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U.S. Foreign Policy on Water Resources in the Middle East



Joyce R. Starr and Daniel C. Stoll



**The Center for Strategic & International Studies
Washington, D.C.**

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December 1987



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Foreword

As a policy studies institute, the Center for Strategic and International Studies conducts research that is both timely and anticipatory.

The water policy research project, initiated by Joyce R. Starr and Daniel C. Stoll of our Near East Studies Program, is a prime example of this focus. Their effort, *U.S. Foreign Policy on Water Resources in the Middle East*, concentrated on the impact that emerging water problems in the Middle East will have on U.S. strategic interests in the region. In the process, they brought together an extraordinarily varied body of water experts, representing the academic, government, and business communities in both the United States and Middle East.

This report is the culmination of over 15 months of research, interviews, and conferences. Given the scope and depth of its treatment of pertinent issues, it should become an invaluable study for students of the Middle East as well as for seasoned analysts.

Amos A. Jordan
President
Center for Strategic and International Studies
December 1987

Executive Summary

The Middle East stands at the precipice of another major natural resource crisis. Before the twenty-first century, the struggle over limited and threatened water resources could sunder already fragile ties among regional states and lead to unprecedented upheaval within the area.

In July 1986, with the generous support of the Prince Charitable Trusts, the Near East Studies Program of the Center for Strategic and International Studies (CSIS) launched a 15-month research effort on the U.S. government response to the unfolding crisis, "U.S. Foreign Policy on Water Resources in the Middle East." Our goal was to recommend a strategy for the future that could protect and reinforce U.S. interests.

Our intended audience was the U.S. policy-making community, specifically those agencies and divisions in the executive branch involved in water-related diplomacy, development, and data collection. The study focused on the region's three major river basins: the Jordan, the Tigris/Euphrates, and the Nile. We concentrated on those countries or areas in the region facing severe water shortages and declining levels of water quality: Egypt, Jordan, Iraq, Israel, the West Bank and Gaza Strip, Syria, and Turkey.¹

The perspective of the Middle East players themselves was essential. Thus, experts from the region were brought in to critique our ideas as they took shape. A steering committee of U.S. experts from wide-ranging disciplines provided intellectual direction.

As the project unfolded, officials from U.S. government agencies participated, generously sharing their time and views. We were grateful for the dedication and professionalism of these experts. Although increasingly restricted by reduced funding and constraints within the government, their skill and far-sightedness have shaped programs that stand as a source of pride for our nation.

This report represents a consensus of views as developed in our ongoing research, seminars, and consultations with government and private sector experts. Section I provides an overview of the anticipated Middle East water resource crisis. Section II summarizes the conferences and seminars held during

the course of this study. Section III details our research findings, based on countless hours of interviews with U.S. government program directors, policymakers, and technical experts—those with practical, hands-on experience in shaping U.S. efforts. Section IV sets forth our recommendations for steps to temper or avert the looming water crisis.

There was consensus among the participating experts that diplomatic momentum should be encouraged wherever possible. The group stressed, however, that diplomacy per se is a long-range, laborious, and usually tortuous process. By contrast, technical advances—although not a substitute for diplomacy—can result in discernible, near-term gains.

U.S. government and private sector representatives participating in this effort recommended that the U.S. government concentrate on four policy areas:

- ★ advanced water technologies,
- ★ resource management and conservation strategies,
- ★ coordination among U.S. agencies dealing with water resources, and
- ★ long-range research and planning.

Through structural and programmatic changes, these goals could be met with high returns at minimal cost. Congressional awareness of the looming Middle East water-resource crisis and support for a strengthened U.S. government position is essential, however.

The following recommendations for action were developed as a result of this study.

- ★ A coordinating body within the U.S. government for all Middle East water research and development programs should be created. This interagency group would serve as a data clearinghouse and "institutional memory" for the government's work on water issues.
- ★ A U.S./Middle East Water Program should be created to encourage the development of advanced water technologies. Topics to be studied would cover a wide range of technical issues including pollution control, horticulture, water-reuse strategies, and the application of solar energy to water technologies. Special emphasis on research related to

desert regions would have applications for both the Middle East and the American Southwest.

This report is a call—indeed, a shout—for action. At present, the United States is the only country in the world capable of exerting leadership on water resource development and cooperation in the Middle East. We have the capability to forge ahead. What is required at this juncture is the vision to persevere.

Joyce R. Starr
Director

Daniel C. Stoll
Research Associate

Near East Studies Program
Center for Strategic and International Studies

I

Overview of the Problem

By the year 2000, water—not oil—will be the dominant resource issue of the Middle East. According to Worldwatch Institute, “despite modern technology and feats of engineering, a secure water future for much of the world remains elusive.”² The prognosis for Egypt, Jordan, Israel, the West Bank, the Gaza Strip, Syria, and Iraq is especially alarming. If present consumption patterns continue, emerging water shortages, combined with a deterioration in water quality, will lead to more desperate competition and conflict.³

The Jordan River Basin

With headwaters originating in the Syrian and Lebanese highlands, the Jordan River has an average annual discharge of 1,287 million cubic meters (MCM). Its principal tributary, the Yarmuk, forms the border between Syria and Jordan and divides Israel from Jordan in the Yarmuk triangle. The Jordan River itself demarcates the boundary between Israel and Jordan.

Conditions will be severe in the Jordan River basin. By the year 2000, Israel’s water needs may exceed supply by 30 percent, with Jordan experiencing a 20 percent discrepancy.⁴ The upper Jordan River already has been developed to maximum capacity. If construction of the proposed Unity/Maqarin Dam proceeds, the Yarmuk—the only major undeveloped tributary—will also become fully utilized. Moreover, the quality of surface

and groundwater supplies is deteriorating at a rapid pace, thereby requiring substantial investment in domestic and industrial wastewater treatment, in groundwater recharge programs, and in water quality monitoring. Some experts now predict that Jordan and Israel will have fully developed all renewable sources of water by 1995 and will reach a critical point in the exploitation of nonrenewable water supplies unless remedial measures are taken quickly.

Quiescent rivalries may well be rekindled and sharpened as Syria continues implementation of development schemes for the upper Yarmuk. These plans could lead to increased salinity levels in the lower Yarmuk and lower Jordan rivers, lower water levels in the Dead Sea, and reduced irrigation water for Jordan's East Ghor Development Project. From a strategic point of view, this long-term Syrian effort could reduce Jordanian access to the Yarmuk, which Jordan relies on to irrigate the Jordan valley, and may affect downstream availabilities for Israel.⁵ Ultimately, the possibility of heightened tension or even armed conflict among the riparians increases dramatically.

Israel

Israel transfers water from the Jordan basin via the National Water Carrier to western portions of the country. Israel is already using 95 percent (of an estimated total of 1,755 million cubic meters per annum) of its renewable resources and consumes five times more water per capita than its neighbors. Current total consumption for Israel is estimated at 1,750 MCM per annum.⁶

Although Israel has managed to reduce the amount of water used in agriculture by 15 percent over the last two years, this reduction has not appreciably eased the strain on existing sources.⁷ If estimates are correct, by the year 2000 Israel will face shortages up to 800 MCM per annum—almost half of its present consumption. Because approximately 75 percent of the water Israel currently consumes is used for agriculture, substantial future reductions in water use by the agricultural sector could avert the crisis.⁸ Given the dominant role agricultural interests have on Israel's politics and economy, however, such hard choices are viewed as unlikely.

Jordan

Thomas Naff of the University of Pennsylvania estimates that in 1985, total consumption in Jordan was approximately 870 MCM. He also predicts that annual demand could reach 1,000 MCM per annum by the year 2000, resulting in an annual water deficit of 170 to 200 MCM.⁹ Jordan uses approximately 130 MCM of water a year from the Yarmuk River for irrigated agriculture in the Jordan basin.

Jordan and Syria recently ratified an agreement allowing for construction of the Unity Dam at the Maqarin site. The 100-meter-high dam is expected to have a storage capacity of 220 MCM per annum and will help regulate the flow of the Yarmuk, expand irrigated agriculture in the Jordan valley, and provide water for municipal and industrial use in upland Jordan. This agreement also limits the scope of Syrian development plans in the Yarmuk basin.

Syria

Syria's development program for the Yarmuk basin calls for building a series of medium and small dams that eventually could divert up to 40 percent of the Yarmuk's waters—if the terms of the agreement with Jordan are not observed.¹⁰ Without a Jordanian agreement, the Syrian plan would take a decade to complete and would sharpen rivalries over decreasing quantities of water.

For Jordan, Syrian diversion of the Yarmuk could mean the loss of significant amounts of water. Jordan is expending most of its share of the Yarmuk waters for agriculture in the Jordan valley. In addition, Yarmuk water is also pumped through pipelines to upland urban centers such as Irbid and Amman for municipal and industrial purposes.

The West Bank and Gaza Strip

According to the West Bank Data Project's *The West Bank Handbook*, "The main water potential of the West Bank, shared with Israel, is exploited to its limit, in a ratio of 4.5 percent to the West Bank and 95.5 percent to Israel."¹¹ The *Handbook* also notes that water authorities plan to allocate 137 MCM per year to the West Bank's Arab population (approximately 1 million

people) by the decade's end and 100 MCM for the Jewish population (100,000 people). Yet in 1985, Jewish settlements in the region already exceeded their water quotas by almost one-third.¹²

The water situation in the Gaza Strip has been described as a "time bomb waiting to explode."¹³ Indeed, the large Gaza Strip aquifer, which supplies all of the area's water needs, is already seriously overpumped. In 1985, annual agricultural and domestic consumption outstripped natural replenishment of the aquifer by almost 50 percent.¹⁴ This overpumping has resulted in partial contamination of the aquifer from seawater intrusion.

Contamination of water supplies in the Gaza Strip is reaching critical proportions. The heavy use of pesticides and fertilizers in the Gaza Strip also presents a potential source of groundwater pollution. Raw sewage in many towns is still not being collected or treated. A recent Israeli state comptroller report on the West Bank and Gaza Strip's civil administration noted that sewage in these areas could devastate underground aquifers. The report warned that "if a solution is not expedited . . . the problem will cause greater damage, and the financial investment required will be much greater than it would be today."¹⁵ New sewage systems in the Gaza Strip alone would cost in excess of \$16 million at today's prices.¹⁶ Israel has refrained from making significant investments in West Bank and Gaza Strip water and wastewater services over the last decade. UN organizations, bilateral donors, the U.S. Agency for International Development (USAID), and nongovernmental organizations have attempted to address this need, but only in a piecemeal fashion.

Tigris/Euphrates River Basins

Both the Tigris and Euphrates rivers originate in the mountains of eastern Turkey. The Euphrates flows through Syria and Iraq to the head of the Gulf, while the Tigris flows directly through Iraq, obtaining additional flows from major tributaries rising in the Zagros Mountains of Iran and discharging in the Gulf. The combined drainage basin of the two river basins is approximately 430,100 square miles. The approximate annual discharge of the Tigris is 42,230 MCM and of the Euphrates, 31,830 MCM.

Decreasing water quantities and deteriorating water quality will be dominant points of controversy in the Syrian-Iraqi-Turkish triangle in the near future.

Turkey

Ambitious development schemes in Turkey, especially the Southeast Anatolian Project (GAP), are reducing the discharge of the Euphrates, which directly affects both Syria and Iraq. Development projects in all three countries are seriously eroding the quality of both surface and groundwater supplies, truncating domestic and agricultural use. Some relief may be found in Turkey's recent proposal to share its abundant resources from the Ceyhan and Seyhan rivers with other Middle East nations via a "peace pipeline," although some experts question this project's political and economic viability.

Syria

Conditions in Syria are difficult to assess. Neither U.S. government agencies such as USAID nor multilateral organizations such as the World Bank are currently undertaking development projects in Syria. Data related to Syrian water projects are tightly controlled by the government, but experts believe the country could face a general deficit as high as 1 billion cubic meters (BCM) by the year 2000 if present patterns of consumption continue.¹⁷ Syria is confronting mounting shortages, the result of reduced flow from the Euphrates and from contamination by pesticides, fertilizers, and salt. Even now, major cities like Damascus and Aleppo suffer from constant water and electricity shortages (from hydroelectric sources), especially during the summer months. Proposed large-scale agricultural projects, if poorly designed and constructed, will only further damage the quality of existing water supplies.

Alarmed by these conditions, the Syrian government has sharply increased the amounts budgeted for water and hydroelectric projects in 1988. Recent figures released by Damascus indicate these areas will account for 43.5 percent of the government's investment budget in 1988, compared with only 10 percent in prior budget cycles.¹⁸ Targeted projects include badly needed water and sewage systems in Damascus, Aleppo, Homs, and Hama.

Iraq

As a consequence of its ongoing war with Iran, Iraq has slowed the pace of development efforts and even suspended several major projects. Iraq is also concerned about Turkey's massive Southeast Anatolia Project—a program of 13 hydroelectric and irrigation projects on the upper Tigris and Euphrates rivers. Despite Turkey's assurances, some experts estimate that the GAP could reduce the annual Euphrates flow into Iraq from 30 BCM to 11 BCM once it is completed. Iraq estimates its minimum requirement for Euphrates water is approximately 13 BCM.¹⁹ Syrian development efforts are also causing alarm in Iraq. Iraq claimed that almost 3 million Iraqi farmers were adversely effected when Syria reduced the flow of the Euphrates to fill the reservoir behind the Al-Thawrah Dam in 1975. Indeed, the dam brought these two countries to the brink of war. Moreover, as the final riparian along both the Tigris and Euphrates rivers, Iraq is most harmed by increased pollution from upstream development. Conditions have deteriorated so markedly in some areas that many villages are now forced to import drinking water by truck.²⁰

The Nile River Basin

As the longest river in the world, the Nile and its headwaters flow through nine African states: Burundi, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda, and Zaire. The Nile basin covers approximately one-tenth of the African continent. The average annual discharge of the Nile is approximately 92,600 MCM.

Drought in the Horn of Africa and unusually low rainfall during the early 1980s focused world attention on the Nile River basin, particularly on Ethiopia and Sudan. Although rainfall briefly returned to a more normal level and improved the situation somewhat, countries sharing the basin still confront the specter of periodic drought, deteriorating water quality, and starvation in some areas. History has shown that cooperation on resource management and development among the nine riparians of the Nile has been difficult to achieve. In 1983, however, a consultative body known as the Undugu Group was formed to

promote cooperation on wide-ranging issues. This group could prove to be a forerunner for more extensive resource coordination.²¹

Egypt

Egypt is almost totally dependent on the waters of the Nile. As a result, extractions upstream reduce the availability of water for Egypt's ever-expanding internal demands and impair electricity generation from the Aswan Dam. Egypt has long recognized the importance of monitoring the development schemes of upper riparians, but has almost no influence in actual planning or execution.

Reliable data on Egyptian water use are sparse, and seasonal flows of the Nile are difficult to calculate. The government of Egypt, with support from the World Bank, has undertaken comprehensive studies on the country's resources, but much of this information remains restricted. Statistics relating to anticipated demand and future availability of supplies are subject to qualification. The work of John Waterbury of Princeton University, however, presents one of the most exhaustive and authoritative collations to date. Waterbury projects total Egyptian demand for water at 73 BCM by 1990, at present rates of water efficiency.²² Because the country has an average annual supply of approximately 68.9 BCM, Egypt could experience a critical water shortfall by the turn of the century, particularly against the backdrop of seemingly unstoppable population growth. Increased pollution, especially in the delta and in selected coastal areas, will exacerbate this reality.

Causes and Ramifications

The water crises described above can be traced to three primary causes: increased water consumption, which is linked to population growth, expansion of industry and agriculture, and increased urbanization; inefficient maintenance and improper operation of water facilities; and poor cooperation among countries sharing common resources.

In table 1, startling statistics on population growth in the countries under study have been provided by the Population Reference Bureau. To help understand the magnitude of the

problem confronting countries in the region, table 2 details the average annual discharge of the river basins in question.

In examining table 1, note that a natural annual population increase of 1 percent or lower is generally considered "manageable." The United States and other Western nations have rates equal to or well below the 1 percent level. Rates of 1.5 percent and above can have catastrophic consequences for developing nations. In this regard, the countries under study are caught in a population spiral that is out of control. As domestic, agricultural, and industrial demands mount, many countries will confront extreme difficulty in providing sufficient quantities of water to their citizens. Even Israel, with its comparatively modest growth rate of 1.6 percent per annum, will be forced to wrestle with the consequences of a seriously overextended resource infrastructure.

Table 1

Population Growth in the Middle East

Country	1986 Population (in millions)	Crude Birth Rate*	Natural Increase**	Estimated Population in 2000 (in millions)
Lebanon	2.7	29	2.1	3.6
Jordan	3.7	44	3.7	6.4
Israel	4.2	23	1.6	5.3
Syria	10.5	47	3.8	17.2
Iraq	16.0	46	3.3	24.2
Sudan	22.9	46	2.9	34.2
Egypt	50.5	37	2.6	71.2
Turkey	52.4	35	2.5	69.7
U.S.	241.0	16	0.7	268.0
World	4,942.0	27	1.7	6,157.0

Source: *World Population Data Sheet* (Washington, DC.: The Population Reference Bureau, Inc., 1986).

* Crude birth rate is the number of births per 1,000 persons.

** Natural increase is the annual percentage increase in population.

Poorly managed and inefficient water facilities—dams, water and wastewater treatment plants, industrial facilities, and irrigation schemes—have emerged as another priority. Although USAID, the World Bank, and other international agencies have worked assiduously to create water infrastructures throughout the Middle East, most of these facilities now operate well below peak efficiency levels. In Egypt and Syria, in particular, technicians

and engineers employed in water treatment and sewage plants typically lack the skills and expertise required to operate sophisticated machinery and monitor complicated processes. All countries examined here suffer from inadequately maintained and poorly operated infrastructure facilities.

Table 2

Average Annual Discharge Rates

River	Discharge Rate (in million cubic meters)
Jordan*	1.287
Euphrates	31,820
Tigris	42,230
Nile	92,600

Source: Figures compiled by the authors from government sources.

* This statistic was taken from the Johnston Plan.

Budgetary constraints also prohibit governments from adequately maintaining water infrastructures once they are completed and commissioned. Even when money is available for maintenance or training programs, governments are often reluctant to tackle the problem, preferring to channel funds to the construction of additional facilities. During the past 20 years, the majority of Middle East water projects have been cofinanced with multilateral and bilateral foreign assistance, chiefly to improve water quality and public health conditions in primary and secondary urban areas. Hence, governments commonly assume that future efforts will be financed in a similar manner.

Finally, there is little or no collaboration among countries sharing common resources. Almost all major water resources in the region (surfacewater and groundwater alike) are shared by two or more states. Maximum utilization of all supplies necessitates far-reaching cooperation. In a region beset by ethnic, religious, and political hostility, however, neighborly goodwill has seldom existed in the past and may become even more elusive in the future.

Syria, Turkey, and Iraq have had difficulty in collaborating on the use of the Euphrates River. This was observed most recently when Turkey announced its Southeast Anatolia Project, which was designed without comprehensive Syrian and Iraqi consultations.

The Trilateral Commission on the Euphrates River, whose members are Turkey, Syria, and Iraq, has discussed only technical

matters, such as river flow and rainfall data. Further, because Turkey regards the area of the Tigris and Euphrates rivers as one basin and Iraq views the rivers and their basins as separate entities, the difference could prove to be an obstacle in obtaining any water agreement in the future. Despite the fact that the GAP will affect the flow into Syria and Iraq and is thus of immediate concern to both, Turkey has so far rejected suggestions for high level negotiations on water allocation and use. Instead, Turkey has agreed only to the creation of a low level technical exchange commission. As a result, the World Bank has refused to provide funding for project components until a cooperative water-sharing agreement is secured.

Similarly, Syria, Israel, and Jordan have never formally agreed on use of the Jordan River. The most far-reaching plan for basinwide development was proposed in the early 1950s by Eric Johnston, President Eisenhower's special ambassador to the Middle East. Although technical understandings were reached, and Israel and Jordan still tacitly operate under many of the plan's provisions, political intransigence and distrust derailed formal acceptance of the Johnston Plan.²³

The proposed Unity/Maqarin Dam, of primary importance to Jordan, has yet to be built. Situated along the Yarmuk between Syria and Jordan, the dam would contribute substantially to more efficient utilization of the river. In short, it would help regulate the flow of the Yarmuk by creating a storage facility. This in turn would prevent scarce water from being wasted by minimizing water discharge to the Dead Sea. Jordan and Syria recently ratified an agreement to proceed with building a smaller facility—the Unity Dam—at the Maqarin site. There is question whether this project will materialize, however, because of the implicit need for riparian understanding with Israel prior to construction of the dam.

Water resources will undoubtedly affect the outcome of negotiations on the Palestinian question. Recent reports of Israeli intentions to pump more water from the West Bank's aquifers elicited sharp protests from West Bank Arabs and from Jordan. With available renewable resources in Jordan, Israel, and the West Bank approaching their development limits, the area will not be able to sustain a major influx of new users.

Along the Nile, with nine riparians sharing the same sources of water, relations are even more convoluted. Although attempts to establish a legal regime for the river date back to

the late nineteenth century, there is still no single agreement binding all the states. The United Nations Development Project (UNDP) Workshop for Nile basin countries, held in January 1986 in Bangkok, took preliminary steps toward achieving a larger, more detailed formula, but substantially more work must be undertaken to bring it to fruition. The workshop participants also agreed to seek the assistance of the UNDP in creating a Nile development program. The Undugu Group, mentioned above, could become a forum for such future cooperative efforts.

Ethiopia remains the "great unknown" of the Nile basin and will assume a more dominant role in the coming decade. John Waterbury estimates that Ethiopia is the source of more than 82 percent of the Nile's water. Given this preeminent position, development plans undertaken by Ethiopia—such as irrigation schemes in the Blue Nile basin and the Baro—could have a deleterious impact on Egypt and Sudan.

Finally, the region's water resource quagmire is even deeper than technical, management, or economic constraints would suggest. More difficult to assess and alter are underlying passions. Although actual physical conditions vary from nation to nation, attitudes about water do not: in every country, access to clean water is considered an undeniable right, and tampering with water supplies is considered an unspeakable crime. Especially in more traditional agricultural areas, consumption patterns reflect deeply ingrained, age-old feelings about water. Water determines the nature of economic survival, permeates cultural norms, and infuses political ideology. Although technology may be harnessed, emotions pose the ultimate challenge.

II

Overview of the Project

International Advisory Council Meeting November 24, 1986

On November 24, 1986, the Near East Studies Program held the inaugural meeting of the International Advisory Council for its 12-month research project entitled "U.S. Foreign Policy on Water Resources in the Middle East: Instrument for Peace and Development."

Among the experts giving presentations at this meeting were Abdul Rasoul Alwash, first secretary of the Embassy of Iraq; Edward E. Azar, director of the Center for International Development and Conflict Management at the University of Maryland; Meir Ben-Meir, director general of the Israeli Ministry of Agriculture; Munther J. Haddadin, president of the Jordan Valley Authority; Raj Krishna, chief counsel at the World Bank for South Asia; Harold Rhode, Southwest Asia policy analyst in the Office of the Secretary of Defense; Selig Taubenblatt, executive consultant for Bechtel Financing Services, Inc.; and H.E. Volkan Vural, deputy director general for bilateral economic relations in Turkey's Ministry of Foreign Affairs.

More than 40 U.S. government, corporate, and scientific participants were present. Given the qualifications of these participants, the conference was a unique event in the history of Middle East intraregional relations.

The meeting opened with a general discussion of Near East water resource problems, but quickly moved to a debate on

opportunities for U.S. government involvement. Although it was anticipated that diplomacy and political intervention would emerge as dominant themes, the discussion instead repeatedly returned to a call for wider U.S. technical outreach to the region. There was consensus among the participating experts that diplomatic momentum should be encouraged wherever possible. The group stressed, however, that diplomacy alone is a long-range, laborious, and usually tortuous process. By contrast, technical advances—though not a substitute for diplomacy—could result in discernible, near-term gains.

The broadening of R&D efforts to improve technologies was a major topic of discussion. Breakthroughs in energy technology and consequent energy cost reductions were cited as fundamental for providing affordable water resource technologies to Middle East countries.

There was agreement that greater R&D monies should be channeled into the development of water/wastewater reuse and saltwater/brackish water desalination technologies. It was stressed, however, that total dependence on desalination of saltwater or brackish water to meet municipal and industrial water requirements is neither desirable nor economically feasible at this time. Desalination of seawater, for example, is cost-effective only if undertaken on a large-scale basis, with a sufficient source of power available.

Nonetheless, there was consensus that, when combined with advanced agricultural practices such as the use of high-value or salt-tolerant crops, desalination could prove vital in forestalling or alleviating water shortages in a variety of situations.

The discussion of technology drew attention to management of existing resources, prompting comments that effective management of existing resources is frequently as crucial as the identification of new sources. Improper or inefficient management techniques exacerbate already strained conditions. The need for additional training programs and collaborative research was also mentioned.

Finally, there was considerable discussion about the need for increased coordination among U.S. government agencies. Current and former U.S. officials acknowledged a lack of continuity in communication among responsible agencies and the reduction in effectiveness of U.S. efforts as a result.

The Johnston Plan and the Jordan River Basin Research Seminar November 25, 1986

The program held its first research seminar on November 25, 1986. Experts making presentations at this seminar included Abdul Rasoul Alwash, first secretary of the Embassy of Iraq; Edward E. Azar, director of the Center for International Development and Conflict Management at the University of Maryland; Meir Ben-Meir, director general of the Israeli Ministry of Agriculture; Munther J. Haddadin, president of the Jordan Valley Authority; Raj Krishna, chief counsel at the World Bank for South Asia; Harold Rhode, Southwest Asia policy analyst in the Office of the Secretary of Defense; Selig Taubenblatt, executive consultant for Bechtel Financing Services, Inc.; and H.E. Volkan Vural, deputy director general for bilateral economic relations in Turkey's Ministry of Foreign Affairs.

The potential for future technical cooperation among the riparians of the Jordan River—particularly Israel and Jordan—was assessed, as well as the impact of water allocation and control on peace negotiations.

The seminar also evaluated the 1956 Johnston Plan and subsequent Maqarin Dam negotiations. Participants noted that the Johnston Plan was one of the earliest comprehensive attempts to solve disputes arising over distribution of water and the first major U.S. initiative on Middle East riparian rights issues. It also helped define relations among the riparians. The Maqarin Dam negotiations were another example of riparians states dealing effectively with water issues. Both situations could set a strong precedent for the course of negotiations for the proposed Unity Dam.

As discussed in section I, the water resources of Israel, Jordan, and the West Bank total a mere 2.5 billion cubic meters, with only modest gains expected in the coming decade.²⁴ At the same time, the area is prisoner to a demographic explosion. As a result, improved water management techniques and more cost-effective technologies will become vital in the years ahead.

To meet future requirements, Jordan must rechannel increasingly larger amounts of water from the Jordan valley to the urban areas of the upland plateau and rely more extensively

on water reuse. In the future, both Israel and Jordan may be forced to significantly increase the rate of investment in brackish water and saltwater treatment. Given the projected shortage of water in the Jordan basin, interbasin transfers of water will become increasingly attractive. The proposed Turkish peace pipeline and the Iraq-Jordan Euphrates pipeline were discussed.

Conference participants further noted that future development efforts in the basin will necessitate decisions on a range of issues including the viability of the Maqarin/Unity Dam, exploitation of regional groundwater supplies, and the creation of an international water authority to resolve water disputes.

**The Nile River Basin:
A Case Study in Riparian Relations
Research Seminar
February 4, 1987**

On February 4, 1987, the Near East Studies Program held its second research seminar. Presentations at this seminar were made by Clyde Burdick, former project engineer for the Bureau of Reclamation's Blue Nile River Reconnaissance Project; Donald Clay, chief planning officer for the Bureau of Reclamation; David J. Fischer, director of the U.S. State Department's Bureau for East African Affairs; Richard Ives, chief of technical assistance for the Bureau of Reclamation; and Stephen F. Lintner, environmental coordinator for USAID's Bureau for Asia and the Near East.

Conference participants observed that the U.S. government's policy structure on water resources is hampered by bureaucratic divisions and lines of authority, which are based on geographic considerations. For example, Egypt is under the auspices of the State Department's Bureau of Near Eastern and South Asian Affairs, while Ethiopia and Sudan are covered by its Office for East African Affairs—despite the fact that the three countries are in the same river basin. This approach impedes comprehensive regional planning and problem solving.

At the seminar, the participants noted that in many Near Eastern countries, government agencies and ministries are staffed by engineers or former military officers. Because of their training, there is often a preference for high-visibility technical responses

to many, if not most, water problems. This preference is the result of a belief that technological breakthroughs will provide solutions to future problems. This outlook places an increasing emphasis on technology rather than management as a means to address current problems.

Water quality will take on heightened importance in the coming years. Industrial pollution in Egypt is rapidly escalating, due principally to untreated industrial wastewater. The mounting use of pesticides contributes to agricultural pollution. Poor land use, especially in Ethiopia, has led to rapid sedimentation. In both Egypt and Sudan, untreated or partially treated wastewater has seriously reduced water quality in some areas, and the disposal of solid wastes in the Nile causes local problems in flow patterns. On a more optimistic note, large-scale investments in domestic wastewater treatment and solid waste management—especially in the primary and secondary Egyptian cities—should lead to a significant improvement in water quality over the next 20 years.

Improved coordination in investment and project development was recommended by participating experts. Aid donors are often reluctant to take the lead on essential infrastructure projects. In addition, two new concerns about future investment, especially for large-scale dams and drainage projects in Ethiopia and Sudan, have emerged. Those concerns center on the stringent environmental standards demanded by bilateral and multilateral donors and cultural survival issues, that is, the displacement of tribes and villages to accommodate projects. Finally, it was noted that conflicting development goals (agriculture vs. industry vs. power generation) lead to fragmentation of planning within each country.

Although Egypt has gathered data on the Nile over a long period of time, the creation of a sustainable data collection system for the entire basin should be encouraged by the United States. Each riparian state could control its own information base, while at the same time, the data could be collected and presented in a standardized form to facilitate efficient project planning.

Water Security and Security Through Water Technology

June 25, 1987

Concluding Conference

The project's final conference addressed the twin questions of water security and water technology. The following experts presented papers at this event: Ewan Anderson, lecturer in the department of geography, University of Durham, England; Leon Awerbuch, principal engineer for Bechtel Corporation; H.E. Cem Duna, special adviser for foreign affairs to the prime minister of Turkey; Carl A. Hodges, director of the University of Arizona's Environmental Research Laboratory; Stephen F. Lintner, environmental coordinator for USAID's Bureau of Asia and the Near East; Donald Osborn, director of the University of Arizona's Solar Energy Research Facility; and Graeme Polk, project director for Brown and Root, USA.

Most participants agreed that desalination could prove a key source of water for energy-rich countries in the Middle East well into the next century. Because approximately 60 percent of the world's currently installed desalination capacity is located in the region (especially in Gulf nations like Saudi Arabia, Bahrain, and Kuwait), some nations in the Middle East are already heavily dependent on this process. In addition, because a large percentage of desalination cost (sometimes as high as 50 percent) is associated with the price of energy, R&D efforts in desalination should undoubtedly focus on heightening energy efficiency. Use of the region's abundant solar power could be one means of achieving this goal.

Solar power can also be applied to other water technologies. In the field of water treatment, researchers have been successful in harnessing solar energy to enhance water-reuse processes. The abundance of solar energy in the Middle East makes it an attractive energy source for regional water facilities, even though many currently available technologies employing solar energy are more expensive than those using oil.

Advances in plant breeding could also contribute to more efficient water utilization.²⁵ In particular, the extensive use of halophytes—plants with a high saline tolerance—could provide

the region with an abundant source of fodder for animals, as well as foodstuffs. Also, because halophytes utilize direct seawater irrigation, untapped coastal areas in the Mediterranean, Red Sea, and Gulf regions could then be exploited for agriculture.²⁶ This, in turn, would both expand greatly the amount of acreage under cultivation and would enable valuable interior farmland to be devoted to higher value crops. Preliminary results from experiments conducted in the United States indicate that halophytes and their by-products could, in some circumstances, become commercially viable within two years after planting.

The senior Turkish representative attending this conference offered the first public elaboration of Turkish Prime Minister Turgut Ozal's proposal for a peace pipeline. The project, which would consist of two pipelines branching from the Seyhan and Ceyhan rivers, would provide water for a number of regional countries. Kuwait, the eastern coast of Saudi Arabia, Bahrain, Qatar, and the United Arab Emirates would receive water from the eastern pipeline, while the western pipeline would serve selected cities in Turkey, Syria, Jordan, the West Bank, and the western section of Saudi Arabia. Both pipelines would supply water only for municipal use and would be intended to supplement rather than compete with existing water resources.

With the cost of the project estimated at \$20 billion, raising the required capital could prove an arduous process. Turkish officials expect a variety of international organizations and investment banks to participate. The greatest obstacle, however, is political friction that exists among the participating countries. The Turkish government hopes to convince these nations that the economic benefits from the pipeline will outweigh political concessions. They argue that the pipeline could potentially reduce regional conflicts, improve cooperation among nations, and increase prosperity throughout the Middle East.

III

U.S. Government Policy Structure on Water Resources

In a recent speech before leading U.S. water experts, M. Peter McPherson, then-administrator of USAID, noted that the "development . . . of water resources is a critical foreign policy issue" for the United States.²⁷ Over the past three decades, the U.S. government, through a variety of departments and agencies, has undertaken extensive technical assistance programs and development projects in the Middle East. Projects for every conceivable purpose have been designed and implemented: wastewater treatment plants, feasibility studies for dams, training programs for regional experts, and many others.

An assessment of federal agencies working on water resource development in the Middle East is presented below. It emphasizes areas of agency responsibility, programs, agency interaction, and constraints on development efforts. This analysis focuses on the role of the federal agency in tracking emerging water problems, in gathering data and information, and in creating development programs. Also included is a description of bilateral commissions and foundations that are involved with Middle East water projects.

United States Department of State

The Department of State has long been successfully involved with regional water issues. Among the offices tracking these

questions is the Bureau for Near Eastern and South Asian Affairs (NEA). Within NEA, country desk officers and the Office for Regional Affairs monitor developments in the region. Embassy staffs (especially in Amman and Tel Aviv) closely follow water issues. In general, the bureau's work addresses the political, rather than economic, dimension of water problems and rarely involves overarching water policy concerns. With little opportunity for long-term, in-depth studies, both embassy and NEA analysts offer near-term assessments of fast-breaking events, and then, only if developments are directly linked to U.S. interests.

The Bureau of Oceans and International Environmental and Scientific Affairs (OES) coordinates the U.S. government's participation in international environmental activities. It also works closely with USAID, the U.S. Environmental Protection Agency (EPA), and other agencies in monitoring environmental trends around the world. The State Department's Bureau of Intelligence and Research (INR) also studies water problems within the region on a high-priority basis, especially those related to international boundary issues.

The State Department takes the lead in all diplomatic efforts on water disputes; the renowned Johnston Plan of the early 1950s exemplifies its capabilities and commitment. Unfortunately, proposed budgetary and staff cuts could reduce the department's effectiveness in coordinating long-range diplomacy, planning, and analysis.

Recently, the department announced that, due to budget cuts, the activities of various bureaus may have to be consolidated. Continued reduction in funding and the regrouping that will result could weaken the State Department's stature and effectiveness in international water-dispute resolution.

United States Agency for International Development

Responsibility for water-resource development in foreign nations rests primarily with the USAID. Serving as the U.S. government's principal funding agency for development efforts, USAID has experience in all facets of water-resource management: water pollution control, water conservation and reuse, management master planning, hydropower studies and facilities, irrigated agriculture, and wastewater treatment.

The agency has undertaken feasibility studies for the politically sensitive Maqarin Dam on the Yarmuk River, funded the rehabilitation of hydroelectrical equipment for Egypt's Aswan High Dam, and conducted master planning studies for domestic water supply, wastewater treatment, and irrigation projects in Egypt, Jordan, and Syria. It is currently implementing programs for major water and wastewater facilities in Egypt and Jordan. Table 3 illustrates the wide range of USAID water projects.

Table 3

USAID Capital and Technical Assistance Projects Involving Water Resource Issues in the Middle East (FY 1975-1987)

Country*	Project	Planned Life of Project Funding Level (in millions of dollars)
Egypt	Water Use and Management	13.0
	Canal Maintenance	25.0
	Cairo Water Supply	91.0
	Irrigation Pumping	8.0
	Canal Cities Water and Sewerage (Phase I)	169.0
	Housing and Community Upgrading	60.0
	Alexandria Sewerage	213.7
	Cairo Sewerage	
	Phase I: Rehabilitation	129.0
	Phase II: New Construction	816.0
	Industrial Pollution Control Subproject	27.0
	Mineral, Petroleum, and Groundwater Project	7.0
	Irrigation Systems Management	139.5
	Science and Technology for Development	3.0
	Rehabilitation and Modernization of Aswan	
	High Dam	100.0
	Decentralization Program	
	(water, wastewater, drainage)	400.0
	Water and Wastewater Institutional Development	15.0
	Sinai Planning Studies	1.0
	Irrigation Pumping	8.0
	Subtotal	2,225.2
Jordan	Maqarin Dam Feasibility Study	1.0
	Jordan Valley Irrigation Design/Maqarin Dam	14.0
	Sprinkler Irrigation Equipment	4.5
	Rift Valley Water Resources	5.0
	Maqarin Dam and Jordan Valley Irrigation System	9.0
	Water Management Technology	1.3
	Aqaba Wastewater	7.5
	Amman Water/Sewerage	39.0
	Irbid Water/Sewerage	53.5
	Zarqa Ruseifa Water/Wastewater	15.0
	Groundwater Resources Investigation	5.0
	Water Systems and Services Management	21.0
	Groundwater Assessment	4.0
	Technical Services and Feasibility Studies Project	5.0
	Subtotal	184.8

Table 3 (continued)

Lebanon	Potable Water I	6.5
	Potable Water and Environmental Sanitation	7.7
	Emergency Water Repair	4.0
	Subtotal	18.2
Israel	Joint U.S./Israel Desalination Project	20.0
	Subtotal	20.0
West Bank/ Gaza Strip	Various Water, Wastewater, and Stormwater Management Activities	5.0
	Subtotal	5.0
Syria**	Damascus Water Supply II	14.5
	Euphrates Basin Irrigation	7.1
	Provincial Water Supply	17.6
	Damascus Water Supply I	48.0
	Subtotal	87.2
Total		2,540.4

Source: Information compiled by the authors from 1975-1987 USAID presentations to Congress.

* Additional activities have been funded in Morocco, Tunisia, Oman, and the Yemen Arab Republic (North Yemen).

** Program discontinued by the U.S. government in late 1983.

USAID-sponsored programs typically have been implemented by private-sector U.S. firms working jointly with host country architectural, engineering, and construction firms. USAID's current portfolio of active or planned water-related projects in the Middle East is extensive: over \$2.5 billion has been spent or allocated for fiscal years 1975-1986.

The USAID Bureau for Asia and the Near East is responsible for the coordination of policy and technical components of Middle East water projects. The Office of Project Development, the Office of Technical Resources, and the desks for specific countries are involved in this process. The Bureau for Science and Technology oversees the work of the Water for Sanitation and Health (WASH) Project.

Until recently, there was a USAID Water Resources Committee within the Bureau for Asia and the Near East. This working group acted as a formal information center and coordinating body for water experts within the bureau. Although the committee lacked policy-making authority, its members did explore policy options and emerging issues. Because of changes in the emphasis and scope of USAID's water resources development program, however, the committee was recently disbanded.

USAID has extensive involvement in large-scale infrastructure projects in the Middle East and Pakistan. These include capital-intensive programs in water supply, sewerage, and irrigation. Although USAID is still committed to completing projects in these areas (e.g., Cairo's wastewater system), there is an increased emphasis on funding complementary activities, which focus on operations and maintenance, technical assistance, and training. USAID is also involved in the review of selected industrial pollution control issues.

There are two reasons for this shift in emphasis. First, because several Near East countries already have highly developed water infrastructures, the maintenance of existing facilities has become a priority. One example is Jordan, whose water infrastructure is so advanced that USAID has turned its attention to the fine-tuning of Jordan's management approach.

Second, even when expansion in infrastructure is required, USAID has been forced to move away from expensive construction projects due to a lack of funding. Recent cutbacks imposed by the Gramm-Rudman-Hollings legislation limit USAID's ability to support infrastructure growth, although a number of major capital USAID projects in Egypt are still under way.

USAID often uses the prospect of future funding to influence structural reform. In concert with appropriate foreign government agencies, for example, USAID missions establish benchmarks for equitable user charges and water rates. The objective is to ensure that water utilities and facilities achieve greater cost recovery and eventually become financially self-supporting. Policy dialogue with Near East governments can also encourage improved operation and maintenance procedures, as well as proper training and adequate compensation for the staff who operate water facilities. USAID strives to affect both short-range improvements and long-range reforms.

United States Department of the Interior

United States Geological Survey

Since 1945, the U.S. Geological Survey (USGS), through its Water Resource Division's Office of International Hydrology, has undertaken no fewer than 95 water programs in the Near East,

funded primarily by USAID and governments in the Gulf. These include scientific and technical exchanges, workshops, and technical assistance programs. Table 4 presents a list of USGS projects from 1964 to 1986. Additionally, the USGS has made a concerted attempt to train and educate foreign technicians in advanced water technologies. Recently, however, the Office of International Hydrology has been phased out, and all international water-resource activities undertaken by the USGS are now handled through the Office of the Assistant Chief Hydrologist for Research and External Coordination.

Table 4**United States Geological Survey Projects in the Middle East (1964-1986)**

Country	Project	Sponsor
Jordan	Installation of geophysical well-logging tapes on Jordan's computer.	USAID
Jordan	Assistance in hydrologic data bank installation.	USAID
Jordan	Groundwater evaluation project.	USAID
Saudi Arabia	Assistance in storage and retrieval of hydrologic data for SAS computer system.	Government of Saudi Arabia
Saudi Arabia	Monitoring quality control and final printing of water atlas.	Government of Saudi Arabia
Saudia Arabia	Assistance in developing step-backwater rating curves.	Government of Saudi Arabia
Saudi Arabia	Quality control assistance in final printing of water atlas.	Government of Saudi Arabia
Qatar	Assistance in artificial recharge of Qatar's main aquifer.	Government of Qatar
Saudi Arabia	Assistance in final printing of water atlas.	Government of Saudi Arabia
Saudi Arabia	Project review and data collection for statistical report.	Government of Saudi Arabia
Jordan	Assistance in organic analysis and data interpretation.	USAID
Turkey	Evaluation of project on karst water-resource research.	UNDP and USGS
Saudi Arabia	Assistance in installation of meteorological equipment, instruction in its use, and establishment of maintenance and calibration procedures.	Government of Saudi Arabia
Saudi Arabia, Jordan, United Arab Emirates	Project review and formulation	Government of Saudi Arabia and USAID
Jordan	Calibrate flow model, North Jordan Ground Water Project	USAID
United Arab Emirates and Kuwait	Prepare reconnaissance assessment of water resources for United Arab Emirates. Advise on artificial recharge for Kuwait.	Government of United Arab Emirates and Government of Kuwait

Source: Information compiled from author interview with Marshall Moss, assistant chief hydrologist, USGS, on August 13, 1986 in Washington, D.C.

The USGS is not an international policy-making body and does not maintain missions in foreign countries. It can, however, participate in projects at the invitation of a host government, another U.S. agency, or a multinational funding organization. The USGS has worked extensively with the U.S.-Saudi Arabian Joint Commission on Economic Cooperation, for example. With commission funds, the USGS prepared a water atlas containing data on all aspects of Saudi Arabian water resources. This atlas could serve as a basis for long-range Saudi projections and planning. With commission backing, the USGS also created a training program for Saudi hydrological technicians, which has trained more than 400 technicians in the past 10 years.

The USGS cooperates with USAID in conducting surveys, data collection, and analyses on groundwater and surface-water resources. For example, USGS has provided extensive assistance to the Natural Resources Authority of Jordan and the Jordan Valley Authority.

The 1984 Water Resources Research Act designated the USGS as coordinator for water-resource research institutes in the United States. The act also called for the creation of a desalination research program, which has not yet been funded but could provide a strong international emphasis.

Bureau of Reclamation

Chartered in 1902 to develop Irrigation Projects in 17 states in the western United States, the bureau's activities have been broadened to include work in foreign countries. Like the USGS, the bureau's Division of Foreign Activities provides technical assistance only at the invitation of other U.S. agencies, multilateral funding organizations, or host governments.

In cooperation with USAID, the bureau is currently advising the Egyptian Electricity Authority on the replacement of turbines and runners for the Aswan High Dam and is advising the Egyptian Ministry of Irrigation on the installation of an automated hydrologic data collection system in the Nile River basin.

The bureau also conducted a review of all water development projects in Sudan and prepared an update of the Nile Waters Study. Among other issues, this review addressed the feasibility of rehabilitating and modernizing the Gezira Irrigation Project and of reducing sedimentation resulting from the Roseires Dam.

The department's recent decision to restructure the Bureau of Reclamation will undoubtedly influence activities outside the

western United States. Both staff reductions and the shift in emphasis from construction projects to water quality and conservation activities will require the redefinition of the Bureau of Reclamation's international role.

United States Department of Agriculture

The Department of Agriculture has three organizations that provide support for international activities. Those organizations under the USDA concerned with water resources are the Office of International Cooperation and Development (OICD), the Soil Conservation Service (SCS), and the Agricultural Research Service (ARS).

Office of International Cooperation and Development

The international activities of the USDA are coordinated by the Office of International Cooperation and Development. The principal source of its funding is USAID, although monies are also provided by the World Bank, the United Nations Food and Agriculture Organization, and host countries.

One of the most successful programs in the Middle East is the Trinational Agriculture Technology Exchange and Cooperation (TATEC) Research Project. Formed in July 1984 with a \$2.5 million grant from USAID's Near East Regional Cooperation Program, the project encourages cooperation among Egyptian, Israeli, and U.S. scientists in promoting agricultural innovations in Egypt and Israel. To date, research undertaken has focused on the intensification of farm system production, medicinal use of desert flora, and disease, pest, and weed control.

Soil Conservation Service

The Soil Conservation Service worked in cooperation with the USGS on the Saudi water atlas. SCS engineers are currently conducting irrigation studies in Egypt and long-term geohydrology studies for Jordan. The SCS has also provided personnel to support a review of range management in Jordan and its impact on water-resource management.

Agricultural Research Service

Drawing from USAID Public Law (P.L.) 480 funds, the Agricultural Research Service supervises several research projects in the Middle East, including cooperative research between regional and U.S. scientists. ARS also participates in the administration of the joint U.S.-Israel Bilateral Agricultural Research and Development Fund (BARD), which seeks advances in the areas of irrigation, dryland agriculture, salt-tolerant crops, and advanced agricultural technologies. ARS is currently active in irrigation water management projects in Egypt and in dryland agricultural systems research in Jordan.

United States Department of Defense

The Department of Defense closely tracks water issues as they relate to U.S. military interests in the Middle East. The Water Resources Management Action Group (WARMAG), for example, plans for the provision of potable water to troops in the field, eliminating water as a wartime constraint.

Defense Intelligence Agency

The Defense Intelligence Agency (DIA) also monitors regional resource trends. Specifically, the DIA focuses on three areas: the scarcity of water as grounds for potential conflict, the implications of water scarcity for economic development and political stability, and the implications of water supply for large-scale military operations in arid environments.

The last major nonclassified study commissioned by the DIA on Near East water resources was in 1983. The Office of the Deputy Assistant Secretary for Near Eastern and South Asian Affairs currently maintains no ongoing research capability on water resources.

United States Army Corps of Engineers

The reputation of the Army Corps of Engineers dates back to the founding of West Point in 1802, when the academy's graduates formed the core of engineering expertise in the United States.

Today, the Army Corps of Engineers is involved in all aspects of construction and engineering relating to water resource development, including flood control, hydropower, supply conservation, potomology (the study of rivers), and coastal protection.

The corps serves as a planning and advisory body, responding to requests from both U.S. and foreign governments. According to Lt. General E.R. Heiberg III, chief of the Army Corps of Engineers, "our recommendations are based on what we call the three 'E's': engineering feasibility, economic sense, and increasingly, . . . environmental sensitivity."²⁸ General Heiberg estimates that 30 percent of Army Corps of Engineers funds and more than two-thirds of its employees (approximately 14,000 people) are engaged in water resource work. Although the corps relies on in-house capabilities for technology and feasibility studies, the majority of its construction projects are actually executed by private companies, both domestic and foreign. Of a total budget of \$10 billion, it is estimated that \$8 to \$9 billion is paid to individual contractors.

Perhaps the best example of the "macro" approach used by the Army Corps of Engineers can be seen in the assistance given to the nine African countries constituting the Niger River Basin Authority. This project, executed in conjunction with USAID, resulted in the compilation of all available data pertinent to the basin's development. A central computer is able to analyze hypothetical situations or desired changes, such as erecting a hydropower plant at a certain location, and projects the ramifications of such decisions. The project thus supplies crucial information for effective decision making where enormous competition over limited water resources exists.

A recent achievement for the corps is the Three Gorges Dam Project on the Upper Yangtze River in China. The dam may well have a potential power generation of up to 13,000 megawatts. The Army Corps of Engineers also provided technical assistance to India for a project involving pollution reduction in the Ganges River and serves in an advisory capacity for the Panama Canal Commission.

United States Environmental Protection Agency

Working through its Office of International Activities, the EPA is currently supporting a number of water-related research projects

in Egypt using P.L. 480 funds. These include industrial pollution research, water quality studies of the Nile River, and research into the environmental effects of pesticides.

Foundations and Commissions

The U.S. government foundations and commissions listed below could serve as prototypes for expanded U.S.-foreign cooperation on water development projects.

U.S.-Saudi Arabian Joint Commission on Economic Cooperation

Established in 1974 to “promote cooperation . . . in the fields of industrialization, trade, manpower training, agriculture, and science and technology,” the Joint Commission is a bilateral organization that relies on Saudi development funds.²⁹ U.S. authorities provide technical counsel and expertise. To date, approximately \$1.25 billion has been spent on commission-sponsored activities. With the Treasury Department as U.S. coordinator, the commission has enlisted the services of virtually every agency of the U.S. government, including the Departments of Agriculture, Commerce, Energy, Health and Human Services, Interior, Labor, and Transportation.

Calling on the expertise of the USGS, the commission initiated and prepared the Saudi water atlas discussed earlier. The commission also established the Agriculture and Water Project, which publishes an updated series of water resource reports and funds basic research in soil and water management. It has worked with the Saudi Saline Water Conversion Corporation (the largest organization of this type in the world) and has sponsored R&D work related to harnessing the region’s abundant solar energy for desalination.

Although the commission has contributed considerably to building Saudi Arabia’s water infrastructure, momentum has been lost in the past few years. The decline in oil prices has reduced support for water resource programming. Moreover, with both Saudi Arabia and the United States increasingly preoccupied with other pressing regional concerns, the commission is receiving less attention from both governments. Nonetheless, it remains an important model for international cooperation on water resources.

U.S.-Israel Binational Agricultural Research and Development Fund

The U.S.-Israel Binational Agricultural Research and Development Fund was established in 1977 to encourage cooperative agricultural R&D efforts by Israel and the United States. Administrative decision making and management are shared through equal representation on a board of directors and a technical advisory committee.

The fund accepts short-term proposals (two to three years in duration) from institutions of higher learning, government agencies, and nonprofit organizations. In the last 10 years, approximately \$63 million has been awarded for 374 different research projects. Among those projects have been efforts focused on water-resource management, on methods of increasing agricultural yields, on development of new plant types with high drought-resistancy, and on soil management.

BARD has been instrumental in the development and installation of computerized monitors, which check soil conditions for moisture levels, thereby reducing unnecessary irrigation. Research on the relationship between soil and water has been conducted, including a study of soil composition and its effect on the absorption and retention of water. Experiments have also been undertaken on the use of reprocessed water for irrigation.

U.S.-Israel Binational Science Foundation

Established in 1972 to promote cooperation between the United States and Israel on scientific research efforts, the Binational Science Foundation (BSF) awards grant monies for research in the health, life, and social sciences; in physics; in chemistry; and in mathematics. At present, spending by BSF averages \$7.5 million per annum.

Summary

As demonstrated by federal agency, foundation, and commission participation, the U.S. government has a strong history of involvement in Middle East water-resource development. By

investing substantial sums of money and committing the combined expertise of its various bureaus and departments, the federal government has emerged as a powerful force in shaping development trends in the region. Overall, its wide-ranging activities have contributed substantially to regional economic growth, improvement in the standard of living, and better health conditions.

At the same time, the U.S. government's efforts could be enhanced by instituting reforms in the following three areas:

- ★ long-range planning,
- ★ coordination among U.S. agencies dealing with water resources, and
- ★ addressing increased staffing requirements.

Despite well-intentioned efforts, federal departments and agencies working with water issues seldom undertake comprehensive, anticipatory planning on critical problems. Time, budgetary, and manpower constraints preclude a macro approach when dealing with regional conditions. Also, the sheer number of issues requiring attention is beyond the scope of any single agency. Government experts are well aware of the crucial questions that should be answered, but are forced to respond on an ad hoc basis.

An emphasis on long-term planning and improved coordination is essential. A new interagency committee should be established to formulate and carry out long-range planning goals. The creation of a centralized data base on water projects would reduce duplication of effort and increase the sharing of information and expertise.

Finally, staff continuity within each agency should be encouraged to provide greater consistency in project design and execution. At present, fairly rapid staff turnover means that projects planned by one group of experts are often completed by another. Assignments of longer duration would ensure greater coherency and strengthen "institutional memory."

IV

A New Role for the U.S. Government?

How can the U.S. government effectively respond to the emerging problems described in this report? U.S. government and private sector representatives participating in this year-long effort agree that the United States can and should remain deeply involved in water development efforts in the Middle East. Toward this end, we recommend that the government concentrate on four areas:

- ★ development of advanced water technologies,
- ★ encouragement of more efficient resource management and conservation strategies,
- ★ improvement of coordination among U.S. agencies dealing with water issues, and
- ★ attention to long-range research and planning.

These goals could be met through the specific structural and programmatic changes described below. These measures can be taken at minimal cost, with high returns. Small, practical investments today would preclude the need for massive aid in the future. Congressional awareness of the looming Middle East water resource crisis and support for a strengthened U.S. government position is essential. CSIS, therefore, looks forward to working with both the Congress and the executive branch to refine and implement these action recommendations.

Policy Emphases

Emphasize Development of Advanced Water Technologies

Although technology is not a panacea for the region's problems, experts participating in this project argued that technology can reduce the strain on existing water supplies. Advanced technologies could prove invaluable in several respects.

Desalination of saltwater and brackish water could supplement current supplies. Although the capital investment and energy expenses now associated with desalination make it prohibitive for many Middle Eastern countries today, improvements in the process—especially those related to reduced energy costs—would heighten its attractiveness in the future.

Attention should also be given to protecting and extending existing resources. Advanced water-reuse technologies, for example, would recycle precious supplies. Although recycled water is already employed in agriculture, future efforts could concentrate on selected domestic and industrial uses. Overall, these methods must be made more cost-effective and reliable under local conditions.

Improved pollution control and water treatment processes will also help safeguard water quality. Contamination of surface and groundwater supplies from agricultural, municipal, and industrial sources is a growing problem in many Middle Eastern countries. Procedures must be developed both to treat already contaminated water and to neutralize pollutants before they damage supplies. Special emphasis should be given to utilizing the region's abundant solar energy in wastewater treatment processes.

Advanced agricultural technologies should also be encouraged. Drip or center-pivot irrigation systems regulate the application of water to crops and thus reduce waste and loss through evaporation. Plant breeding and high value crops maximize the economic benefits of limited water supplies.

The U.S. government has been exploring ways to encourage technological advances through bilateral commissions and foundations. These initiatives could be strengthened to include a

wider range of technical applications such as reducing costs in desalination processes, applying solar energy to water technologies, and improving horticulture and aquaculture.

It should be recognized that advanced technologies are not appropriate nor necessarily better in all situations; sophisticated processes such as drip irrigation cannot be employed effectively without well-trained technicians to operate and maintain the systems. Technology can serve a vital function, but only if applied judiciously and with sensitivity to social, political, and economic conditions.

Encourage Foreign Governments to Adopt More Efficient Resource Management and Conservation Strategies

Experts from the Middle East and U.S. government alike point out that the region's water problems stem as much from improperly used resources as from increased demand. To varying degrees, the countries examined here suffer from poorly maintained utilities, improperly designed water projects, and inadequately trained staffs for water facilities. These three conditions are interrelated, and each compounds the effects of the others, thereby exacerbating the strain placed on scarce supplies.

Particularly urgent is the inadequacy of personnel operating and maintaining water infrastructures. Lack of incentive to keep standards high, low salary levels, and an absence of encouragement for professional responsibility all contribute to continuing personnel difficulties. In addition, physical problems in water systems add to infrastructure difficulties. For example, enormous amounts of water are lost in urban areas because of leaks in distribution systems and contamination by untreated or partially treated sewage. Many industrial facilities use water-intensive technologies that are inappropriate for the region.

Poor initial planning on project designs impose even greater burdens. This is most apparent in the case of large-scale irrigation schemes. In Iraq, improperly planned and executed irrigation projects have led to the abandonment of large tracts of land in the lower Mesopotamian plain. In Egypt, faulty drainage systems have saturated agricultural land, resulting in a higher water table, increased salinity, and numerous health problems.

The United States should accelerate training programs to familiarize specialists from the region in advanced water management and conservation techniques. Expanded training

programs would also encourage regional self-sufficiency. USAID, the Bureau of Reclamation, the USGS, and other agencies have extensive experience in training personnel from Egypt, Jordan, Saudi Arabia, Sudan, and other nations. The U.S. government should build upon existing programs, rather than undertake major new initiatives.

Improve Coordination Among U.S. Agencies Involved with Water Development Issues

There is a need to improve coordination and communication among U.S. government agencies concerned with water issues. In part, this is necessary because of the wide variety of activities undertaken and the sheer number of organizations involved. Experts within the U.S. government acknowledge their inability to follow the work of counterparts in other agencies—primarily a reflection of inadequate staff levels. Only the Department of State and USAID have a joint committee on Near East water resource issues that meets regularly.

A centralized process for policy coordination, program planning, and data collection should be established for Middle East water projects. Experts could then easily draw upon past efforts, while keeping their counterparts throughout the government informed of ongoing work or anticipated programs.

Encourage Long-Term Research and Planning to Identify Emerging Issues and to Offer Possible Policy Responses

The U.S. government has traditionally lacked the means or capability to undertake long-term studies on water resource trends in the international arena. Even when a specific division within a major agency tracks evolving water issues, the focus is rarely anticipatory. Budgetary and manpower constraints result in a reactive approach, with little possibility for anticipating or preventing a crisis certain to emerge.

A process in which long-term assessments can be conducted and future policy initiatives outlined is sorely needed. Analyses of the viability of proposed programs like the Turkish peace pipeline or the Maqarin/Unity Dam in Jordan should be undertaken.

Anticipatory planning is vital. One example of such planning can be seen in the approach to famine and drought.

As a response to the 1984-1985 crisis in Ethiopia, the interagency Famine Early Warning System (FEWS) was created. Based in the Office of Technical Resources within USAID's Bureau for Africa, FEWS uses information supplied by the National Aeronautics and Space Administration (NASA), USGS, the National Oceanic and Atmospheric Administration (NOAA), and other sources to track a variety of conditions in eight African countries to determine the likelihood of another African drought.

Recommendations for Change

Based on the above findings, this report recommends that the U.S. government undertake the following steps:

I. Create a Coordinating Body Within the U.S. Government

A central coordinating body should be established within the U.S. government for all Middle East water research and development programs. This interagency group would serve as a data clearinghouse for the government's work on water issues.

This interagency coordinating body should be responsible for alerting the U.S. government to potential water crises. This would not detract from or diminish the responsibility of agencies already working on water problems: the Department of State would continue to formulate overall policy with the advice of USAID, and the USGS and Bureau of Reclamation would continue their technical assistance outreach. The proposed body would, however, bring greater continuity to U.S. government efforts. Its primary function would be to track problems and approaches rather than initiate new programs and, therefore, would reinforce existing policy.

The executive branch should designate an agency within the U.S. government to serve as the secretariat for this coordinating body. An annual report, drawing on both unclassified and classified data, would be presented to the Congress and executive branch each year.

2. Create a U.S.-Middle East Water Program to Encourage the Development of Advanced Water Technologies

This multilateral program could be loosely patterned after existing bilateral commissions and foundations. Topics of study would cover a wide range of technical issues, including pollution control, horticulture, water-reuse strategies, and the application of solar energy to water technologies. Special emphasis on research related to desert regions would have applications for both the Middle East and the American Southwest. The program would also undertake research in the social sciences pertinent to the human dimension of water issues.

For greatest effectiveness, this program should come under the auspices of the U.S. interagency coordinating body described above. The secretariat of this body would also serve as the secretariat for the multilateral Middle East water program.

The program would be apolitical. Regional experts would be engaged, both as representatives of their respective governments and as water authorities in their own right. A consortium of U.S. academic and private-sector research institutions should be actively engaged in this process. Research would be shared with all participating countries and would not be linked to the Arab-Israeli peace process.

Although the majority of the program's initial funding would be derived from congressional budgeting, participating nations would also be asked to contribute. Start-up funding should fall within a \$5 to \$10 million range over a period of three years to give the program an adequate base from which to begin its important task.

Appendix A

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Notes

1. Lebanon was not included in this study for two reasons. First, with its relatively abundant resources, Lebanon is not facing severe water shortages. Second, given its internal political turmoil, there is little likelihood the United States can play a meaningful role in developing the country's resources in the coming years.
2. Sandra Postel, *Conserving Water: The Untapped Alternative*, Worldwatch Report 67 (Washington, D.C.: Worldwatch Institute, 1985), 5.
3. Consumption patterns in most countries are a function of pricing policies. Most experts in the United States and the countries examined here believe that present water subsidies will not be reduced dramatically in the years ahead because of internal political reasons. Hence, impending shortages will be exacerbated.
4. Thomas Naff and Ruth Matson, eds., *Water in the Middle East: Conflict or Cooperation?* (Boulder, Colo.: Westview Press, 1984), 229.
5. Ze'ev Schiff, military correspondent, *Ha'aretz*, interview with Joyce R. Starr, Tel Aviv, Israel, August 21, 1987.
6. Joe Stork, "Water and Israel's Occupation Strategy," MERIP Reports 13, no. 116 (1983): 19.
7. Meir Ben-Meir, director general of Israel's Ministry of Agriculture, interview with Joyce R. Starr, Tel Aviv, Israel, August 15, 1987.
8. Stork, "Water and Israel's Occupation Strategy," 20.
9. Thomas Naff, "Water: An Emerging Issue in the Middle East?" *The Annals of the American Academy of Political Scientists* (November 1985): 68.

10. Interview with Ze'ev Schiff.
11. Meron Benvenisti, *The West Bank Handbook: A Political Lexicon* (Boulder, Colo.: Westview Press, 1986), 223.
12. Elaine Ruth Fletcher, "'Territories' Water Supply Drying Up with Overuse," *Jerusalem Post*, July 2, 1987, p. 4.
13. Interview with Ze'ev Schiff.
14. Fletcher, "'Territories' Water Supply Drying Up with Overuse," 4.
15. Ibid.
16. Ibid.
17. Off-the-record interviews with World Bank officials, September 1986.
18. "Syria's Budget: Where the Cash Flows in '87," *The Middle East* (May 1987): 33.
19. Ewan Anderson, "The Current Water Crisis in the Middle East" (Paper presented at the "U.S. Foreign Policy on Water Resources in the Middle East and Horn of Africa" Conference, Center for Strategic and International Studies, Washington, D.C., February 20, 1986).
20. Dr. Abdul-Amir al-Anbari, ambassador of Iraq, interview with Joyce R. Starr, Washington, D.C., November 2, 1987.
21. Mohammed el-Diwany, minister, Embassy of Egypt (Remarks at "The Nile River Basin: A Case Study in Riparian Relations" Conference, Center for Strategic and International Studies, Washington, D.C., February 4, 1987).
22. John Waterbury, *Hydropolitics of the Nile Valley* (Syracuse, N.Y.: Syracuse University Press, 1979), 226.

23. Selig Taubenblatt (Presentation at "U.S. Foreign Policy on Water Resources in the Middle East: Instrument for Peace and Development" Conference, Center for Strategic and International Studies, Washington, D.C., November 25, 1986).

24. Ibid.

25. Of particular interest is the work on plant breeding being undertaken by the Volcani Institute in Israel.

26. The Environmental Research Laboratory of the University of Arizona has conducted extensive studies on the potential applications of halophytes. Under the direction of Carl N. Hodges, the laboratory has explored the commercial use of halophytes in tests plots in Mexico and the United Arab Emirates.

27. M. Peter McPherson (Presentation at "U.S. Foreign Policy on Water Resources in the Middle East and Horn of Africa" Conference, Center for Strategic and International Studies, Washington, D.C., February 20, 1986).

28. Lt. General E.R. Heiberg III (Presentation at "U.S. Foreign Policy on Water Resources in the Middle East and Horn of Africa" Conference, Center for Strategic and International Studies, Washington, D.C., February 21, 1986).

29. United States-Saudi Arabian Joint Commission on Economic Cooperation, *Annual Report* 1984/1985, p. 3.



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