The Middle East water project", *Water Resources Research* 38 (11), 25(1)–25(13), November 2002, submitted with this testimony. This paper contains examples of the use of the tools for both infrastructure analysis and conflict resolution.

I also submit a less technical forthcoming paper, F.M. Fisher, "Water Value, Water Management, and Water Conflict: A Systematic Approach".

It should be noted that the estimates of the value of cooperation in these papers are now known to be greatly understated, due to additional information that has been incorporated since they were written.

²Indeed, I am informed that current contracts call for a cost of \$.50 per cubic meter. This makes the conclusions in the text even stronger.

- e. Note, however, that, while desalination plays a central role in this example, it is not the efficient solution to the water problem (although it may contribute). The WEP's results suggest that (under proper management) desalination will not be efficient on the Mediterranean Coast of Israel and Gaza for at least the next 15 years, except in times of extreme drought. The scarcity value of water on the Mediterranean Coast (the shadow value of water as defined below) is unlikely to be high enough to justify either desalination or Turkish imports.

The major lesson to be learned here is that it is important to think about water in terms of water *values* rather than only in terms of water *quantities*. Water, despite the fact that it is essential for human life, is not beyond price.

Indeed, the question of whether there is "enough" water is not well posed. As the example shows, any country with a seacoast can have as much water as it wants, provided it is willing to pay for it. But whether it is so willing will depend on water values. And such values are different for different uses, for some uses have a high priority and a high value, while other uses have a low priority and a low value. Proper analysis of water problems must deal with this.

In fact, there is no shortage of water for human consumption in the region being considered. The problem is rather that there is no *cheap* water for agriculture. Agriculture that must operate on fresh water is not profitable; hence, agriculture must either be subsidized or must use treated wastewater.

Further, consider the following: A country that owns water and uses the water itself does not obtain the water for free. Rather it incurs an opportunity cost—giving up the money for which it could have sold the water. Naturally, it will choose to do this if it values the water more than the money and will not do it if it values the money more than the water. *But this is no different from the behavior of a buyer that purchases water if it values the water more than the money required to make the purchase and refrains from purchasing if it values the money more than the water. Note that this means that the questions of who owns water and of who optimally uses the water, while both potentially important, are unrelated, different questions.*

In sum, water can and should be thought of as an economic commodity—although one that has special attributes. By doing so, the water problem can be monetized, de-emotionalized, and put in perspective. One finds that *water can be traded off for other things*. Water negotiations should not be left solely to water negotiators who, quite naturally, have traditionally thought only in terms of water quantities.

3. THE WAS TOOL: SIMULATED MARKETS

Using such principles, the WEP has produced a computer-driven tool for the rational analysis of water systems and water problems. The tool is called "WAS" (for "Water Allocation System").³

WAS deals explicitly with water values. In so doing, it departs from the standard (but inadequate) mode of thinking about water only in terms of quantities and provides guidance along market-driven lines.

Of course, the standard economic answer as to how to allocate scarce resources is through the use of free markets. However, there are circumstances in which that answer needs to be modified. In particular, the use of actual markets works correctly only if those markets are competitive and then only if all the social benefits and costs of resource use are reflected in private benefits and costs and hence in private profit and loss calculations.

Neither condition is true of water. In particular, many countries (including Israel and Jordan) subsidize water for farmers, implying that water used for agriculture is regarded as more valuable to society than the price that the users (farmers) are willing to pay. To take another example, water use surely has environmental consequences not borne by private parties alone. Beyond all this, water and water quality have implications for the spread of disease—and societies have interest in that beyond the interest of particular patients.

It is possible, however, to produce a simulated market-driven solution that corrects these problems. One way to describe WAS is to observe that it does exactly that.

WAS models the water economy of the area studied (country, territory, region). It takes information on demand, water sources, and infrastructure—actual or projected—and shows how to allocate the available water to maximize the benefits ob-

³There is another tool ("AGSM") that permits the analysis of the effects of varying water policies and availability on crop choice and agriculture generally. I shall not discuss that in detail here.

tained from it. In so doing, it permits the user of the tool to impose constraints—constraints that reflect the social values of water that are not just private values. (For example, the user can specify that water be made available to certain users at set prices or that a given minimum amount of water be allocated to certain uses.)

When this is done, the output of WAS also includes a system of prices (“shadow values”) that can be used to guide decisions just as prices do in an actual free market. But these shadow values reflect the social values of water whether private or public. As further described below, these shadow values are the efficient prices with which to guide international cooperation in water.

4. USES OF WAS: SINGLE COUNTRY

For a single country in isolation, the WAS tool can be used to evaluate the costs and benefits of proposed infrastructure projects. Among other examples, the WEP has used it to evaluate the benefits of:

- a water recycling plant in Gaza (see below);
- projects designed to bring badly needed water to Amman;
- the construction of an additional Israeli pipeline to supply Jerusalem.

WAS can also be used to assess and guide water policies.

Further, the WAS shadow value of water in a particular location gives the price that a country should be willing to pay for an additional source of water at that location. Such a source can be a desalination plant, the development of a new well area, or even imports from outside.

For example, Turkey is a water-rich country and has proposed at various times to export water to others by sea or pipeline. The use of WAS by prospective importers of such water (Israel, Jordan, or the Palestinians, for example, or even Iraq) can show the price that they should be willing to pay for it.⁴

In all such evaluations, WAS automatically accounts for the effects of the change in water flows caused by a project and, more generally, for the scarcity value of water including the opportunity costs of changing the amount of water available elsewhere in the system. It is a powerful tool, dealing with demand benefits as well as supply costs.

5. USES OF WAS: NEGOTIATIONS

But the uses of WAS are not merely domestic. It can be used to facilitate international negotiations in water and in the design of a mutually beneficial system of regional cooperation in water. I begin with negotiations:

- The use of the WEP’s tools 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 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 ownership problem can be made a manageable one.
- Even using the Project’s tools to investigate only the water economy of the user’s own country, the user can evaluate the effects 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.
- For example, use of WAS for Israel shows that the loss of the water sources on the Golan or of the entire flow of the Hasbani River (over the Lebanese pumping of which there was heated controversy not long ago) would cost Israel about \$5 million a year in non-drought periods and well under \$50 million in drought times.

6. USES OF WAS: REGIONAL COOPERATION

But the standard form of a water treaty (water quantity division) is not optimal. Perhaps most important of all, the Project shows clearly that continued cooperation

⁴As observed above, we find that it is unlikely that Israel will find it economically efficient to import water from Turkey except in drought years. Of course, such imports may be deemed desirable for non-economic reasons.

in water tends to be for the benefit of *all* parties. Such cooperation in the form of an agreement to trade water⁵ 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. For example, project results show that there are very large benefits to *both* Israel and the Palestinians from such an arrangement. The gains are far larger than the value of ownership of more or less of the disputed water will ever be. Indeed, under cooperation, the value of a shift of ownership of 10% the Mountain Aquifer would only be about \$8 million per year by 2010. By contrast, the value of cooperation itself would exceed \$80 million per year, with both parties benefiting. By 2020, such a shift in Aquifer ownership would be worth about \$15 million per year, while the value of cooperation would exceed \$130 million per year.⁶

Similar results (although not so large ones) hold for a cooperative agreement involving Jordan.

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 populations grow and incomes and technology change. Such an agreement can turn water from a source of stress into a source of cooperation.

Note that no party to such an arrangement is forced to sell (or to buy) water. Trades take place only when *both* parties gain. And, indeed, as in all willing trades, both parties do gain. The buyer receives water that it values more than the money it pays; the seller receives money in excess of the value it places on the sold water—money above and beyond the amount needed to compensate its water-users for having to make do with less or more expensive water.

7. SOME EXAMPLES

I now present some examples of the way in which the WEP's tools could be used in the Middle East.

a. Israel and the Palestinians

1. Every regional run of the WAS model strongly shows that it would be mutually beneficial for both Israelis and Palestinians if there were a water recycling plant in Gaza with some of the output sold to Israel for agricultural use in the Negev where there is no aquifer to be polluted.⁷ *This means that Israel has a positive economic interest in assisting with the financing of such a plant. That would be a fairly inexpensive confidence-building measure in an area—water—that very many people, experts included, have thought must result in conflict because of "scarcity".* An agreement on this confidence-building step would not impinge on the core issues separating the parties.
2. The construction of such a plant and the agreement to use it as described could be the first step in a general water-trade agreement of the sort described above. Moreover, in the presence of such an agreement, it would be mutually beneficial for Israel to sell water to Gaza, supplying it through the Israeli National Water Carrier that already runs nearby.⁸
3. Without some form of cooperation, with their present water resources, the Palestinians will have to incur the costs of desalination at Gaza. Indeed, if the problem is not resolved, they will have to pump the desalinated water *uphill* to the southern West Bank. That is obviously costly and inefficient and would be easily avoided by a cooperative agreement of the kind described.

b. Elsewhere in the Region

4. The rebuilding of Iraq will necessarily involve the rebuilding of Iraq's water system. WAS can be used to assist in the planning of that enterprise, providing a country-wide analysis of benefits from different infrastructure plans.
5. Such uses are not restricted to Iraq. I also note that Saudi Arabia is about to spend billions of dollars on water infrastructure. The Saudis also could greatly benefit from the use of the WAS tool to guide that program. Indeed, Syria, and other countries without a fully developed water infrastructure could be helped in this way.

⁵ Or, to avoid sovereignty issues, to trade short-term permits to use each other's water.

⁶ The quantitative results given are for normal years, as opposed to drought. With drought, the values rise, but the result as to the greater value of cooperation still holds.

⁷ I am informed that the construction of such a plant was actually considered some time ago.

⁸ A small amount of water is already so supplied.

- It should be noted that the offer of the WAS tool for domestic purposes—in a bilateral arrangement between the US and the receiving country—may be a way to promote the mode of thought about water that leads to regional cooperation.
6. Further, as mentioned in an earlier footnote, in addition to WAS, the WEP has produced a tool (AGSM) specifically for analyzing the effects of water policies and water availability on crop choice and agriculture. The rethinking of agriculture and its water use is critical to what happens to the marsh Arabs in Iraq, to the Palestinians in the West Bank, and to the future of Jordan's rural population.
 7. Iraq, Syria, and Turkey have an ongoing dispute over the great rivers. As with other water disputes (including the Israeli-Palestinian one), there are different principles of international law, and they do not lead to the same conclusion. The use of a WAS tool could assist in resolving the disputes, using prices to allocate the disputed water, and doing so to the mutual benefit of all the parties.
 8. Turkey (despite such disputes) is a water-rich country. It has proposed to sell water to others. This could be the foundation of a general trade agreement for water—and the WAS tool could be used to guide the prices and the regional water flows involved. Indeed, one can imagine a general regional water authority stretching from Turkey through Syria and Iraq to Lebanon, Israel, Jordan, and the coming Palestinian state. This is a bold vision, but now may be the moment to make it come true.

8. A NOTE ON SECURITY

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 the Palestinians, 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 the Palestinians.)

Interestingly, this conclusion may not hold. WAS results show that it will not be cost-effective (at least in years of normal hydrology) for the Palestinians to build desalination facilities in the Gaza Strip (its only seacoast) simply to supply the growing Gazan population. Rather, with water ownership in the West Bank restricted to present quantities, it would pay (without cooperation) to build such facilities and expensively pump desalinated water uphill to the southern West Bank. But this result also implies that a withdrawal by Israel from a cooperative agreement could be met by Palestinian pumping more than permitted by treaty on the West Bank while building a Gazan desalination plant. This reduces the security issue under discussion.

9. WHERE DOES THE WEP STAND POLITICALLY?

I add a few remarks on how these ideas are viewed by various governments (to the extent that they are known at all).

- The Israeli-Jordanian-Palestinian project has been facilitated and financed by the government of The Netherlands, which still stands squarely behind it.
- Nabil Sha'ath, Palestinian Foreign Minister, has been a strong supporter for a long time. Moreover, the Palestinians have been negotiating with the Dutch over a bilateral continuation of the WEP and appear eager to have it continue. On the other hand, the Project is highly controversial in the Arab press, being sometimes erroneously described as a Zionist plot to force the Arabs to sell "their" water.
- This reflects the fact that the WEP's way of thinking about water is not well understood among the general population (not only the Palestinians) and, indeed, seems revolutionary. Considerable progress has been made, however, among water experts and some government officials.

- I do not know how the present Israeli government regards these matters. Some earlier governments were in support. Prime Minister Sharon has never had a serious exposition of the subject.
- The attitude of the Israeli Water Commissioner's office varies over time—often depending on non-water events. Not surprisingly, there is a “not invented here” syndrome (although the WEP has several Israeli leaders). Israel, with its well-developed infrastructure, has the least to gain domestically from the use of WAS—although it has much to gain internationally.
- The current Jordanian Water Minister, Hazim El-Naser, is a former leader of the Jordanian team of the WEP. He has told the Dutch, however, that the project is now a low-priority one for Jordan—a position that is not necessarily shared by all his colleagues, at least some of whom look forward to a regional use of WAS with Jordan a principal participant.
- Approaches have been made to Syria from time to time. When this was first done some years ago, there was very substantial interest from the Ministries of Economics and Irrigation, but, as one might expect, the attitude of the Syrian Foreign Office has consistently been that they will discuss nothing until the Golan is given back. That is short-sighted, since they could well use a WAS model for their own domestic purposes and since their principal water disputes do not involve Israel at all. It might now be possible for the US government to convince them of this.
- I have recently had positive signs from Lebanon indicating interest both in WAS model for domestic purposes and in regional matters.

10. CONCLUSION: THE TIME IS RIPE

The tools are now available with which to solve water conflicts and assist the countries of the region in efficiently dealing with water management and infrastructure.⁹ This can be done by thinking in terms of water values rather than quantities and using a simulated market-driven mechanism to guide policies, projects, and cooperation. If that is done, the nature of agriculture in the region could be rationalized based on rethinking water availability and cost on a regional and national basis.

Moreover, American military control of Iraq, the need for a dramatic sign of improved US/Turkish cooperation, the need for Syria to find an area in which it can cooperate, Presidential involvement with the Israel-Palestine Road Map, and, above all, the need to find an area of cooperation permitting a bypass of the deadlock between Israelis and Palestinians are all part of a mosaic in which a strong American-led initiative that is market driven could be very successfully advanced.

⁹I should perhaps add that those tools are available without charge as would be my own time and efforts to assist in their understanding and use.

Water Value, Water Management, and Water Conflict: A Systematic Approach

Franklin M. Fisher
Jane Berkowitz Carlton and Dennis William Carlton Professor of Microeconomics
Massachusetts Institute of Technology*

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."¹ 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

* The project whose results are discussed in this paper is the work of a great many people – too many to acknowledge all of them. Chief among those people are the coauthors of Fisher, *et al.* (2002), especially Annette Huber-Lec. A shorter form of the present paper appeared as Fisher (2002).

¹ In this paper, "valuing water" means valuing molecules of H₂O. 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.

following example:²

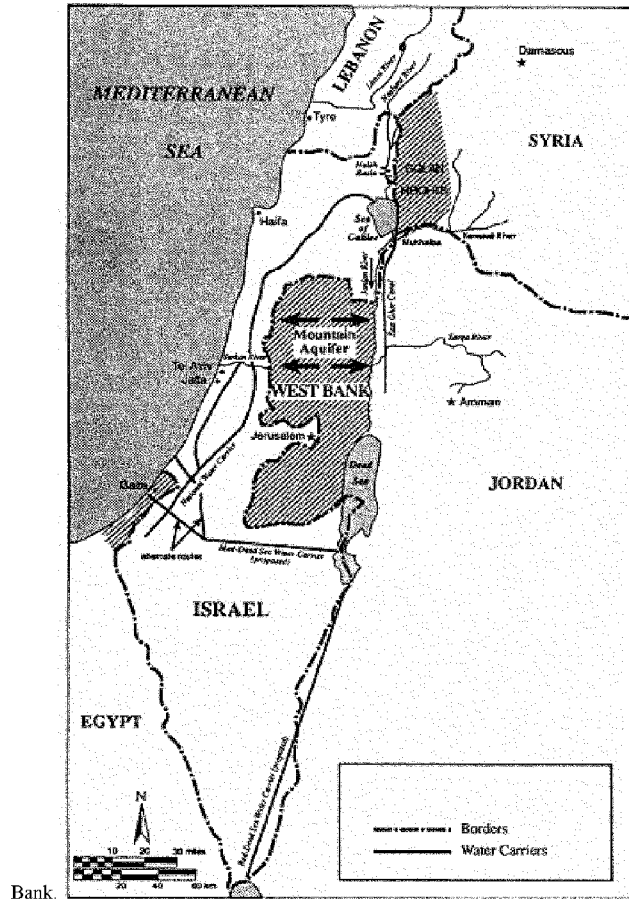


Figure 1: Simplified Map of the "Middle East" (Israel, Jordan, and Palestine), Its

² In this example, I have updated Fishelson's calculation to reflect current estimates.

Major Water Resources, and Major Conveyance Infrastructure³

A major part of the conflicting water claims of Israel and Palestine⁴ consists of rival claims to the water of the so-called Mountain Aquifer. (See Figure 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 coast⁵ would cost roughly 40 $\$/m^3$. But that 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. *This is a*

³ Adapted from Wolf (1994), p. 27.

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 convenient term, "Palestine", out of respect for my Palestinian colleagues, and because nearly all sides now predict the existence of a Palestinian state.

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.

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€/m³.

2. The Water Economics Project

Fishelson's remarks were a principal impetus to the creation of the Water Economics Project (WEP).⁶ 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

⁶ Formerly the Middle East Water Project (MEWP).

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 the Palestinians 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.⁷

3. Water Values, Not Water Quantities

Returning to Fishelson's example, the calculation of the value of the water of the Mountain Aquifer may seem a surprising result. 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 two things:

1. The markets involved must be competitive consisting only of very

⁷ The most extensive published discussion of the WEP's methods and results now available (A book is now nearing completion.) is Fisher *et al.* (2002). Differences in numerical results between previously published work and the present paper are due to data revisions.

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 are 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 consider it.

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. 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.

I first briefly describe the theory behind such tools applied to decisions within a single country. I then consider the implications for water negotiations and the structure of water agreements. I give examples drawn from the analysis of water in the Middle East.

4. The WAS Tool

The tool is called WAS for "Water Allocation System".⁸ 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 recycling 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 recycled water 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 treatment plants, expand or install

⁸ The pioneering version of such a model (although one that does not explicitly perform maximization of net benefits) is that of Eckstein *et al.* (1994).

conveyance systems, and create seawater desalination plants.

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.

Figure 2 shows an example of the main menu that the user sees when using WAS.

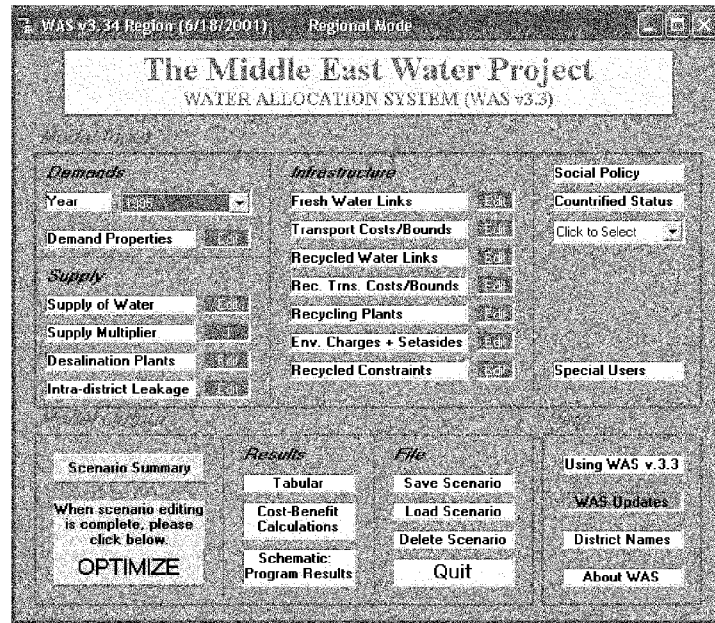


Figure 2. Water Allocation System: WAS Main Menu.

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.

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.

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.

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 (at the end of 2003). Results involving cooperation are given later.

a. Desalination: Israel

I begin with Israel and desalination. Figure 3 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% -- 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

¹⁰ The infeasibility listed for the Jordan Valley Settlements in the drought case reflects the fact that the full amount of subsidized water required to deliver to agriculture there cannot be delivered.

shadow value is at Acco and is only $\$.315/m^3$ – well below the cost of desalination. This means that desalination plants would not be needed in years of normal hydrology.

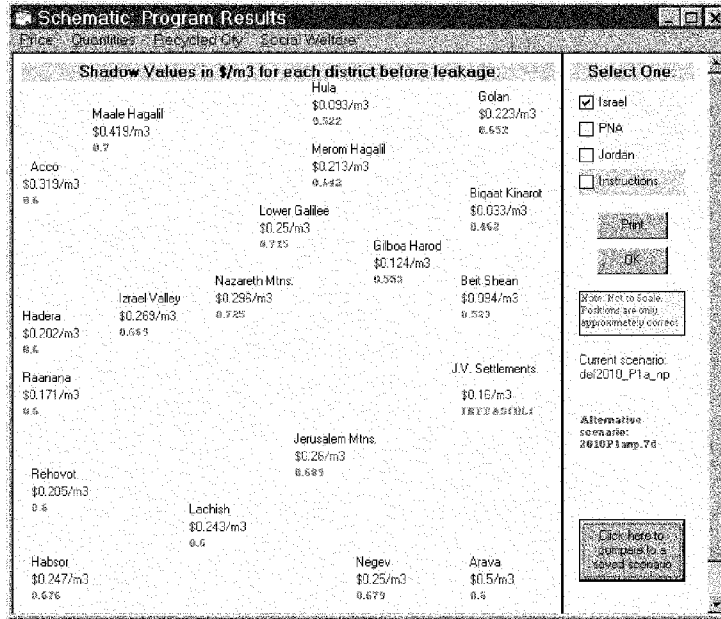


Figure 3. 2010 Shadow Values with Desalination: Normal Hydrology vs. 30% Reduction in Naturally Occurring Fresh Water Sources; Fixed-Price Policies in Effect

On the other hand, such plants would be desirable in severe drought years. In the lower numbers in Figure 3, desalination plants operate in all the coastal districts at an assumed cost of $\$.06/m^3$. The required sizes of such plants (obtained by running WAS

without restricting plant capacity and observing the resulting plant output) are given in Table 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 in each district are larger.

Of course, much of the costs of desalination are 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 3 (highest $\$316/m^3$). 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 1, and some would not be required at all.)

Table 1. Desalination (or Import) Requirements in Mediterranean Coastal Districts in 2010 with 30% Reduction in Natural Fresh Water Sources and Fixed-Price Policies in Effect

District	Water Requirements (MCM/Yr.)
Acco	80
Hadera	64
Raanana	53
Rehovot	51
Lachish	29

¹¹ Note that a multi-year version of WAS (discussed below) could be of substantial aid in such a calculation.

TOTAL	277
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b. Desalination: Palestine

A similar analysis for Palestine produces a quite surprising result. Palestine can desalinate seawater only on the seacoast of the Gaza Strip (See Figure 1.). Consider Figure 4. Here results for 2010 are presented on the assumption that Palestine builds recycling plants and conveyance lines.

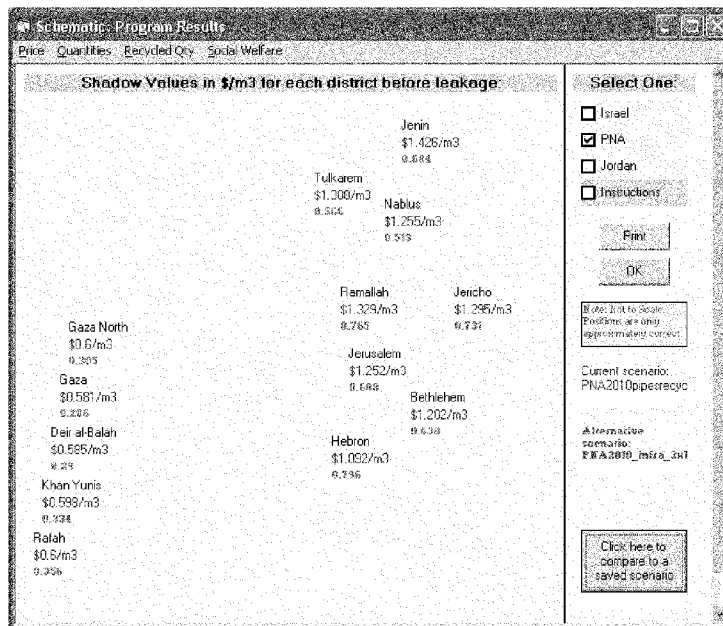


Figure 4. Comparison of Full Infrastructure Scenario in PNA in 2010 with and without Double the Quantity from the Mountain Aquifer

The upper shadow values are for the case in which Palestine has only its current natural water resources. We see that desalination at \$.60/ m³ 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 the Palestinians 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 \$.356/ m³. 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 necessity 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 \$.55/ m³. An important implication of these results will appear when we consider cooperation below.

c. Jordan and the Interdependence of Infrastructure Decisions

For Jordan (where seawater desalination is currently possible only at Aqaba on the Red Sea), we 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/m³ by 2020 (and that in years of normal hydrology). This is not a tenable situation, and the value of \$27/m³ 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 has plans to increase the capacity of the conveyance line that takes Jordan River to Amman from 45 MCM per year to 90 MCM per year no later than 2005. 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/m³, still unacceptably high.
3. Jordan is considering the construction of a pipeline from the Disi fossil aquifer to Amman. This will help considerably. If the pipeline 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/m³, 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 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 $\$.91/m^3$. 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.

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.

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 conveyance system to 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.

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

¹³ This is an application of the well-known Coase Theorem of economics. See Coase, 1960.

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 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.)

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 nonwater 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 1.) is often said to be a major problem in negotiations between

Israel and Syria, because the Baniyas 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 Baniyas 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 USD 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 USD per year. These results take into account Israeli fixed-price policies towards agriculture.

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 roughly \$ 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 Baniyas apply equally well to the Hasbani. The effects on Israel would be fairly trivial.¹⁴

Water is not worth war!

¹⁴ 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, but, as of yet, they have not been willing to cooperate in building one.

7. Cooperation: The 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 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 the Palestinians from such cooperation, and finds them to exceed the value of changes in water ownership that reflect reasonable differences in negotiating positions.

Figures 5A and 5B illustrate such findings and more. In those Figures, I have arbitrarily varied the fraction of Mountain Aquifer water owned by each of the parties from 80% to 20%.¹⁵

The two line graphs in Figure 5A show the gains from cooperation in 2010 for Israel and Palestine, respectively, as functions of ownership allocations.¹⁶ Israeli price policies for water (“Fixed Price Policies”) 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 (the red line) benefits from cooperation by about \$69 million per year when it owns only 20% of the aquifer. In the same situation, Israel (the blue line) benefits by about \$20 million per year. As Palestinian ownership increases (and Israeli ownership correspondingly decreases), the gains from cooperation first fall and then rise. At the other extreme (80% Palestinian ownership), Palestine gains about \$31 million per year from cooperation, and Israel gains about \$29 million per year. In the middle of the Figure, joint gains are about \$19-23 million per year.

¹⁵ I have equally arbitrarily assumed in these Figures that Israel owns 100% of the water of the Jordan River. None of these assumptions is intended to convey a political message as to the appropriate allocation of water ownership.

¹⁶ 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.

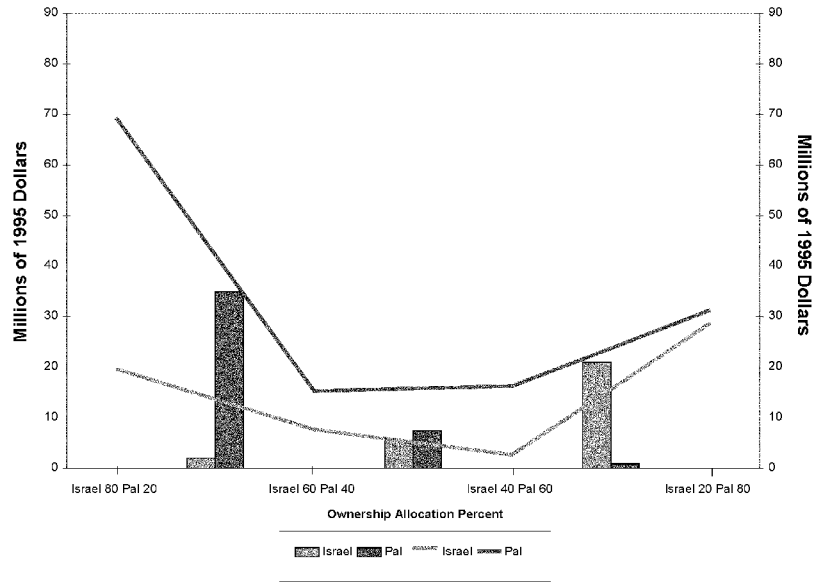


Figure 5A. Value of Cooperation and Value of Ownership without Cooperation – 2010. Israeli Fixed-Price Policies in Effect

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 by tens of million of dollars per year 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 and Israeli ownership decreases? That is because, at the extremes, there are large gains to be made by transferring water from the large owner to the other party. Israel has large benefits at the right-hand side of the diagram because it can obtain badly needed water; it has large gains at the left-hand side because, when it owns most of the water, it can gain by selling relatively little-needed water to the Palestinians (who gain as well). The same phenomenon holds in reverse for Palestine.

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 optimizing water-use allocations of the optimizing cooperative solution. That is very unlikely to happen in practice (and, if it did, would only reach the optimal solution for a very short time, as explained below). In our runs, it does not happen for two reasons.

- 1 I have not attempted to allocate ownership in the Mountain Aquifer in a way so detailed as to match geographic demands. Instead, I 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 5A. The height of the various bars in the figure show the value to the parties without cooperation of a change in ownership of 10% of the Mountain Aquifer (about 65 MCM per year). 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% of the Mountain Aquifer starting at an allocation of 70% to Israel and 30% to Palestine; the next set of bars examines the value of a 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.

Further, now look at Figure 5B. This differs from Figure 1A only in the height of the ownership-value bars. In Figure 5B, the height of those bars represents the value of shifts of 10% 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.

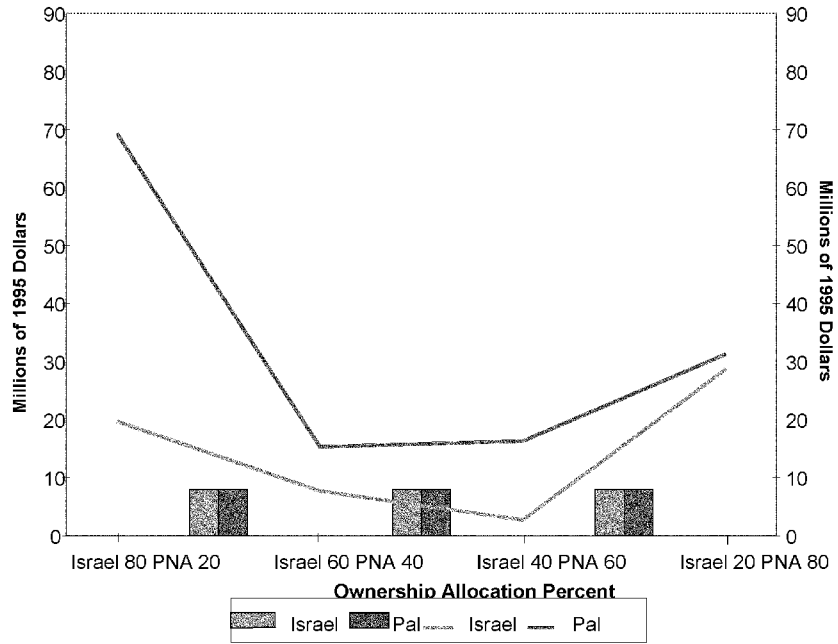


Figure 5B. Value of Cooperation and Value of Ownership with Cooperation – 2010. Israeli Fixed-Price Policies in Effect

The results for 2020 are qualitatively similar to those for 2010 except for one interesting phenomenon. While in the results from 2010, Palestine always gains more from cooperation than does Israel, that is not so in the results for 2020. The results imply that, if Israel retains its fixed-price policies, it may well need cooperation more than does Palestine.

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.

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 the Palestinians.

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% of the Mountain Aquifer) also implies that a withdrawal by Israel from a cooperative agreement could be met by Palestinian pumping more than permitted by treaty on the West Bank. This reduces 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 early 2004 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

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Chairman HYDE. Dr. Shaked.

STATEMENT OF HAIM SHAKED, PH.D., DIRECTOR, THE MILLER CENTER, UNIVERSITY OF MIAMI

Mr. SHAKED. Mr. Chairman, I have a 5-minute presentation. I timed it. I hope that is a relief.

I am very pleased to have the opportunity to testify before the Committee, and, if I may take sides, to commend you, Mr. Chairman, on the decision to devote a hearing to this complex and urgent subject.

Over the past 45 years I have been studying the Middle East in various capacities. I do not presume to have the answers, but I do believe that I have gained certain insights into the Middle Eastern situation, and I think I know what may or may not work in that troubled but extremely important region.

The Taplin Middle East Peace Project at the University of Miami's Miller Center consists of several initiatives dealing with innovative ways of building peace between Israelis and Arabs. One such initiative, the subject of my testimony today, deals with the problems of the Jordan River Basin generally and specifically the severe crisis in its Dead Sea sub-region, caused primarily by negative water recharge.

The Dead Sea, the lowest point on Earth and ecologically and historically unique, is dying rapidly. I circulated some aerial photographs which were taken by the Jordanian Ministry of Water and Irrigation, and I think these three photographs, one of which is a simulation, tell the world the whole story of what is happening in the Dead Sea.

In recent years a broad range of national, international, and non-governmental stakeholders have become involved in the effort to save the Dead Sea, including, formally and publicly, Israeli and Jordanian Government ministers. Also, a series of conferences were held, notable amongst them those organized by Friends of the Earth-Middle East, whose Director is Mr. Gidon Bromberg, from whom we heard.

A number of alternative solutions have been suggested: Restoring the flow into the Dead Sea of the Jordan waters or pumping water from the Mediterranean or the Red Sea to replenish the Dead Sea. All three alternatives are highly complicated and very costly. The fourth alternative, business as usual, is, of course, catastrophic ecologically and eventually also economically.

While much has been said and written about this, forward movement is impeded to a large extent by the divergent approaches taken by various stakeholders. These fall roughly into the following categories: National actors in the region, primarily Jordan and Israel, and to a certain extent also the Palestinians and Syria; non-governmental organizations; international financial institutions; public and private corporations; and potential donor countries. One of the problems inherent in stakeholder-driven solutions is that they inevitably (and legitimately) reflect individual stakeholder interests. A successful approach may well require going beyond the specific agendas of any single stakeholder, and even beyond the specific issues of the Dead Sea sub-region.

The Dead Sea is part of a larger system and is affected directly by what happens in other parts of the Jordan River Basin, and therefore the solution to its problem may well require a comprehensive, systemic approach. Here we have been inspired by a unique American-Canadian institution, the International Joint Commission, known as IJC, established in 1910 as a consequence of the Boundary Waters Treaty of 1909 governing the waters across the United States-Canadian border. The IJC reflected the need to overcome a century of conflict and tension along a 5,600-mile-long border, with its mandate, "to apply the treaty and help prevent and resolve water resource and environmental disputes between the two countries through processes that seek the common interests of both," it provided a way of managing critical relations between unequal partners with different interests.

One of the reasons for the outstanding success over more than 9 decades of the IJC is its status as an international body as well as its structure that expresses the partners' primary interest in successful regional management rather than the assertion of sovereignty or political primacy of one party over the other. The IJC manages resources by consensus rather than by majority fiat.

Mr. Chairman, I would like to take this opportunity to announce that we at the University of Miami plan to convene an unofficial gathering of all relevant stakeholders. Its purpose will be to examine the possibility of adopting a regional management model similar to the IJC to the needs of the Jordan River Basin generally and the reclamation of the Dead Sea specifically. We have already secured a significant portion of the necessary funding.

Finally, it is our hope that this proposed gathering will contribute to dealing with one critical issue facing this part of the Middle East. The alternative to this, I fear, might be the Biblical solution to the problems of the Dead Sea area, the destruction of the Cities of the Plain, Sodom and Gomorrah, with fire and brimstone. This Biblical solution must, of course, be averted.

We believe that this can be done. And if I may, being a historian, insert a piece of little known history.

Over 150 years ago, in the year 1848, a U.S. Naval Lieutenant Commander landed on the eastern shores of the Mediterranean, in the city of Acre, with two collapsible boats, and took them with a camel caravan to the Sea of Galilee and then went down the river all the way to the Dead Sea. Along the way, Lieutenant Commander Lynch produced the first modern scientific charts of the River Jordan and the Dead Sea. These charts have been used until quite recently. The importance of this is not only in the charts. I believe that this was the first time ever that the flag of the United States was hoisted in the Holy Land. So there is tremendous historic continuity for this House being involved, because when Lynch came back, he submitted a report including his two maps to the U.S. Congress.

Thank you, Mr. Chairman.

Chairman HYDE. That is very fascinating. Thank you, Doctor.
[The prepared statement of Mr. Shaked follows:]

PREPARED STATEMENT OF HAIM SHAKED, PH.D., DIRECTOR, THE MILLER CENTER,
UNIVERSITY OF MIAMI

Chairman Hyde and honorable members of the House Committee on International Relations, I am pleased to have the opportunity to address you today and to contribute to the discussion on innovative approaches to peace building in the Middle East within the context of this hearing on "Water Scarcity in the Middle East: Regional Cooperation as a Mechanism toward Peace."

My name is Haim Shaked. I am the Dr. M. Lee Pearce Professor of Middle East Peace Studies; the Founding Director of the Middle East Studies Institute and the Sue and Leonard Miller Center for Contemporary Judaic Studies; and, a professor in the Department of International Studies, the College of Arts and Sciences at the University of Miami. Over the past thirty-five years, I was one of the founders and the Director of the Moshe Dayan Center for Middle Eastern and African Studies; and Dean of the Faculty of Humanities at Tel Aviv University, I created the Lauder School of Government, Diplomacy and Strategy at the Interdisciplinary Center in Herzliya, Israel's first private university and I established the Graduate School of International Studies at the University of Miami.

This background, by way of introduction, is to give the Committee some indication of my decades' long professional study of and interest in regional issues of war, peace, politics and governance. I do not presume to have "the answers"—a presumption that this Committee may have encountered before and is foolhardy, given the sharp twists and turns of events in the Middle East in modern times. I do believe, however, that over the years I have gained certain insights into what may or may not work in that troubled but extremely important part of the world.

Having said that, I am grateful for this opportunity to appear before this distinguished Committee. First, if I may, I would like to commend you, Mr. Chairman and your staff, on the decision to devote a hearing to the extremely complex and urgent subject of water scarcity in the Middle East. In this connection, I would like to describe some of the work being done at the University of Miami's Miller Center as part of the Taplin Middle East Peace Project, particularly with respect to the Jordan River Basin and the reclamation of the Dead Sea.

The Taplin Peace Project is a cluster of peace building initiatives that are funded by a generous grant from the Sol Taplin Foundation and initiated as a result of the efforts of Mr. Aaron Podhurst, a member of its Board and a Trustee of the University of Miami. The overall management of the Taplin Middle East Peace Project is in my hands and those of my colleague Professor Eugene Rothman, who has an extensive background in peace building in the Middle East and elsewhere.

The major thrust of the Taplin Project is to look at innovative ways of peace building in the Middle East between Israelis and Arabs, using new approaches to specific problems in order to develop an ever-expanding basis for cooperation and collaboration. These small steps are important for three reasons: (a) to encourage a peace building momentum, developing what might be called "the habit of cooperation"; while (b) at the same time laying the groundwork for the "day after", or, in other words, what could happen the day after peace "breaks out"; and (c) highlighting—for the benefit of political negotiators—concrete "peace building blocks and dividends". The last two points are critical in view of the painful series of events that have become the hallmark of the past three and a half years of Israeli-Palestinian relations.

An example of the 'Taplin approach' to a peace building project is the Middle East Public Health Diplomacy Initiative currently being organized jointly by the University of Miami, the Hebrew University's Kuvim Center for Tropical and Infectious Diseases and Al-Quds University's School of Medicine. The background to this initiative is the fact that it is obviously difficult to control and contain infectious diseases in times of conflict because of the absence of trans-border collaboration. The expectation, therefore, was that the incidence of such diseases would increase during the recent *intifada*. Because of the innovative approaches used by the Hebrew University and Al-Quds University, and against all odds, cooperation between Palestinian and Israeli medical professionals has continued rather than come to a halt.

This success story has become the basis for a peace building project that extends beyond the Middle East and the creation of a broad-based coalition for its implementation. The Taplin Project's Co-Director, Professor Rothman and I, with the support of an international coalition of scientists and policy makers, headed by Dr. Sanford Kuvim, founder of the Kuvim Center and scholars from the University of Miami (Professors Sherri Porcelain and John Beier of the Global Public Health Group, assisted by Professor Clyde McCoy, Chair of the Department of Epidemiology), have been working to bring together Israeli, Palestinian, Egyptian, Jordanian, North American, South American and Caribbean partners to adapt the best practices of the suc-

successful Israeli-Palestinian effort to control infectious diseases as a model that can be applied to other areas. Thus, Palestinian-Israeli interaction can be expanded to include other parts of the Middle East, such as Iraq, or in the Western Caribbean, especially Haiti. In addition to serving the very important interests of global public health, this initiative is also a 'health diplomacy-for-peace initiative' that can contribute to peace building. We hope to enlist the support of the American and Canadian governments and international non-governmental organizations in this collaborative effort to promote global public health and peace building.

The "health diplomacy" model is not unrelated to the subject of this Hearing which focuses on issues of water scarcity in the region and how regional cooperation can both alleviate or even resolve acute problems and simultaneously contribute to peace building. Within this conceptual framework, one of the major thrusts of the Taplin Project is the adaptation of the approaches just described to deal in an innovative manner with the problems of the Jordan River Basin, generally, and the severe crisis in the Dead Sea, specifically.

In this connection, I would like to note that the Jordan River Basin and the Dead Sea have a long historic but little-known connection to the United States. Over 150 years ago, in 1848, an American Naval Lieutenant Commander, William F. Lynch, landed in Acre on the Eastern Mediterranean with two collapsible boats, arranged a camel caravan to carry them across the land to the Sea of Galilee, then went down the Jordan River into the Dead Sea. Lynch's maps of the Jordan River basin and Dead Sea, submitted as part of his report to the United States Congress, were the first modern systematic and scientific efforts to survey and chart the Jordan River and the Dead Sea and were in use until quite recently. To the best of my knowledge, it was Lynch's expedition that hoisted the flag of the United States in the Holy Land for the first time in history.

Much, however, has dramatically changed in the condition of the Dead Sea in the century and a half following this expedition. In this connection, Israel's Minister of the Environment, Yehudit Naot, recently warned that "the Dead Sea is dying, and only a major engineering effort can save it." This sentiment echoes an earlier statement made by King Abdallah II of Jordan that "The Dead Sea is an important economic and tourist asset which should be environmentally preserved."

Some background: The Dead Sea, a body of water that is 1,320 feet below sea level—the lowest point on earth, is 38 miles long and about 11 miles wide and is situated primarily between Israel and Jordan, while in a relatively small section, the north-western shore of the Dead Sea is contiguous with the West Bank/Judea. This body of water and its surroundings, ecologically and historically unique, also constitutes a major economic resource supporting Israeli and Jordanian industries, such as potash, as well as tourists who visit the Dead Sea mainly for its waters that are known for their high level of salinity and concentration of minerals and reputed healing powers. All this—including unique natural ecosystems—is threatened because the Dead Sea is, ironically, dying.

Until a few decades ago, the high levels of Dead Sea water evaporation were balanced by its only source of surface water, the Jordan River that flows into it from the North. However, for the last forty or more years, Israel and Jordan have been diverting large amounts of the Jordan's waters for drinking and agricultural use without providing replacement water. A five-year drought has further exacerbated the problem.

As a result, the Dead Sea has receded in places over the last twenty years by as much as 2000 feet and, if remedial action is not taken soon, the sea will continue to recede approximately 3 feet a year, until it reaches a new equilibrium in about 400 years after a water-level decrease of 300 to 400 feet. This will lead to the disappearance of adjacent ground water, and, consequently, the buckling and collapse of surrounding land—sinkholes are already a problem—and the loss of nearby wild-life and vegetation, a process that has begun and now is threatening to become a major detriment to the Dead Sea's ecosystem.

In recent years, recognizing the severity of the problem, a broad range of national, international and non-governmental actors and stakeholders have become involved in the effort to "save the Dead Sea." The governments of Israel and Jordan through the Israel Ministry for National Infrastructures and the Jordanian Ministry of Planning, signed an agreement in September 2002 to develop a joint approach to restore the Dead Sea; the Canadian International Development Agency (CIDA) and its affiliate, the International Development Research Centre (IDRC), funded hydrological studies by Friends of the Earth Middle East; the Israel Geological Institute carried out a modeling study to forecast the results of some of the proposed solutions; The Kingdom of Jordan's Ministry of Water and Irrigation has been working on plans to remedy the situation; and, recently, the World Bank began working on the Terms of Reference (TOR) for a major feasibility study on efforts to reclaim the Dead Sea.

A series of conferences and symposia were held, notable amongst them were those organized by groups such as Friends of the Earth—Middle East, including “One Basin, One Strategy” in 1999 or, more recently, the parallel conferences held in Israel and Jordan, “The Dead Sea between Life and Death.” Concrete steps for regional cooperation, especially between Israel and Jordan, moved ahead, including an agreement between the two countries on a monitoring and data management program in the Red Sea as part of the Red Sea Marine Peace Park Cooperative Research, Monitoring and Management Program (RSMPP). This continues with the organization of an international conference on water demand management by the Government of Jordan to be held at the Dead Sea at the end of May and the beginning of June 2004.

A number of alternative solutions have been suggested. The most natural, of course, would be to restore the flow of the Jordan waters that have been diverted. This, however, would require new water sources to provide primarily Israelis and Jordanians but also Palestinians with substitute water supplies for their drinking and irrigation needs.

A second proposal is the “Med-Dead” solution, namely, to construct a canal or pipeline from the Mediterranean Sea through the Judean Hills/West Bank shared by Israelis and Palestinians, or around, that is, within the Green Line, north or south of the Judean Hills to the Dead Sea. This solution faces political obstacles; tremendous engineering difficulties; high costs economically; and, finally, the ecological challenge of mixing the waters of the Mediterranean with those of the Dead Sea.

The third most recent proposal is the “Red-Dead” solution, which has come to be known as the “Peace Conduit”. It calls for the channeling of water from the Red Sea to the Dead Sea. The water carrier (canal and/or pipeline) would pass through Jordan and—like the “Med-Dead” proposal—exploit the altitude differential between the Red Sea and the Dead Sea in order to generate energy and desalinate seawater. Initial estimates indicate that the project’s costs might be as high as \$4 billion and would involve moving 1.9 billion cubic meters of Red Sea water per annum—with half pumped into the Dead Sea and the other half being used for drinking and/or agricultural purposes. Like the “Med-Dead” solution, the “Red-Dead” proposal involves overcoming major political, engineering and economic obstacles, as well as the ecological challenge of mixing the waters of the Red Sea with those of the Dead Sea.

The “Peace Conduit” proposal figured prominently in a recent World Bank document, *Red Sea-Dead Sea Water Conveyance Project—Feasibility Study and Environmental and Social Assessment*. It stated that the goals of this project include saving the Dead Sea, providing drinking water to the peoples of the region, and serving as a symbol of peace and cooperation. The report is part of the process of preparing agreed-upon Terms of Reference (TOR) for the major feasibility study that should precede any such project.

The successful completion of the TOR is not proving to be easy. A number of versions have already been drafted and rejected. Agreement is prevented to a large extent by the divergent approaches taken by various stakeholders as well as regional political complications. Environmental organizations, such as Friends of the Earth—Middle East, a key group in promoting the efforts to save the Dead Sea, argue that insufficient consideration has been given to the various critical elements involved in any of the above solutions, including the “Peace Conduit.” They have argued that all activities in areas such as engineering, social, institutional, economic, and environmental must be considered using a sustainable development approach.

The stakeholders in the process that seeks to arrive at a solution to the problems of the Dead Sea and its environs fall roughly into the following categories: national actors in the region—namely Jordan, Israel and the Palestinians—reflecting their own national interests; leading non-governmental organizations, such as the Friends of the Earth—Middle East—whose agendas are environmentally-driven; international financial institutions who are concerned, on the one hand, with the broader international issues of regional peace and stability and, on the other hand, with an efficient, technically feasible, economically viable and cost-effective process for saving the Dead Sea; public and private corporations in such fields as engineering, construction, electricity, desalination, tourism (including medical-tourism); and potential donor countries.

The national actors, the non-governmental organizations and donors have over the past ten years carried out studies and organized gatherings to look at the science and/or policy aspects of saving the Dead Sea. Yet, the waters of this unique resource continue to recede rapidly! One of the problems in mounting an effective effort, first, to arrest the drying out of the Dead Sea and, then, replenish it with water from other sources may be an outcome of the fact that many of these efforts are stake-

holder-driven and, therefore, inevitably (and legitimately) reflect individual stakeholder interests and agendas. A successful approach may well require going beyond the specific agenda of any single stakeholder or group of stakeholders and even beyond the specific issues of the Dead Sea itself. The Dead Sea is part of a larger system, it is affected directly by what happens in other parts of the Jordan River Basin and, therefore, the solutions to its problem may well require a systemic approach.

As part of the Taplin Project, my colleagues (Professor Rothman and Professor Fernando Miralles-Wilhelm of the University of Miami's Department of Engineering and the University's Center for Ecosystem Science and Policy) and I have been examining alternate approaches towards the broader issues of management, policy, science and peace building with respect to the Dead Sea and the Jordan River Basin. The purpose of this effort has been to find ways to encourage the development of new and innovative regional models that also can help focus the efforts to save the Dead Sea.

Our work in this respect does not seek to replicate the excellent efforts of the various governments, agencies and organizations that have been working in the field. Instead, our efforts are directed at the development of a broader conceptual framework that can provide the means for arriving at a regional Jordan River Basin-oriented solution that at the same time will also contribute to the reclamation of the Dead Sea.

Our point of departure was to examine the issues that affect the entire Jordan Rift Valley, that is, the area stretching from Mount Hermon/Jabal Ash-Shaykh in the North to the Gulf of Aqaba/Eilat in the South. This broader regional approach encompasses issues as varied as the potential peaceful exploitation of Mt Hermon/Jabal Ash-Shaykh; the restoration of Lake Hulah; the reclamation of the Dead Sea; and, Israeli-Arab (Jordanian, Egyptian, Saudi Arabian) collaboration on issues related to the Red Sea.

Each of these issues has a life of its own, but they are all linked by one common denominator—water. Therefore, they all constitute one system—the remediation of which might be facilitated by a common approach, or better yet, by a common system of management providing an integrated framework for the science and policy necessary to deal with these and other issues now and in the future. What seems to be called for is a macro structure, innovative and flexible, that could then facilitate the resolution of each of the specific problems mentioned above.

Regional management has been present in the Middle East since the days of the ancient Egyptians and Babylonians. Since the First World War there have been numerous suggestions and plans for the regional management of the Jordan River Basin. This continues today, with proposals by environmental organizations such as Friends of the Earth-Middle East for the establishment of a Dead Sea Basin Biosphere Reserve to the call, in 2000, by Dureid Mahasneh, the former Secretary General of the Jordanian Jordan Valley Authority, for a "jointly managed commission . . . to be formed to enable the implementation of these [Dead Sea] projects. Such a commission," he continued, "granted international support and managed through private sector type initiatives, is necessary to cut red tape, execute projects and prevent future water conflicts in the region." However, more often than not, the obvious merit of such an approach has been defeated by the relentless logic of conflict and politics in the Middle East.

Perhaps, the answer can be found elsewhere. Perhaps, working models from other regions and river basins could be adapted to serve the pressing needs of the Middle East. In this connection, we have been inspired and assisted in our work by a unique American-Canadian institution, the International Joint Commission (IJC), and, specifically, by the Canadian Section and its Chair, the Right Honorable Herb Gray, former Deputy Prime Minister of Canada, and his staff.

The IJC was established in 1910 as a consequence of the Boundary Waters Treaty of 1909 governing the waters that cross the U.S.-Canadian border. The IJC was a reflection of the need to overcome a century of conflict and tension along that border and to manage the water resources that crossed the border. It was a way of managing critical relations between unequal partners with different interests. One historian, John W. Holmes, writing on the 70th anniversary of the creation of the IJC, described its dynamics involved as follows:

"At last Washington had reconciled itself to the existence of Canada as a large and permanent, if regrettable, fact of continental politics. . . . As for the Canadians . . . they had now overcome their natural fear of joint institutions to embrace one that was imaginatively designed to protect their interests. . . . It promised equity without interfering with national sovereignty."

The similarities and relevance to the Middle East are striking.

The common view of the IJC is that this low profile but highly successful organization governs the water and air quality of the Great Lakes that lie between the United States and Canada. In fact, this function, while important, accounts for only 25% of its activities. The work of the IJC encompasses the basins and waters that make up almost the whole of the U.S.-Canadian border, from the Atlantic to the Pacific coasts, including the Alaska-Yukon-British Columbia boundary, in all, 5625 miles.

According to the IJC, its mandate is "to apply the [Boundary Waters] treaty and help prevent and resolve water-resource and environmental disputes between the two countries through processes that seek the common interests of both." In other words, the IJC has become an instrument for the regional management of the waters and basins between the two contiguous countries. The application of this broad mandate indicates remarkable parallels with the needs of the Jordan River Basin. As the IJC has indicated, "a major responsibility . . . is to evaluate progress toward restoring and maintaining the chemical, physical and biological integrity of the waters of the Great Lakes ecosystem."

One of the reasons for the outstanding success of the IJC is its status as an international body and its structure, one that expresses the partners' primary interest in successful regional management rather than the assertion of sovereignty or the political primacy of one party over the other. The IJC consists of six Commissioners, three appointed by the President of the United States and three appointed by the Prime Minister of Canada. There is an American Co-Chair and a Canadian Co-Chair. Unlike most other bi- and multi-partite international agencies, the number of voting participants is even and the Co-Chairs, therefore, do not have casting votes. Rather than give rise to a continuing deadlock where 3-3 votes along national lines become the rule, this approach transformed the IJC into an agency that manages resources by consensus rather than by majority fiat. Only once throughout its first 91 years did the IJC record a vote. IJC Commissioners—upon being appointed—sign a declaration confirming their impartiality. They deal with regional problems without being subject to instructions from their respective governments. In its own words, "The Commission acts as a single body seeking common solutions rather than as separate national delegates representing the positions of their Governments."

However, the management of a border basin area in excess of 5000 miles requires more than a central management structure, no matter how cleverly designed. The IJC, therefore established a subsidiary structure that involved the setting up of more than 20 boards to assist it in fulfilling its mandate. The board members are drawn from the two countries, but work as individuals in their personal and professional capacities, not as national or organizational representatives. This joint fact-finding approach enables the IJC to reach a consensus on different issues on their merits rather than as part of political linkages. This structure, thus, has the strength of central management while enjoying the flexibility of focusing on specific issues and problems.

The IJC is one of over 130 organizations involved in managing trans-border, or "shared" bodies of water and basins and represented in the International Network of Basin Organizations (INBO) in Paris. A similar body, MENBO, the Mediterranean Network of Basin Organizations, with over 60 member entities helps serve regional interests. Thus, the IJC type of structure is widespread and appears to hold much promise as a model for the management of the Jordan River Basin and the various elements of that system. A model based on the best practices of INBO, MENBO and IJC could provide a mechanism for the overall collaborative management of Jordan River Basin water resources and, within that framework, facilitate the resolution of specific problems such as the reclamation of the Dead Sea, pollution in the Gulf of Aqaba/Eilat or management of the Jordan River and its tributaries.

Equally important is the fact that this model, one that "promised equity without interfering with national sovereignty," as noted above, could contribute to peace building in the region. It provides the opportunity for partners to pursue public interest needs with respect to water resource management and protect their legitimate national interests in a fair and effective manner.

Mr. Chairman, Honorable Members of the Committee, I would like to take this opportunity to publicly announce for the first time that the next stage of the work of the Taplin Project will be the convening by the University of Miami of an unofficial gathering of all relevant stakeholders, interested non-governmental organizations, representatives of international financial institutions, potential donor countries and the private sector.

The purpose of this conference will be to examine the possibility of adapting a regional management model similar to the IJC to the needs of the Jordan River Basin,

generally, and the reclamation of the Dead Sea, specifically. This conference has already received the moral and material support of the University of Miami's Center for Ecosystem Science and Policy, headed by Professor Mary Doyle and the Taplin Foundation. Two other requests for seed-money grants are under consideration. We have also been encouraged to proceed by national and international agencies as well as private sector organizations, hitherto uninvolved in this issue.

Representatives of the IJC will be invited to participate, in the hope that they can serve as informal midwives to the birth of a concept and organizational structure that may hold much promise for dealing with the problems of water scarcity and management in the area today as well as in the future after critical political issues are resolved by the relevant parties through their governments.

Without prejudging the outcome of this international consultation, we will propose the consideration of a multi-tiered multi-national approach that will focus on the possibility of: (a) first, an Israeli-Jordanian model; (b) then, an Israeli-Jordanian-Palestinian model; and, (c) finally, an Israeli-Jordanian-Palestinian-Syrian one.

At the same time, we hope that this gathering will examine, within the structure described above, the ways and means for establishing a consensus on management, science and policy with respect to the reclamation of the Dead Sea. It would seem imperative, on the one hand, to deal with the immediate crisis of the Dead Sea within a broader Jordan River Basin conceptual and organizational framework and, on the other hand, to actually test this broader framework by applying it to the reclamation of the Dead Sea. In no way should the broader Jordan River Basin concept hinder or delay the design and implementation of specific concrete solutions to the urgent Dead Sea problem.

It is our belief that the development and elaboration of this model is neither an "academic" undertaking nor an "end of days" exercise. Instead, we feel that the effort to deal with water scarcity and management can be carried out regionally while at the same time focusing on the specific. If the desired final outcome is the establishment of a broad-based regional management model, this does not preclude beginning with the reclamation of the Dead Sea. The initial effort can be to create the microcosm of an IJC-like structure whose first effort will be to focus on resolving the immediate problems facing the Dead Sea. With an eye to the broader regional context, this structure can deal with the specifics of what needs to be done and how this can be done effectively in order to save the Dead Sea. If successful, this then could become the basis for the expansion of the model throughout the Jordan River Basin.

Mr. Chairman, Honorable Members, it is our sincere hope that this proposed gathering and its underlying ideas will contribute to arriving at a means of dealing with some of the critical issues facing this part of the Middle East, namely, water scarcity and peace building. The alternative to this, I fear, may be the Biblical "solution" to the problems of the Dead Sea area—the destruction of the Cities of the Plain, Sodom and Gomorrah, with fire and brimstone.

This Biblical "solution" must, of course, be averted and we believe that it can be done.

Thank you.

Chairman HYDE. Dr. Fisher, does the discrepancy in development levels between the countries of the Jordan River Basin weaken their ability to use market mechanisms to allocate water?

Mr. FISHER. I don't think so. I don't believe it does. Let me point out that what my project is involved with is not an actual market, but a simulated market mechanism. And no matter whether there are poor—whether countries are poor or countries are rich, it is still true that willing trades bring gains. And in the proposal the project brings, nobody sells unless they are willing to sell; and, of course, nobody buys unless they are willing to buy. And as I said before, everybody gains.

It is not required that actual markets be set up. I think that is both infeasible and incidentally won't lead to the right results. What is required is some form of regional agreement to operate jointly a mechanism that tells you what the optimal flows of water are and who should get compensated for giving up water.

Chairman HYDE. In an article entitled, "Water Policy in Israel," published in 2000 by the Institute for Advanced Strategic and Po-

litical Studies in Israel, Steven Plaut, P-L-A-U-T, states, and I quote:

“The main problem with Israeli water policy is that it is a politicized system instead of a market system. Administrative and bureaucratic considerations dictate water allocation, not economic considerations.”

Do you agree with this statement?

Mr. FISHER. Is Professor Shamir going to carry what I say back home?

Chairman HYDE. Most likely.

Mr. FISHER. I was afraid of that.

It is true on the one hand that Israeli water policy has an awful lot of political issues in it. To take one which I guess could be described as political, Israel subsidizes water for agriculture. It does so in large part not just because the farmers have political power, which may, in fact, be true, but because it is part of the Zionist dream to return to the land, and that is considered important.

There is nothing wrong with that. In the proposal that I am putting forward, Israel could exercise those kinds of values before you get to the market point. I do think it is true that Israeli water policy has traditionally rested very largely on political agreement, technical expertise to be sure, and not a serious analysis of the economics of water, but I am hopeful that that might, in fact, change.

Chairman HYDE. One more question. Some high-level Israeli officials have said that importing water from Turkey is more about politics than need. Do you agree? Is importing water an appropriate solution to the problem?

Mr. FISHER. Okay. I am happy to comment on that. Our project finds that Israel—I am going to get to Turkey, I promise.

Chairman HYDE. Sure.

Mr. FISHER. Is that Israel does not, in fact, need desalination plants on the Mediterranean coast except—or won't for the next several years, except in years of drought, which is important. And the problem is simply that the desalination is expensive. It is not that there isn't enough water; as I said before, it is that it is too high-priced for agriculture.

Now, water from Turkey, as I understand it, is going to have a landed cost that is higher than the cost of desalination now is. That means that the same result says no. If you are going to run this simply as a rational economic system, you do not want to be bringing water in from Turkey. If you wanted that water, you should be desalinating it, and probably you shouldn't be doing either.

Israel nevertheless has contracted to bring in water from Turkey, and although I am not privy to the discussions, it is my general view that I do agree with the statement you read; namely, Israel is very anxious to maintain good relations with Turkey. The Turks have done a good deal to prepare the infrastructure to bring the water to the coast and sell it; and that the treaty is undertaken not for purely economic reasons and not purely for reasons connected with water, but as part of the general political relations between the two countries.

Chairman HYDE. And, Dr. Shaked, what is the environmental impact of mixing water from the Red Sea into the Dead Sea?

Mr. SHAKED. I am afraid I am not an expert in the specific sciences which are required to give you a proper answer. I know that some studies are being conducted. I am aware of a study conducted by Friends of the Earth-Middle East. I know also that everyone who has been involved in looking at this project has stated that much more research is required in order to determine the answer to your very important question. It also goes to the question of bringing water from the Mediterranean into the Dead Sea.

Chairman HYDE. Well, I thank you. And we will adjourn our hearing now, but I want to commend you for your very instructive testimony and statements. This is a fascinating and vital, meaning life-and-death, issue. It is a disappointment that more Members aren't here, but I can assure you we have eager staff, as well as Members, who will read these matters and use this as the basis for further hearings on this very important subject. So I thank you for your great contribution and for your patience.

The Committee stands adjourned.

[Whereupon, at 1:42 p.m., the Committee was adjourned.]

