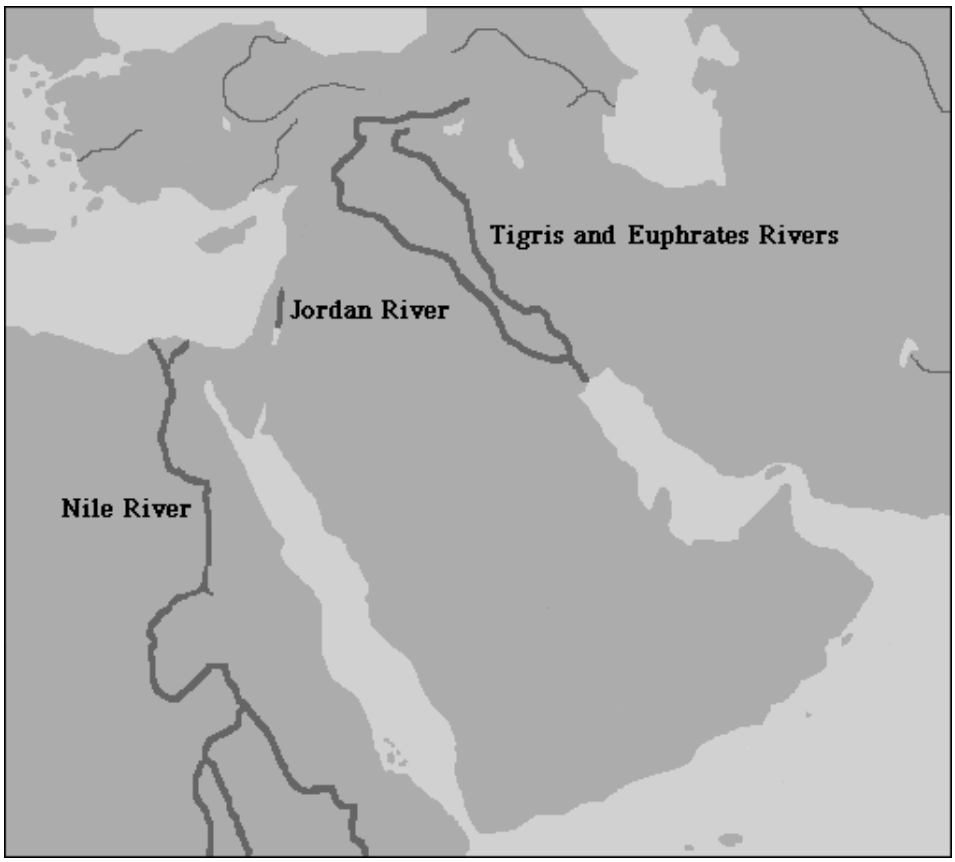
"Averting a Water Crisis in the Middle East: Make Water a Medium of Cooperation Rather Than Conflict"

GREEN CROSS International

Report of a Workshop Held in Paris on 18 March 1998



« Major River Basins of the Middle East »

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PREFACE

Water is truly the lifeblood of all human and natural systems. Although most regions of the world have abundant water resources, supplies of drinking water are inadequate in many parts of the world. By one measure, some 20 countries were experiencing chronic water shortages in 1990. Based on population projections alone, some 33 countries are expected to have chronic water shortages by 2025. Moreover, such projections do not take into account the possibility that climate change could eventually further exacerbate water shortages. Current and projected water shortages are nowhere so acute as in the arid countries of the Middle East.

Over a century ago, American author and humorist Mark Twain observed that "whiskey is for drinking, water is for fighting" as he reflected on both the scarcity of water and the importance given to water and water rights in the semi-arid American West. Indeed, battles have been fought over water allocation in the United States - - and in many other countries as well. The potential for a conflict over water is perhaps at its most serious in the Middle East where water supplies are extremely limited, political tensions traditionally run high, and water is just one of the issues that may divide countries and make cooperation difficult.

The word 'conflict' need not automatically be associated with water, not even in the Middle East. Cooperation to solve water problems is possible. Indeed, joint action on water has the potential to lead to even greater cooperation in the wider political arena, as resolution of water problems may help key Middle Eastern actors slowly build the trust needed to settle other issues that divide them. All would agree that mutually beneficial, 'win-win' solutions are preferable to conflict or stalemate. Conversely, arrangements that are not perceived to fairly allocate one of life's most important necessities can only perpetuate conflict.

With its March 1998 workshop in Paris, of which this report is a summary, and in collaboration with the United Nations Educational, Scientific, and Cultural Organization, Green Cross International is continuing its initiative on seeking ways to resolve water resource conflicts. We are especially grateful for the support and encouragement of His Excellency Flavio Cotti of Switzerland, H.E. King Hussein of Jordan, Director-General Federico Mayor of Spain (and UNESCO) and former Prime Minister Shimon Peres of Israel in this endeavor. This report reflects Green Cross's conviction that the resolution of water problems in the Middle East is both important and possible. Our exploratory workshop has convinced us that the water resource problems of the Middle East are not insoluble and that through its networking strength and function as an honest broker, Green Cross can help make a difference. We invite you to join us as we implement this new focal activity over the course of the next few years.

Mikhail Gorbachev
President
Green Cross International

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1. WORKSHOP REPORT

1.1. SUMMARY

In cooperation with the International Hydrological Program of UNESCO, Green Cross International (GCI) convened a one-day workshop in Paris on 18 March 1998. Attended by fifty people from a broad cross-section of countries and disciplines, the workshop aimed to structure and stimulate discussion on various dimensions of water problems and conflicts in the Middle East. The objective was also to build networks of individuals and institutions, disseminate information, and identify and design possible directions for GCI's water conflict resolution activities in the region. The views of individual participants varied considerably, and opportunities as diverse as promoting the implementation of existing technical solutions to establishing water markets were discussed.

Two important conclusions were that there is a need to manage water resources in an integrated, basinwide fashion and that progress on implementing technical options could help build trust and hence lead to progress on other important issues. Participants concluded that Green Cross has the opportunity to use its value-added capacity to coordinate and support applied research, disseminate information, support education, and build multisectoral cross-cutting partnerships to help reduce conflicts in the Middle East. Workshop participants identified a number of opportunities to avoid or reduce conflict as well as specific activities that GCI could undertake.

Four opportunities emerged from the day's deliberations as the most appropriate themes for advancing GCI's Middle East Water Project:

- integrating qualitative **strategic scenario planning** with quantitative forecast models;
- disseminating information on **best available technologies** (especially to save water in agricultural applications);
- promoting water-related development projects through guides and guidance on **viable project proposals**; and
- **educating people** in the region about important water resources issues.

To implement these themes, Green Cross intends to organize a series of workshops and create a network of partners and national organizations in the region.

« A basin-wide regional authority is needed »

1.2. BACKGROUND

1.2.1. History

Over the past decade, water conflicts and the potential for conflict escalation have intensified and spread to numerous -- if not all -- corners of the world. Problems of water quality and quantity have crossed municipal, local, state, and regional boundaries. Increasing rates of urbanization, agricultural consumption, and population growth have accentuated water stress and scarcity. Problems are particularly acute in arid regions, such as the Middle East. Enduring political animosities and geopolitics have either hindered or curtailed the potential to collaborate and produce innovative responses to water management and allocation problems.

Concern and need for action and dialogue was led to the creation of programs both within existing organizations and in entirely new structures to address water issues and problems. In 1996, for example, the World Water Council (WWC) was established in Marseilles, France as a water policy think tank mandated to develop a global "Vision for Water, Life and the Environment." Other institutes such as the Global Water Partnership (GWP) were also founded at roughly the same time period.

In 1997, Green Cross International (GCI) introduced water and desertification as one of its five international programs and undertook a study of world-wide freshwater conflicts. Throughout the Spring of the year, GCI continued to develop contacts by participating in the First World Water Forum in Marrakech, organized by the WWC. GCI also created a freshwater conflict website to serve as a gateway to disseminate information and continue networking activities.

GCI's analysis contributed to the organization of a June 1997 roundtable on freshwater as a source of international conflict. This event, held on World Environment Day, was presided over by President Mikhail Gorbachev and Claude Haegi, State Councilor of the Republic and Canton of Geneva. Numerous leading water experts from intergovernmental organizations, research institutes, and policy think tanks attended this meeting, which underscored GCI's resolve to continue its networking and information dissemination efforts and served as an impetus to further develop and expand the freshwater conflict project.

In August 1997, GCI released a study entitled "International Freshwater Conflict: Issues and Prevention Strategies". The report provides an overview of freshwater issues and assesses water conflicts or potential conflicts in different hemispheres by indexing a series of case histories. It also provides a broad strategic vision for future Green Cross water conflict prevention work. It is anticipated that such work will include activities like awareness building, creation of multi-sectoral partnerships, and integrated assessment of water basins.

During the Fall of 1997, GCI's program activities intensified with a roundtable on international freshwater conflict in Los Angeles. This meeting, organized by Global Green USA, explored common issues and strategies across three geographic regions: the Western United States, South America, and the Middle East. Building on these endeavors, GCI then developed a vision and concept paper on the necessary organizational components to establish a water forum focused on the Middle East. This paper described the forum's possible structure, identified key actors from multiple sectors of society, and led directly to GCI's March 1998 workshop, which was held in Paris immediately prior to the 3-day International Conference on Water and Sustainable Development.

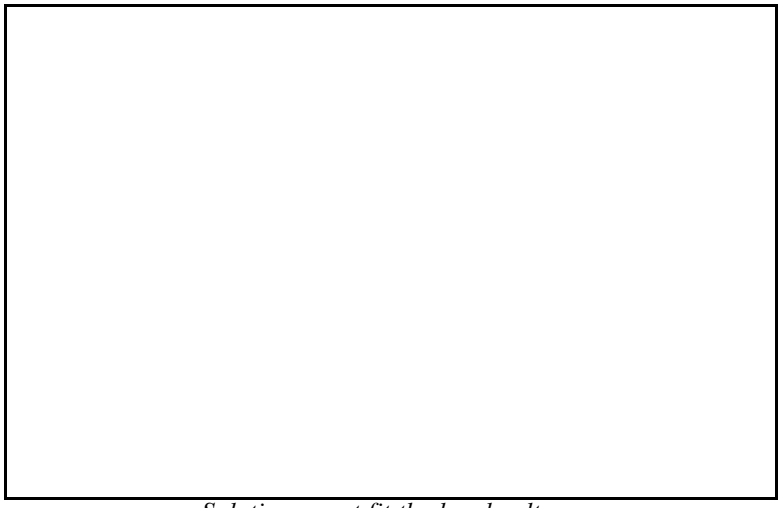
1.2.2. The Workshop

In cooperation with the International Hydrological Program (IHP) of the United Nations Educational, Scientific, and Cultural Organization (UNESCO), GCI convened a one-day workshop in Paris on 18 March 1998. Entitled "Averting a Water Crisis in the Middle East: Make Water a Medium of Cooperation Rather Than Conflict." The workshop was designed to stimulate and structure discussion around various dimensions of water problems and possibilities for cooperation in the Middle East. The workshop also aimed to build networks of individuals and institutions, disseminate information, share research findings, and identify and design possible directions for GCI's Middle East water project.

Approximately 50 participants attended the workshop, representing various academic and policy circles from the Middle East, Europe, and North America. The group included a mixture of public and private sector interests, in addition to representatives from UNESCO and the European Commission.

Intergovernmental development organizations such as the Untied Nations Development Program (UNDP), funding institutions such as the Global Environmental Facility (GEF), and government agencies such as the Swiss Agency for Development and Cooperation (SDC) also took part in the meeting. A comprehensive listing of the participants, along with their affiliation and complete addresses, is included in the appendices.

« The quality of the water must be preserved. »



«Solutions must fit the local culture.»

1.3. FINDINGS

1.3.1. Introduction and Idea Exchange

Session 1 introduced the workshop, its objectives and desired outputs. Several presentations were made in this session, including a discussion on the use of scenarios and a modeling demonstration of the Nile River basin. The session ended with a break-out group exercise in which participants were each asked to identify one or two best opportunities to avert a water crisis in the Middle East.

Among the most important suggestions during the first session, participants indicated the need to undertake a regional and holistic approach to improve water management and efficiency, involve and mobilize grassroots organizations and the private sector to generate support, employ innovative participatory mechanisms, and involve outside specialists to mediate and encourage cooperative relations and negotiation processes. Participants also stressed the need to build awareness, confidence, trust, and capacity within the Middle East region, particularly through research, education, and training.

Other suggestions for addressing potential water conflict included:

- promotion of greater water-use efficiency,
- decrease agricultural consumption by developing more water-tolerant crops,
- re-use of wastewater,
- sustainable use and management of surface and ground water,
- establishment of water markets,
- promotion of education stressing the fact that water shortages are a common problem requiring cooperative solutions,
- improvement of communication among those who determine water policy within and across watersheds,
- greater use of strategic scenarios as management and educational tools,
- consideration of decision-making at a regional level encompassing multiple watersheds, and
- establishment of a regional commission to manage water jointly.

Participants recognized that although the implementation of any single suggestion would help, a combination of these and other policies would be needed to make the best use of the limited water supplies in the region.

1.3.2. Formal Presentations

The second session was organized around a series of thematic presentations by leading water experts. Topics included issues of social and economic development, water and food security, water saving strategies and opportunities in agriculture, public-private sector partnership arrangements, conflict management and case illustrations, and strategic scenario planning. Among the key points to emerge out of this session were the following:

- The management and resolution of water problems in the Middle East are intimately **linked** to the solution of the broader political problems in the area. Some participants asserted that if the political problems can be solved, the water problems will take care of themselves. Others noted that incremental progress on solving water problems, starting with issues that are mostly technical in nature, could lead to the building of trust and, hence, to further progress on the political front.

- **Agriculture** consumes more than 85 percent of available water in the Middle East. Hence, any effort to avert water crises in the Middle East must examine how water is being used and managed in the agricultural sector. Changes may be required in the types of crops that are planted, the type of irrigation system employed, the cost of water, and in other technical and management factors leading to greater water-use efficiency.

- Several participants argued that the real issue is less one of water security than of food security. Where domestic sources of water are lacking, they say, water embodied in imported food can make up for the shortfall. Thus, water shortage in the Middle East may not be as great a problem as sometimes portrayed, at least where countries can develop healthy export markets that generate the income to buy **"virtual water."** Some participants cautioned, however, that countries that became completely dependent on virtual water could become vulnerable to strategic blackmail.

- Some participants noted the large potential of **water markets** as a tool for promoting greater water-use efficiency. Treating water in a manner similar to other goods that are bought and sold would mean that water would "flow" to its highest-valued use, typically to cities and industry and away from agriculture. Other participants cautioned that the marketing of water may create problems for third parties, such as agricultural workers, and that the establishment of markets in the near term, given the large economic discrepancy among countries in the region, is probably not feasible.

- It was broadly agreed that the best means to manage water is in an integrated, basin-wide fashion, balancing the needs of water for agricultural, urban, industrial, and environmental uses; **fairly allocating the water resources of a basin** among all countries with territory in the basin; jointly managing ground and surface water; and considering needs for flood control, recreation, and other purposes. It was also recognized, however, that such comprehensive management is more easily discussed in the abstract than implemented, especially given the political situation in the Middle East.

- There may be significant potential in addressing water problems from a regional, inter-basin perspective, that is, by attempting to optimize the use of water among the six states in the region (Iraq, Israel, Jordan, Lebanon, Syria, and Turkey) through **inter-basin water transfers**. Although this option may be difficult politically, the timing may be right to bring together both academic water experts and technical people to begin discussing possibilities.

- The **private sector** may be able to play a much greater role than it does at present in some aspects of water resources management. Private sector involvement is particularly attractive because of the management expertise and financial resources that it is able to provide.

- The need to maintain **water for environmental purposes** is an important but often overlooked aspect of Middle East water resources management. Preserving water for the environment may become even more difficult than it currently is as the population in the Middle East increases and greater demands are made on already scarce water resources.

1.3.3. Options for Shaping the Future

The third session of the workshop then examined contributions that GCI could make, how the organization could go about accomplishing this task, and with whom it could implement its water program activities. This session was conducted in 5 working groups.

The working groups raised numerous points, many of which emphasized GCI's continuation of promoting cooperation through information dissemination, networking, and education. The groups also recognized GCI's unique role as a non-governmental organization capable of mobilizing grassroots public support, while simultaneously providing the necessary leadership to convince the top-down bureaucracy of governments and intergovernmental organizations to endorse collaborative water management initiatives and projects. The opportunities described below were suggested as being most appropriate for GCI to pursue.

1.3.3.1. Communicating Needs and Lobbying New Key Players

Effective bilateral and multilateral cooperation in the region requires the participation and good will of all key actors. First and foremost, riparian state actors such as Lebanon and Syria, are not always involved in discussions on water resource issues and need to be engaged in more dialogue. Second, all sectors and levels of society, including both public and private interests and local and national organizations, need to join efforts to solve water problems in the region. GCI's added-value is its capacity to muster resources from the bottom up, while providing seasoned political leadership capable of mobilizing scarce resources.

1.3.3.2. Synthesizing Research and Promoting Scientific Collaboration

Valuable scientific work is often not sufficiently transferred to the policy making community because results are not presented in an appropriate form. Research and knowledge thus need to be synthesized and distributed to target audiences in both the public and private sectors. Moreover, there is a strong need to link scientific, theoretical research to practical field projects having "win-win" or positive-sum characteristics. Participants found that GCI could promote scientific collaboration by establishing multilateral teams composed of technical experts from academia and the private sector. These teams could conduct feasibility studies on a selected number of multilateral or bilateral cooperative water resource projects in the region and evaluate their environmental, economic, social, political, and strategic dimensions.

1.3.3.3. Disseminating Information, Convening Workshops, and Educating

Information needs to flow to different sectors in a transparent and efficient manner. One way Green Cross can contribute is by developing and advancing its web-based information site. Participants in the workshop also found that GCI could convey information by convening workshops and education-related events designed to train different stakeholders in managing water resource problems. In the Middle East, educational and training programs need to be conceived with the double objective of promoting both ecological sustainability and peaceful relations.

1.3.3.4. Building Crosscutting, Multisectoral Partnerships

A fourth and related opportunity is the creation of partnerships cutting across multiple sectors of society. To this end, GCI needs to develop its network by establishing Green Cross national offices and identifying local, partner organizations and affiliates in the region. This entails close association not only with other non-governmental or civil society-based organizations, but also with public and private sector interests (local and governments, schools and universities, and businesses) who play pivotal roles in water resource issues.

« Can Green Cross bring more key actors into the process ? »

1.4. NEXT STEPS - THE GREEN CROSS PLAN

In order to promote informed decisionmaking and the integrated management of Middle East water resources, Green Cross has decided to work on the objectives and tasks outlined below over the next 3 -5 years. The magnitude and speed of implementation of the plan will be adjusted to match the resources made available for the project.

1.4.1. Themes And Generic Tools Will Be Developed

Four thematic opportunities have been identified from the workshop which will provide the direction for further development work by GCI:

1.4.1.1. Strategic Scenario Planning

Soft strategic scenarios and hard computer modeling work will act as means for bringing a wide diversity of people together for conversation, thinking, and strategic planning on integrated water basin.

The need and opportunity to integrate soft scenarios with hard computer forecast modeling was one thematic output of the workshop. Scenarios are plausible and challenging "stories" about what the future may hold. They differ from quantitative forecast modeling by their qualitative and imaginative traits. They are based on understanding the key forces that largely determine future outcomes. Scenarios are also designed to illuminate human relationships and interaction and help decision and policy makers conceive, articulate, and evaluate possible developments. Proper scenario planning and elaboration, however, requires theoretical judgments which are often based in forecast modeling studies and research. There is thus a need to integrate both quantitative and qualitative methodological efforts in order to be better prepared for decision making in unpredictable environments. Integrating scenario planning with forecasting constitutes a valuable approach which GCI can develop and advance in provoking thought and reflection on the future of water management and conflict prevention in the Middle East. By engaging in such work, GCI will also build capacity and generate multisectoral support for various initiatives.

1.4.1.2. Best Available Technologies

Information about institutes and web sites which publish information on best available environmentally-sound technologies that relate to water (including agriculture) issues will be disseminated.

Confronting water shortages will require technological assessment, innovation, and application. The development of new techniques needs to be supported and implemented. Using advanced technology or biological breeding to grow high-yield plant varieties, for example, could significantly decrease agricultural water consumption. This is just one example of a positive-sum solution in solving food security and water distribution and allocation problems. GCI could make an important contribution to this process by identifying and networking with specialists from public and private sectors who are active in research and development of environmentally sound technologies. GCI could also serve as a gateway in disseminating information on research institutes and the latest technologies through its web site on the Internet.

1.4.1.3. Viable Project Proposals

Guides and guidance about how to prepare and write project proposals to attract technology and/or financial partners will be developed. The goal will be to move from talking to action to implementation of real demonstration projects designed to put river basins on a better path to a sustainable future.

The need to provide facilitation and guidance in the development of eco-friendly projects was an important thematic result of the working groups. In many respects, international NGOs such as GCI have a comparative advantage in guiding and facilitating projects because of their neutral and proactive status. Moreover, international NGOs tend to have a higher degree of prestige and fund raising ability than local organizations. GCI could thus serve as an important bridging organization between foreign technical and financial partners and local affiliates in developing and supporting the implementation of pilot projects in selected river basins.

1.4.1.4. Education and Communication

Guides and lesson plans will be developed for teachers on the issues, and a network of schools throughout a water basin will be created. Key lessons will be communicated to target audiences, and a movie will be produced for broad dissemination.

Education represents a fundamental building block for an informed and responsible society. Youth, in particular, need the opportunity to learn and understand the necessary means and methods to develop a more sustainable and peaceful future. To this end, Green Cross intends to build capacity and public awareness - particularly of the youth - by networking schools and teachers throughout the region. Emphasis shall be placed on developing proper and efficient use of water resources.

« Funds are available for good projects. »

1.4.2. Further Workshops Will Be Organized And Reports Published

1.4.2.1. September 1998 in Paris
Experts' Workshop together with UNESCO on the **Strategic Scenario Planning** theme/tool

1.4.2.2. Late 1998 in USA
Roundtable to build support for the **Viable Project Proposals** theme/tool

1.4.2.3. December 1998 in Europe
Gathering of some **"Global Leaders"** to exchange ideas about globalization and the Middle East water issue

1.4.2.4. About 20 March 1999 in Cairo
The Green Cross **Middle East Water Forum** to address all 4 themes/tools, probably integrated together with the WWC/GWP meeting on global vision for water

1.4.2.5. About 20 March 2000 in the Hague
Seminar on **Strategic Scenario Planning** for water resource use in the Middle East probably integrated with WWC/GWP international conference on global vision for water

1.4.3. Partnerships And National Organizations Will Be Created in the Middle East region

1.4.3.1. Bahrain
with support of Mr. Jamil Al-Alawi of the Business Promotion Center

1.4.3.2. Egypt
with support of local organizations like CEDARE

1.4.3.3. Israel
with support of former Prime Minister Shimon Peres and the Peres Peace Center

1.4.3.4. Jordan
with support of His Excellency King Hussein and Crown Prince Hassan

1.4.3.5. Kuwait
with support of Mr. Abdlatif Y. Al-Hamad of the Arab Fund for Economic and Social Development

1.4.3.6. Palestine
with support of Dr. Jad Isaac, Applied Research Institute - Jerusalem

1.4.3.7. Turkey
with support of Dr. Olcay Unver of Southeastern Anatolia Project (GAP)

2. PRESENTATIONS AND PAPERS

Part II of the report provides the abstracts, formal reports and biorgaphical summaries of the writers. Although some of the papers have been published elsewhere, the authors authorized Green Cross to republish them in this report. Within each section the material is presented in alphabetical order by family name of the author. Green Cross lightly edited the abstracts and biographies, the papers, however, have not been edited, and represent solely the views of the authors.

2.1. ABSTRACTS OF TALKS

2.1.1. Suggested Issues For Middle East Forum, Jamil S. Kadhem Al-Alawi

Business Promotion Center, Bahrain

The Middle East region is facing major water supply constraints, and only three countries in this region (Turkey, Iran, and the Sudan) have per capita water consumption levels above the currently accepted minimum. Unfortunately, the present methods by which the limited water resources in the Middle East are managed could lead to major disasters, especially if Gulf States continue to extract groundwater as if it were an abundant resource.

The prosperity of the Gulf states as a result of oil revenues has made it possible for these countries to invest heavily in the installation of very costly desalination plants. These plants supply most domestic and industrial needs. Agriculture still depends mainly on groundwater resources. However, unbalanced extraction has led to an increase of salinity, thus making some water unsuitable for agricultural requirements.

The cost of desalinated water was acceptable when demand was reasonable and oil revenues were at their peak. In recent years, however, increased population, a higher standard of living, and subsidized water tariffs have increased demand. Oil revenues have declined at the same time, and this has lead to lower rates of investment in infrastructure. A result is that some countries are not able to meet current demands. In certain countries, demand is met by additional groundwater extraction, but this contributes to a faster depletion of groundwater resources.

The call for a conference by Green Cross is timely and appropriate. However, such a conference should target high-level decisionmakers and not the technocrats who are already familiar with and concerned by the problems. If a Middle East water conference is organized, the key issues that should be discussed are:

- Water desalination and water reuse
- Regional and international research cooperation
- Water management policies
- Privatization
- Training and human resource development
- Public awareness on water issues and water conservation

These topics should be addressed with a particular emphasis on reducing the cost of desalinated water so that is becomes available and affordable for those who need an alternative water resource. Desalination is a future solution to the developing water crisis in the region and may in certain instances help solve water conflicts.

2.1.2. Virtual Water: A Long Term Solution for Water Short Middle Eastern Countries, Tony Allan

Water Issues Group, School of Oriental and African Studies
University of London

The paper addresses the issue of why there has been no war over water in the Middle East, even though many economies in arid regions have only half the water they need and many leading figures, including King Hussein and Boutros Boutros-Ghali, have warned that there would be a water war. It will show that the Middle East region has been able to access water in the global system via trade. Economic systems, not the evidently inadequate hydrological systems, have solved the water supply problem for the region. Water in the global trading system is known as "virtual water." It is the water embedded in key water-intensive commodities such as wheat. The international wheat trade is a very effective and highly subsidised global trading system which operates to the advantage of water- and food-deficit countries.

2.1.3. Water In California Today: An Experiment In Conflict Resolution, David Behar

California Water Consultant, San Rafael, California

Although vastly different in a multitude of ways, water conflicts in California bear some interesting similarities to those in the Middle East. Both regions are largely semi-arid, leading to significant constraints in establishing long-term water supply sufficiency. In both regions, population growth is a key driver of conflict - California and the Jordan River basin riparians are expected to grow by 56 percent and 79 percent, respectively, by the year 2025, at which point each region will hold about 50 million people. Finally, water use patterns are similar, with over 80 percent of total supply going to agriculture in both regions, while growing urban populations are clamoring for an increased share of the pie.

Today, California leaders are increasingly focusing on building conflict resolution processes seeking to end the state's "water wars" and find long-term solutions that meet the needs of the agricultural and urban sectors, while at the same time protecting the environment. These processes, in particular, focus on the San Francisco Bay/Delta estuary, one of the largest aquatic ecosystems in the world, which supplies over half the state's water supply.

The new atmosphere has developed during a period when the uneasy truce between urban and agricultural water users which divided up supply from the Bay/Delta system began to dissolve due to two primary factors: growth in demand from urban areas, and the ascendance of an environmental ethic mandating protection of the degraded Bay/Delta system. In the late 1980s and early 1990s, an endangered species crisis and a six-year drought, combined with strong environmental laws and public opinion which sought environmental protection, contributed to increased conflict among what were now three main stakeholder groups: agriculture urban, and environmentalists.

At the same time, the economic costs of water conflict - and environmental degradation - became evident. Due to declines of key fisheries, the commercial and sport fishing industry virtually collapsed, damaging the economies of both coastal and inland communities. Big business, in turn, became concerned that without a reliable long-term water supply for urban areas, growth would be difficult to accommodate. The Bank of America, the state's largest bank and an important lender in the agricultural sector, began to urge policymakers to solve environmental problems associated with the Bay/Delta as a first step to finding long-term solutions that met the need of cities and rural areas.

In 1994, the Clinton and Wilson administrations and key stakeholder representatives signed the landmark Bay/Delta Accord, which gave increased protection to the environment while also guaranteeing a reliable, if somewhat decreased, water supply to farms and cities while long-term solutions could be negotiated. The forum for these negotiations is the "CalFed" process.

CalFed, now in its fourth year, is a highly ambitious, joint federal-state-private effort aimed at finding long-term solutions to the water supply, water quality, and environmental problems associated with the San Francisco Bay/Delta estuary. If successful in its environmental goals, CalFed could lead to the most extensive ecological restoration program ever undertaken in a single estuary. If successful on the hydrological front, it has the potential to defuse water conflicts driven by climate, growth, and urban-rural conflict well into the next century.

The existence of CalFed has not ended conflict over water in California, but it has changed the atmosphere, at least for now. With all the key interests at the bargaining table, required to consider the needs of the other as well as their own, it is hoped that a new paradigm for resolving water conflict is developing in the state.

Key questions remain. Do CalFed leaders have the vision and political will to grapple with the toughest issues, including maximizing water use efficiency before seeking to build new facilities, which are anathema to environmentalists? Will rural areas agree to any reallocation of their historic water supply to growing cities? Will interests perceive themselves as better off under the new paradigm of cooperation and compromise, or will they perceive greater advantage in conflict-based arenas and step away from the process?

CalFed is slated to select a preferred long-term program in late-1998 or 1999. The reception this program receives among stakeholders will determine whether water can become a medium of cooperation or will remain a driver of continued conflict in the state.

2.1.4. Scenarios in the Public Interest, Barbara J. Heinzen

Consultant, Gray's Inn, London

In recent years there has been a growth in the demand for professionals who understand scenario building processes. Much of this demand has initially come from the private sector. These managers have felt they were facing an increasingly unpredictable world where scenario planning - a method based on the acceptance of uncertainty - had something to offer.

Part of the sense of uncertainty derives from major shifts in industrial structures around the world - whether it is the shift from agriculture to industry in developing countries or the expected shift from industrial to information societies in developed countries. An additional source of uncertainty comes from a growing mistrust of governments around the world. This has led to a search for local solutions to local problems as well as supra-national solutions to global problems - like the CFC convention.

In 1993/94, Scottish Enterprise, an economic development agency in Scotland, commissioned a study to find out where and how scenario planning had been used by the public sector for purposes of economic development. This revealed a wide range collaborative public exercises which involved some attempt to understand future uncertainties - and possibilities - using scenarios. The best of these exercises used scenario building to generate good analysis, strong political agreements and the involvement of those implementing new policies. Most were outside of government structures, although government was a frequent partner in the exercises.

The 1993/94 Scottish study had several important findings for creating successful public scenario exercises, which were described as a form of "Collaborative Learning." Most generally, there were two key components of the work, which can be summarised as "Know Yourself" and "Inform Yourself." To know yourself includes knowing your own wishes, fears and visions of the future, while informing yourself includes learning the facts about deep trends and the present state of things, which will both shape the future. More specifically, one must allow enough time to prepare for the work. This can take up to a year or more. During that preparation time it is important to decide who the work is for, who should be involved, what the schedule should be, how it can be financed, and who will be the ringleader holding the process together. It is also important during this period to build support for the work and gather the right people together to participate in the exercise. Once the work begins, it then makes an enormous difference to use outsiders who can facilitate the process as well as contribute new insights and information. Equally important are the practical details of setting clear tasks, schedules, and goals.

The Scottish report also noticed that there were "rate factors" that ensured the highest success. There should be an atmosphere of tolerance for competing views, a perception of need for the work, and the acceptance that the discussion process provides a "neutral space" for people to meet and share their concerns. It is also very helpful to gain the support of top leaders for the work and the results that derive from it. The scenario team itself, which will have responsibility for managing the exercise, also needs to be composed of very special people.

The best teams include people who are good facilitators of discussions as well as good researchers sensitive to the value of an apt question and of useful data to answer it. They are also, importantly, people who can work in an interdisciplinary setting. More personally, they need to be people who are strong characters, but have muted egos, individuals who do not need to 'insist on their own way'. In addition, the scenario team and process should be 'anti-methodocratic,' because a good exercise is one built around the needs of participants, drawing on tools of analysis and discussion as they are required, rather than insisting on one methodology over another.

Finally, the most successful scenario exercises recognise the need for commitment, continuity and time. The process is not rushed, but paced to allow the necessary room for dialogue, reflection and understanding.

2.1.5. The Need To Alleviate Palestinian Fears Of A Dry Peace
Jad Isaac and Walid Sabbah

Applied Research Institute of Jerusalem (ARIJ)

Palestine, defined here as the Gaza Strip and the West Bank including East Jerusalem, is facing an acute water crisis not because of the area's arid conditions but primarily because of the abnormal political conditions represented by Israel's control over the Palestinian groundwater and surface water resources. Israel is currently utilizing more than 80 % of the Palestinian groundwater resources and denying Palestinians their rightful utilization of the Jordan River. Palestinians are currently allocated 80 mcm per year for domestic use leaving the per capita consumption under suppressed demand at an average of 30 cm/year which is far below the required standards of water supply. For agriculture, Palestinians have access to 150 mcm per year which they are using to irrigate around 10 % of their cultivated lands while Israel is enjoying abundant water to irrigate 50 % of its cultivated land. The situation is exacerbated by the fact that Jewish settlers are consuming more than 90 mcm per year from Palestinian water resources.

According to Oslo II agreement, Israel recognized the Palestinian water rights, but these are to be negotiated in the permanent status negotiations.

However, so far, no negotiations have taken place to enumerate the Palestinian water rights. The issue of Palestinian water rights will be one of the most difficult issues in the permanent status negotiations. Palestinian water rights include both the groundwater of the West Bank and Gaza Aquifer Systems and the surface water of the Jordan River Basin. While Israel provided Palestinians with additional quantities of water, these quantities are not enough to meet the growing needs of the population which is still experiencing shortage of water supply.

The Oslo II interim agreement divided the West Bank into areas A, B and C where Palestinians have full authority in areas A (less than 3 %) and civil responsibilities in areas B (less than 27 %). Area C which represents more than 70 % of the West Bank area includes the most sensitive water resources especially in the Jordan Valley and the Israeli settlements. Different maps representing the Israeli security and strategic zones in the West Bank are being suggested by Israeli leaders. Water security became one of the criteria that was used for determining the extent of further re-deployment of Israeli forces.

According to this map, Israel will not re-deploy from Palestinian areas overlying the Western Aquifer System in the West Bank. The Israeli Defense Forces came up with their own security map which calls for the retention of the Jordan valley by Israel. If these maps are both superimposed, it becomes clear that Israel intends to retain its control of the majority of Palestinian water resources.

To alleviate Palestinians fears of a dry peace, Israel needs to provide Palestinians with water data and to immediately satisfy Palestinians needs for water. Israel should also lift the restrictions imposed on Palestinians to utilize the land and water resources especially in the Jordan Valley. Israelis and Palestinians should start working immediately on clearing the heavily mined areas in preparation for the future. Israel, Jordan and Palestine need to start the process of constructing the West Ghour Canal which was agreed upon in the Johnston plan. The international community needs to start the process of building a basin wide regional authority for the Jordan River basin with participation of all riparians. A mechanism must be established to ensure that negotiations on Palestinian water rights between Israelis and Palestinians take off seriously. Unless the Palestinian water rights are addressed immediately and properly according to the international laws and principles that will translate their water rights to actual water in their pipes, Palestinians will remain the thirsty partner in the Middle East with a severe water crisis that will impact the sustainability of the peace process.

2.1.6. Models For Private Sector Participation In Water And Waste Water Cormac McCarthy

Severn Trent plc

The presentation sets out the main options for private sector participation (PSP) and public/private partnerships (PPP) for the water and waste water sector. Key options based on the best international practices, including the main contractual and institutional models used in the francophone and anglophone countries, are discussed. The presentation also introduces the key factors that a client should consider in choosing which option may be most suitable for him.

2.1.7. A Crucial Factor of Water Equilibrium, Samuel Pohoryles

The Peres Center for Peace, Tel Aviv, Israel

The topic of Efficiency of Water Use in is of major importance in the Middle East. Within this framework, three main subjects are addressed:

- Structural readjustment of water use policy;
- The interaction between land, water and technology; and
- Regional cooperation

The scarcest resource in the Middle East and North Africa is water. In fact, of all the regions in the world, our Middle East region faces the most severe water shortage. With about 5 percent of the world's population, it has less than 1 percent of all renewable fresh water. The main conclusion of our analysis if that unless they drastically change the way

they manage their water resources, the Middle East and North African countries will suffer from severe water shortages and economic decline in the next 30 years.

If steps are taken immediately, water availability for domestic and industrial use could be increased by 50 percent, and municipal water losses, now accounting for about 50 percent of supplied water could be halved in the next 10 years. The main steps are: increasing efficiency of water use, reducing pollution, controlling ground water extraction, recycling and reusing treated wastewater, securing alternative sources of water through import, and, at a later stage, affordable desalination.

The main conceptual approach of the Middle East and the Mediterranean Desert Development Program is based on a unique developmental philosophy. This calls the less favored areas of the world to compensate their inferior natural constraints - such as desert infertile lands, water scarcity, soil erosion, salinity, etc. - through the gradual introduction of modern technologies. Reference here is to mix of research, agro-technology, genetic engineering, and extension and mechanization that has raised the share of productivity not explained by water and land in Israel's agriculture. This share in the first 20 years stood at around 50 percent of total productivity. Throughout the recent decade intangible factors contributed 96 percent of the total productivity rate, whereas the "tangible" factor contributed only 4 percent. Today, at least a dozen advanced technologies are having considerable impact on productivity in agricultural development in general and in desert ecosystems in particular.

Israel's experience has shown that arid and semi-arid zones can support a high level of agriculture - as high or higher than that achieved in temperate climates - but this alone is not enough. Our common ecosystem intrinsically demands the highest possible degree of cooperation among we who inhabit the area. Our comprehensive application of human inventiveness, our liberal exchange of know-how, and our joint efforts in extensive development projects can convert even desert into green, fertile fields. It is an ambitious goal, yes, but it can be achieved by mobilizing the available scientific, technological, educational, and organizational resources. In the context of regional cooperation, Israel can contribute several of the necessary components: seeds, semen, and embryos of high genetic quality; and tissue cultures, irrigation equipment, and new varieties of desert-resistant crops and livestock.

2.1.8. A Reevaluation of Conventional Wisdom on Water Security, Food Security, and Water Stress in Arid Countries in the Middle East, Hillel Shuval

The Hebrew University of Jerusalem, Jerusalem Israel

Many countries, including some very arid ones, believe that conventional wisdom requires that their national water resources and agricultural policy be based on a concept of *water security* and *food security* which dictates self-sufficiency in most food products as a matter of *national security*. They claim that this is necessary in case of a threat of a long term embargo, siege, or blockade which would prevent food imports. In some cases very arid, but oil rich countries have carried this policy to the extreme and have produced wheat and other food staples with desalinated sea water costing over $1.00/m^3 and by severe overpumping and mining of limited ground water resources to the point of their almost total depletion. Estimates indicate that the cost of production of wheat under such conditions has been as much as five times that of the world market price.

This paper will show that the modern, rational, economic approach to this question is that countries with little water should accept the reality that it is more rational to import most of the high water consuming food and fodder they need, particularly the staples which can be shipped easily and stored for longer periods, from those countries with plenty of water from natural renewable, sustainable sources and sufficient areas of arable land. In other words, as formulated by Professor Tony Allen, to import *virtual water* in its most economical form-food. Studies by the FAO indicate that the amount of water required to grow all of the food for one person is between 1000-2000 m^3/yr, depending on the standard of living and the amount of meat consumed.

While the *water and food security* concepts sound appealing and inspire strong national feelings, these concepts often generate unrealistic perceived needs for water that are irrational and non-sustainable in most arid areas. The concept of *food sufficiency*, on the other hand, only requires that there is on-going sufficiency of food supply for the needs and development of a society, attained chiefly *by trade*. *Food sufficiency*, does require an economy that generates enough cash income from exports to cover the cost of the needed food or *virtual water* imports. In the arid areas of the Middle East there is, in the long run, very little alternative other than developing a sustainable economy based on low water consuming high-tech industry, trade, commerce, and tourism which will provide employment and a higher standard of living, rather than one based mainly on agriculture.

Two other inter-related concepts which have somewhat complicated the understanding of this question are the *Water Stress Index* developed by Professor Malin Falkenmark of Sweden and the water supply *Benchmark* concept as proposed by the World Bank and a number of major authors. The 1,000 m^3/p/yr *Water Stress Index* or *Benchmark* level of assured water supply has led many to assume that major amounts of water must be available in every country for agriculture and food production.

These concepts have been mis-understood and misused, resulting in *virtual water stress*.

While it is fundamentally correct, that *some place in the world the water must be available to grow enough food for all of the population in the world,* it is erroneous to imply that each and every country should or must have at its disposal enough water to be self sufficient in agricultural food production. It is also erroneous to imply that a country with less than $1000m^3$/p/yr, by definition, faces conditions of *water stress* as implied by the *Water Stress Index* and the *Water Benchmark*.

When water is really scarce, the first task, from the point of view of human welfare, a sustainable policy of economic development, and rational use of limited water resources, is to meet the needs for domestic and urban use. In addition, it is essential to provide the water needed by commerce, tourism and industry, so as to supply employment for the population which can generate income to purchase *virtual water* in the form of food on the world market from the water rich countries that can produce food most cheaply.These water and land rich countries must be provided with the motivations to produce low cost food for the world. This more rational and more economic approach can provide the only realist global *water and food security*.

Instead of world water resources authorities and experts devoting their time, energies, and money in developing often highly expensive and unsustainable water resources projects in arid areas to grow food at higher costs than would be available on the world market, it would be more economically efficient and socially sound to help develop world financial institutions such as a *World Food Bank* to assure that water poor and cash poor countries have reasonable access to food staples or imports of lower costing *virtual water* to meet their needs.

The Minimum Water Requirement (MWR) concept I propose for the arid areas of the Middle East is a total of 100-$125m^3$/p/yr for domestic, urban, commercial, and industrial use. This is the amount of water that many countries in both humid and arid zones actually require to meet all domestic, urban, commercial, and industrial needs on condition that they practice reasonable levels of water conservation. Israel, with its rapidly developing and successful high-tech economy uses only that amount of water for all domestic, urban, and industrial use and generates the income required to import all of the food staples it requires. Israel does not perceive that it faces severe conditions of *Water Stress,* despite the fact that its total available renewable fresh water resources in 1998 are only about 250 m^3/p/yr.

The MWR concept does not include any other direct allocation of fresh water for agriculture, but does assume that additional water for agriculture and/or other industrial or non-potable urban uses can be made available through the *recycling and reuse of some 65% of the water allocated for domestic/ urban/industrial use*. Thus, the total effective supply of water could reach 190 m^3/p/yr ($125m^3$/p/yr from fresh water sources and 65 m^3/p/yr from recycled wastewater). Israel is following this strategy of maximal water recycling and reuse, and by 1998 was actually recycling some 70 percent of its urban wastewater flow to agriculture and industry. Thus recycled water can become a sustainable source of water under conditions of water scarcity.

In conclusion, there needs to be a fundamental revision in the conventional wisdom and understanding of such concepts as *water security, food security, water stress* and *water benchmarks* in relation to the really arid countries of the world, such as those in the Middle East, that can only achieve the needed levels of water and food security by developing economies based on commerce, tourism, and industry. By developing their economies, these countries can earn sufficient cash to enable them to import low cost *virtual water* by purchasing all the required food stables on the world market. A World Food Bank may be required to help poorer countries in transition meet these needs.

2.1.9. Integrated Systems Approach to the Water Problematique: Use of Computer-based Reasoning to Resolve Conflicts and Engender Cooperation, "Sree" N. Sreenath and Mihajlo D. Mesarovic

Case Western Reserve University, Cleveland, Ohio, USA

Scarcity of fresh water resources globally is expected to become a major factor in limiting the development of regions and cause conflict between regions sharing the same water resource. It is well known that the security and development of a region or a nation is tied in a fundamental way to the availability of replenishable water resources. Waters shared across many borders either could be a major source of conflict, or alternately could force, nurture, engender, and enhance cooperation. This paper discusses the application of integrated assessment for support in policy analysis, negotiations and conflict resolution. A case study of the Nile, focusing on Egypt and two of its upstream riparian Nile countries, the Sudan and Ethiopia, is discussed as an illustration. A detailed discussion of the case study is given elsewhere (Sreenath, Mesarovic, and Vali, 1997).

2.1.10. Regional Socioeconomic Development and Water: Southeastern Anatolia Project (GAP) of Turkey, I.H. Olcay Ünver

GAP Regional Development Administration
Republic of Turkey, Prime Ministry

The Southeastern Anatolia region is part of Upper Mesopotamia, the cradle of the ancient Mesopotamian Civilization. The Southeastern Anatolia Project (GAP) area, with a population of some 6 million people and a surface area of over 75,000 square kilometers, corresponds to one tenth of Turkey. It has been endowed with both water and soil resources. The Tigris and Euphrates Rivers represent over 28 percent of the national surface water supply, and the total economically irrigable area in the GAP region accounts for over 20 percent of that for the entire country. GAP is implemented in the nine southeastern provinces of Turkey.

The main issue in the utilization of this potential is the "mismatch"of soil and water resources. The recognition of the potential of both led to plans for an integrated development of the region's water and soil resources for irrigation, hydropower generation, and the control of floods and droughts. This work was originally planned as a water resources development package only, but was later transformed into an integrated, multi-sectoral, regional development programme.

The social and economic sectors embraced by the project include agriculture, energy, transportation, tele-communications, healthcare, education, and urban and rural infrastructure.

GAP is one of the largest of its kind in the world. The water resources development program includes 22 dams, 19 hydropower plants, and an irrigation network for 1.7 million hectares of land. The ultimate aim of GAP is to create an environment in which the people of the region can fully translate their potential and preferences into reality. Thus, besides investments geared toward the development of water and land resources, parallel progress will be made in social principles such as fairness, equity, and participation; in environmental protection; and in improvement of land-use and the integrated provision of infrastructural services, all of which contribute to improving the quality of life.

2.1.11. Conflict And Cooperation Along International Waterways, Aaron T. Wolf

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There are 268 international rivers, covering almost one half of the total land surface of the globe, and untold numbers of shared aquifers. Water has been a cause of political tensions between Arabs and Israelis; Indians and Bangladeshis; Americans and Mexicans; and all ten riparian states of the Nile River. Water is the only scarce resource for which there is no substitute, over which there is poorly-developed international law, and the need for which is overwhelming, constant, and immediate. As a consequence, "water" and "war" are two topics being assessed together with increasing frequency.

This paper investigates the reality of historic water conflict and draws lessons for the plausibility of future "water wars." The datasets of conflict are explored for those related to water only seven minor skirmishes are found in this century; no war has ever been fought over water. In contrast, 145 water-related treaties were signed in the same period. These treaties, collected and catalogued in a computerized database along with relevant notes from negotiators, are assessed for patterns of conflict resolution. War over water seems neither strategically rational, hydrographically effective, nor economically viable. Shared interests along a waterway seem to overwhelm water's conflict-inducing characteristics. Furthermore, once cooperative water regimes are established through treaty, they turn out to be tremendously resilient over time, even between otherwise hostile riparians, and even as conflict is waged over other issues. These patterns suggest that the more valuable lesson of international water is as a resources whose characteristics tend to induce cooperation, and incite violence only in the exception.

2.2. PAPERS

2.2.1. Make Water a Medium of Cooperation Rather than Conflict

Jamil S. Kadhem Al-Alawi

Business Promotion Center, Bahrain

The Middle East region is facing major water supply constraints, and only three countries in this region (Turkey, Iran, and the Sudan) have per capita water consumption levels above the currently accepted minimum. Unfortunately, the present methods by which the limited water resources in the Middle East are managed could lead to major disasters, especially if Gulf States continue to extract groundwater as if it were an abundant resource.

The prosperity of the Gulf states as a result of oil revenues has made it possible for these countries to invest heavily in the installation of very costly desalination plants. These plants supply most domestic and industrial needs. Agriculture still depends mainly on groundwater resources. However, unbalanced extraction has led to an increase of salinity, thus making some water unsuitable for agricultural requirements.

The cost of desalinated water was acceptable when demand was reasonable and oil revenues were at their peak. In recent years, however, increased population, a higher standard of living, and subsidized water tariffs have increased demand. Oil revenues have declined at the same time, and this has lead to lower rates of investment in infrastructure. A result is that some countries are not able to meet current demands. In certain countries, demand is met by additional groundwater extraction, but this contributes to a faster depletion of groundwater resources.

The call for a conference by Green Cross is timely and appropriate. However, such a conference should target high-level decisionmakers and not the technocrats who are already familiar with and concerned by the problems. If a Middle East water conference is organized, the key issues that should be discussed are:

- Water desalination and water reuse
- Regional and international research cooperation
- Water management policies
- Privatization
- Training and human resource development
- Public awareness on water issues and water conservation

These topics should be addressed with a particular emphasis on reducing the cost of desalinated water so that is becomes available and affordable for those who need an alternative water resource. Desalination is a future solution to the developing water crisis in the region and may in certain instances help solve water conflicts.

2.2.2. Global Soil Water: A Long Term Solution for Water-Short Middle Eastern Economies?

Professor Tony Allan

Water Issues Group
School of Oriental & African Studies, University of London

Middle East and global water resources: the link.

The issue of whether there will be enough water for a future global population double its present size is controversial. The answer to the question is of particular importance to the peoples and political leaders of the Middle East and North Africa. The region's economies are already as dependent on global water as they are on the renewable waters of the region. They will be much more dependent on global water in future.

The answer is almost certainly a resounding yes. There will be enough fresh water in the global system. But on the supply side, that is freshwater availability, the science has not yet been done to prove the future capacity of the global freshwater system. A researched estimate of sufficient precision to be useful for politicians and decision makers would cost many billions of dollars. On the demand side, freshwater needs are driven by rising populations. Here the range of the estimates of future global population vary by over fifty per cent. In this uncertain information domain there is space for numerous pessimists and optimists to spin counter interpretations. Whether we believe the optimists, including the author and most economists (Islam 1995, IFPRI 1995 & 1997, Dyson 1994:403), or the pessimists (Brown 1995 and 1996, Brown and Kane 1996, Postel 1997) depends upon the assumptions used by the respective analysts.

Mega questions tend to be ignored; or attract untestable ideological interpretations of religious intensity. Is there enough freshwater for future populations is a mega question and it is not given a fraction of the attention it deserves by scientists.

In the 1960s and 1970s there were attempts in the former Soviet Union to review the world's water balance (L'vovich 1969 and 1974). Water availability and use have also been addressed (Shiklamanov 1985, 1986 and 1994, Shiklamanov and Sokolov 1983, Shiklamanov and Markova 1987, Gleick 1994)

Meanwhile agencies such as the World Bank are prepared to devote five million dollars a year (at least) to providing advice on managing water and on lending much more for water projects without offering a view on the status of global water. Institutions such as the World Bank can produce shelves of reports about allocating and managing water for the interested professional and general reader (World Bank 1993, Serageldin 1994 and 1995) and for the specialist focused on local and regional issues (World Bank 1991, 1993a, 1993b) without situating the debate in the global resource context. Since 1994 there has been a welcome and responsible attempt by the Food and Agricultural Organization (FAO) to address the subject of water availability for Africa and the Middle East (FAO 1995a and 1997a) and on water use by the major using sector, irrigation (FAO 1995b and 1997b). The publications provide first approximations which should be given prominence so that the reliability of the data can be enhanced by progressive iteration.

A balanced perspective on the population, water and food nexus tends to come from the International Food Policy Research Institute (IFPRI 1995) which identifies low, medium and high scenarios for population.

These predict respectively 7.7 billion, 9.4 billion and 11.1 billion for the global population by 2200.

In its 1996 study, the United Nations found that population growth between 1990 and 1995 was 1.48 percent per year, rather than the 1.57 percent projected in 1994. In light of this lower rate, the United Nations revised its projections for population growth in the next century, based on three different assumptions about the fertility of the world's women. The medium fertility model - the one usually considered the most likely - would put the world's population at 9.4 billion by 2050 (half a billion lower than the United Nations 1994 estimates). World population would continue to grow until 2200, according to this model, when it would stabilize at 10.73 billion.

The medium fertility model falls in the middle of a wide range of possible outcomes. Low fertility would result in a world population of 7.7 billion by 2200, whereas high fertility would mean 11.1 billion mouths to feed in 2200. These extremes are by no means unrealistic, and the population debate is far from over. Public policy and individual behavior, they say, will ultimately determine the world's population (IFPRI 1997).

About Middle East water there is less scientific controversy. The Middle East as a region ran out of water in the 1970s. The news of this important economic fact has been little exposed. In politics, facts, including those on water, which are judged to have costly political consequences can easily be ignored or de-emphasised. With selection and distortion of information being the norm in political processes it is predictable that discourses on Middle Eastern and North African water will be misleading and confusing.

For political leaders in the region political imperatives are more compelling than scientific facts. On water, these imperatives drive them to assert that their economies have **not** run out of water.

An ex-Prime Minister of Egypt (Higazi 1994), and mid-1990s Egyptian ministers of water resources, of agriculture and of planning have vied in public in the vehemence of their assertions that Egypt has sufficient water. (Arab Research Centre 1995) The main reason that there can be such different interpretations by scientists and politicians is that the politicians do not specify what 'sufficient' means.

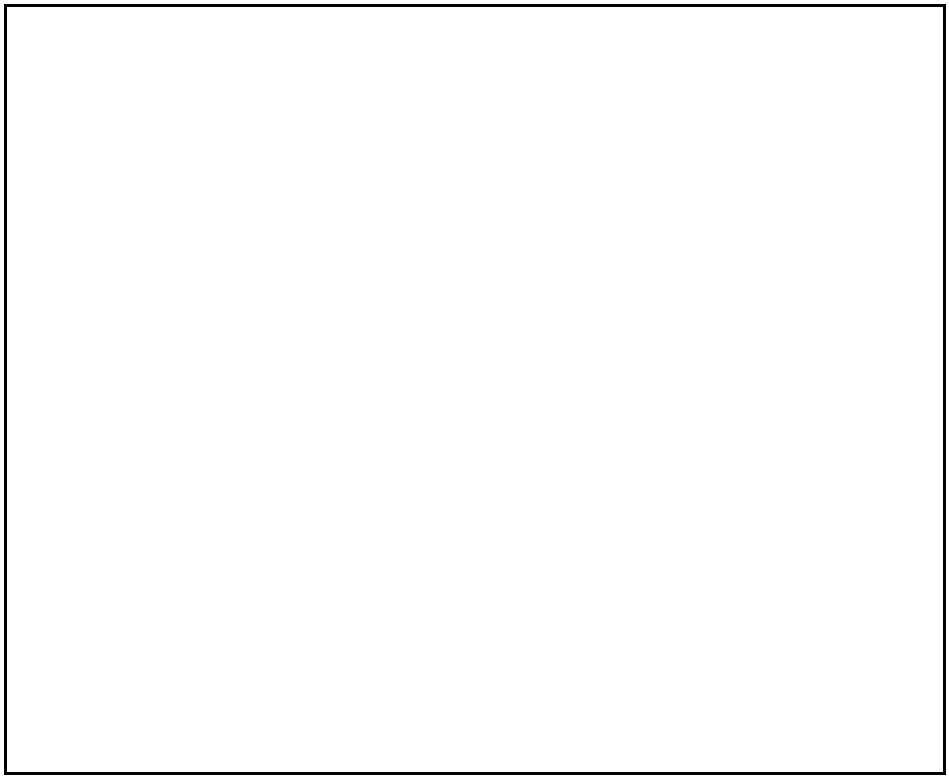
By sufficient, scientists mean sufficient 'indigenous' water to meet the total water needs *including water for food production*, for the industrial and municipal water needs of an economy and for household requirements. Politicians do not specify. They imply they mean the same as the scientists but in practice they mean only part of the 'total' needs. Without making their assumptions clear they are asserting that 'sufficient freshwater' is that volume necessary to sustain the existing jobs in agriculture and industry and for municipal and industrial needs. In an economy such as Israel this may be only 25 per cent of the water which would be needed for food self-sufficiency. For Egypt it is about sixty per cent of the water needed for food self-sufficiency. For politicians in almost all countries in the region the food gap caused by the insufficiency of water has to be ignored. To draw attention to the water gap and the food gap could be politically suicidal.

The reason the Middle East is important vis-à-vis water is because it is the first major region in the world to run out of water. The water demands of the populations of the Arabian Peninsula and desert Libya had exceeded the capacity of their water resources for food self-sufficiency by the 1950s. Israel and Palestine also ran out of water in the 50s, Jordan in the 1960s, Egypt in the 1970s. The Maghreb countries have recently entered water deficit.

The Tigris-Euphrates riparians have not fully utilised their water resources but will do so in the next decades. The Sudan has some way to go before it fully utilises the share it has agreed with Egypt on the Nile - a share not endorsed by the other upstream riparians.

The major indicator of the scale of the water deficit of an economy is the level of its food imports. The reason food imports are such a strong indicator of water deficit is that the water required to raise food is what an economist would refer to as the dominant consumptive use of water. The use is dominant whether viewed from the point of view of the individual citizen or the national economy. Water used in the agricultural sector exceeds by ten times the water used by the industrial and municipal sectors combined.

An individual needs each year only one cubic metre of drinking water, between 50 and 100 cubic metres for other domestic uses, though a much lower actual use is the norm in many rural communities in countries in other regions, for example in the economies south of the Sahara. By contrast an individual needs each year at least 1000 cubic metres of water, either naturally occurring in soil profiles, or transported to the profiles by irrigation systems, to raise the food needs for that individual. At the national level over 90 per cent of all national water budgets are devoted to the agricultural sector.



In the arid and semi-arid Middle East the dominance of the agricultural water demand is stark. There is little or no naturally occurring soil water even in the winter when parts of the region do receive rainfall. By contrast in the economies located in temperate latitudes, in Europe and the humid tracts of North America for example, the issue of the relative demands of the agricultural and the industrial (including services) sector is scarcely evident. In temperate latitudes crop production is almost totally based on soil water which occurs naturally. Soil water tends to be taken for granted in the economies located in the humid temperate zone. The huge volumes of water utilised by agriculture are not counted as part of the national water budget. Such water is a free good.

While water is treated as a free good in temperate humid regions, in the semi-arid and arid Middle East and North Africa agricultural water is expensively won because of the costs of storage and distribution. Storage is needed to ensure timely availability and to reduce the loss of water to an economic system.

Mobilising such water can in addition be politically stressful both nationally - through environmental impacts, and internationally - through riparian conflict. The comparative disadvantage in economic terms of the Middle East and North Africa with respect to water is an extreme and classic case.

Soil water and the economic efficiency of water use are vital themes. The reasons, though not evident, are powerful. First, it is *global soil water* which balances the water budgets of all the economies of the Middle East and North Africa, with the arguable exception of Turkey. Secondly, the *effective allocation of water* between sectors to gain high returns and high levels of employment are fundamental to economic and political stability. The environmental significance of water and water quality will not be addressed here, not because they are unimportant. It will be argued that understanding the global availability of water and the economically sound use of water are the major current water policy and management priorities for the first region to run out of water.

The Regional Water Gap and the Global Water Surplus?

The rate at which food imports have been rising in the Middle East and North Africa since the 1970s confirms the scientist's contention that the region has run out of water. The production of every tonne of a food commodity such as wheat requires a water input of about 1000 tonnes (cubic metres). The trend in cereal imports reflects a reasonable approximation of the capacity of an economy to meet its strategic food needs.

The trend in cereal and flour imports in the Middle East and North Africa since the 1960s has levelled off in 1986, which reflects changes in particular agricultural and food production policies mentioned above by Egypt and Saudi Arabia, the two biggest players in both cereal and flour production and consumption in the region. Egypt changed its subsidies policies in 1986 which had favoured cotton, so that wheat production became a sound financial option for its farmers. By 1986 Saudi Arabia's irrigation projects had begun to produce sufficient wheat for most of its needs, and it was about to become a significant wheat exporter in the world market. Saudi has subsequently reduced its wheat production because it was palpably an unrealistic way to use its fossil water.

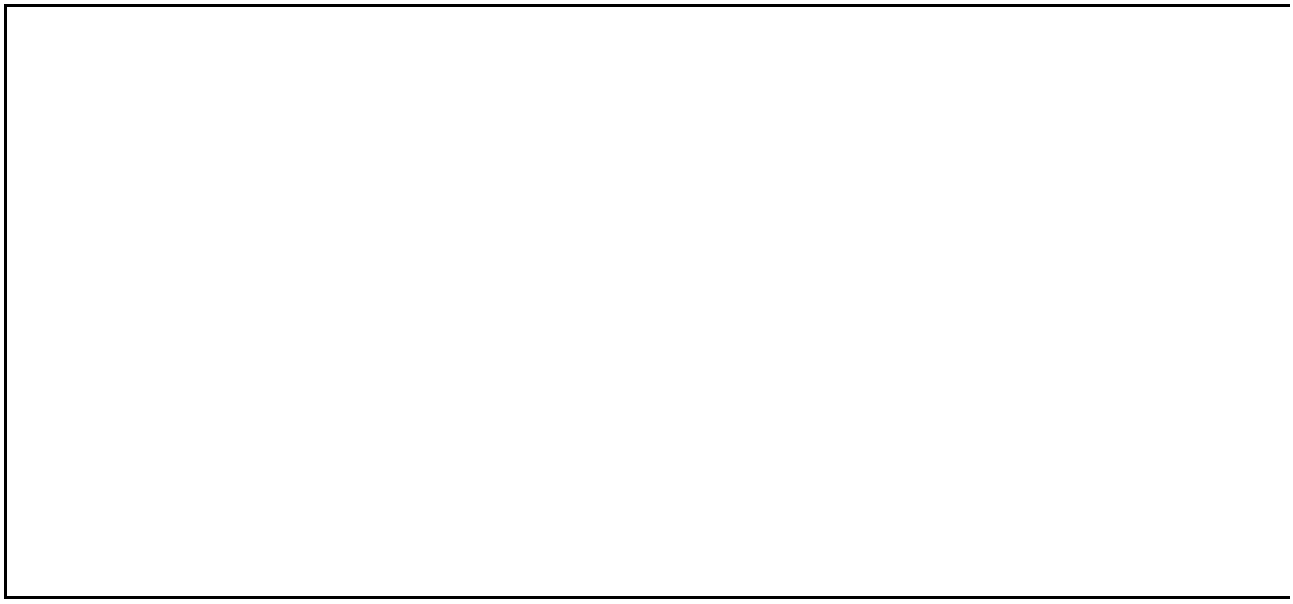
Scientists can demonstrate that the Middle East is the first region in the history of the world to run out of water. (Rogers 1994, Allan 1994) Meanwhile the peoples and their leaders in the region refuse to recognise these resource and economic realities. *Their interpretations of Middle East hydrological and economic contexts are at best underinformed and at worst dangerous; their perception of global hydrological and economic contexts is unsafe.*

Table 1.1 Middle East and global water uncertainties and the scope for optimism and pessimism

	Middle Eastern water for regional self-sufficiency		**Global water for global self-sufficiency**	
	Evidence (scientific & professional)	**Perception** (politicians & people)	**Evidence** (scientific & professional)	**Perception** (politicians & people)
Availability	Deficit **Pessimism** **[ignored]**	No deficit **Optimism** **[dominant]**	Surplus??? **Optimism & pessimism** **[contadictory optimism accepable]**	No view **Optimism** **[dominant]**
Utilisation	Productive efficiency possible **Optimism** Allocative efficiency possible **Optimism**	Prductive efficiency possible **Optimism** Allocative efficiency politically impossible **De-emphasis** **[dominant]**	Productive efficiency possible **Optimism** Allocative efficiency possible **Optimism** **[contradict'y]**	Productive efficiency possible **Optimism** Allocative efficiency politically impossible **De-emphasis** **[dominant]**

- Table 1.1 summarises the estimated status and utilisation of first, Middle East, and secondly global water resources as researched by international scientists and compares them with the perceptions of these phenomena by politicians and peoples. The table shows that there is scope for dangerous confusion and contradiction at both the regional and the global levels. Both scales are of vital economic and strategic significance to the region.
- Table 1.1 also shows that global environmental knowledge is even more prone to diverse interpretations. In this case scientists cannot provide reliable information on either the supply side - the availability of water, nor on the demand side - the current and future demand for freshwater driven by future populations. Estimates of future population differ by over 50 per cent.

Table 1.2 Uncertain Middle East & North Africa scenarios: population and water consumption scenarios; interpretations of water demand



Assumptions:

[1] Optimistic assumptions

- changed food consumption patterns - less livestock products
- optimistic estimate of the demographic transition
- success of economic demand management policies - by allocating to high returns to water activities
- success of economic demand management policies - by technological improvements to high returns to water activities
- effective trade

[2] Pessimistic assumptions

- Static patterns of food consumption by individuals
- even more extravagant than current diets in terms of water consumptive use
- a pessimistic estimate of the demographic transition
- static technology,
- inflexible national political institutions
- inflexible international institutions
- ineffective trading systems

The Middle East's hydrological system is definitely less and less able to meet the rising demands being placed upon it. Food imports are the important indicators of water deficit. (Figure 1.1 and Table 1.2). Meanwhile the global hydrological system is evidently in surplus as it is able to meet the most demanding element of global water demand, the global consumption of food. Assuming a medium water consumption scenario of 1500 cubic metres per person per year, global freshwater needs are about 8.25 billion cubic metres annually. (Table 1.3) A consumption level of 8.25 bn m3/ppy is well within the estimates of global freshwater availability. (Rodda 1996) But there are differing interpretations of the future position vis-à-vis future demands driven by higher world population. (Brown 1996, Postel 1997, IFPRI 1996) At this stage in history the global freshwater surplus is palpable and so the region's water deficit is not serious because global systems - trade - balance the Middle East's deficit. (Allan 1994) Note it is an economic systems and not hydrological and water engineering systems which achieve water security for the economies of the region.

Table 1.3 Uncertain global scenarios: population and water consumption scenarios: interpretation of global water and food demand and availabilty

Assumptions

[1] Optimistic assumptions

- changed food consumption patterns - less livestock products
- optimistic estimate of the demographic transition
- success of economic demand management policies - by allocating to high returns to water activities
- success of economic demand management policies - by technological improvements to high returns to water activities
- effective trad

[2] Pessimistic assumptions

- static patterns of food consumption by individuals
- even more extravagant than current diets in terms of water consumptive use
- a pessimistic estimate of the demographic transition
- static technology,
- inflexible national political institutions
- inflexible international institutions
- ineffective trading systems

At the regional level there can only be versions of pessimism about the future availability of water, at least for irrigated food production. Optimism exists on the future volumes of MENA (Middle East and North Africa) freshwater but it is based on non-scientific assumptions. On the other hand optimism about the capacity to use the region's water more productively is sound. And it is on this aspect of water management that politicians and regional optimists focus, as well as those who have financial and consulting services to contribute from outside the region.

At the global level there is certainty neither about volumes of freshwater available nor about the capacity to use the water effectively. In these circumstances there is evidence to support the arguments of both optimists and pessimists. Because of the mighty 'error bars' on the statistics produced by the as yet inadequate models of global change (Conway 1993:291, Conway and Hulme 1993 and 1996, Conway, Krol, Alvamo, J. Hulme 1996) very different views emerge concerning the capacity of the world's agricultural systems to raise food, which leads in turn to a very confusing debate.

The pessimistic global freshwater scenario is persuasive if we assume:

- static patterns of food consumption by individuals
- or worse, patterns even more extravagant than current diets in terms of water consumptive use
- a pessimistic estimate (high scenario) of the demographic transition
- static technology
- totally inflexible political and international institutions
- ineffective trading systems.

If, however, it is assumed that:

- communities can change their food consumption behaviour, just as they can be weaned off tobacco and over indulgence in sun-bathing
- the world's growth in population will level off in the second half of the twenty-first century at about ten billion
- economically sound policies can improve the productivity of water by ensuring that it is allocated to activities and crop production which bring high returns to water
- technology can significantly improve the productivity of water in food production
- the mechanisms of international trade in staple foods continue to operate with proven effectiveness to ameliorate the uneven water endowments of the world's regions,

then one can conclude that the world's water and food futures are uncertain but not seriously insecure. Basic to a serious scientific input to the debate is the contribution by the scientific community of best estimates of the status of existing soil water surpluses in addition to the rather more easily estimated future populations of current and future water challenged regions. Unfortunately these numbers are difficult to obtain because the concept of soil water availability is hard to define and agree (Schmugge 1995) and even if the concept were generally agreed a method of monitoring it comprehensively has not yet been defined. (GEWEX 1997).

The insecurity of the Middle East and North Africa region arises not just from its resource endowment, which is significant, but mainly in the capacity of its agricultural sectors and governments as well as the international institutions to adapt to the resource scarcity and take measures to find and mobilise substitutes. There is also a knowledge problem in that at this point in history scientists cannot answer the question posed above about the global freshwater system - is there sufficient water in the world's soil profiles, surface water and groundwaters to meet a notional average water consumption per person for say ten billion people?

The imprecision of current estimates of freshwater demand and potential availability is immense. Will there be seven, ten or twelve billion water users? What is a reasonable estimate of average water consumption in the dynamic political economies of the future? Should it be 1000 cubic metres per person per year or 2000 cubic metres per year, for all food, domestic, drinking, municipal, industrial and leisure water? How do we factor in environmental water? Some communities in the world are already operating beyond the high end of this consumption pattern, for example in parts of the United States. At the other extreme individuals in the vast semi-arid tracts of Africa south of the Sahara have access to an unreliable and very seasonal say 1000 cubic metres of soil moisture in their local soil profiles and a tiny daily use of ten litres per day for domestic and drinking purposes, that is a mere 3.5 cubic metres per year; a total use per individual of about 1000 cubic metres per year.

Current and future water gap uncertainties are not quite of the *Himalayan scale* cited by Thompson and Warburton (1988:2) where they observed a difference between the highest and lowest estimates in a review of soil erosion in the Himalayan region of about 400 times. For Middle East water the estimates of future freshwater demand differ by a factor of at least two. (Table 1.2) The comparatively small range in the estimates should not lead to complacency in that the number of people within the range would be at least four billion.

The two variables affecting the estimate of future freshwater needs are first, growth in population and secondly, the use of water per head. Population growth estimates differ by 40 per cent, with the lowest about 50 per cent higher than the current population. (IFPRI 1997) When this 50 per cent is multiplied by either the low (1000 cubic metres per head) or the high (2000 cubic metres per head) estimates of the freshwater likely to be needed per person the estimates of potential water needs for the Middle East and North Africa move further apart to a high estimate which is 180 per cent higher than the lowest, and 400 per cent higher than current levels. (See Table 1.4)

Table 1.4 Population and water in the Middle East and North Africa illustrating the range of future low and high scenarios

Years	1995	2100 low scenario	2100 high scenario
Population bn	5.5	7.7	11.1
Water Consumption in m^3 / year / inhabitant		1000	2000
Total Water Consumption in 10^3 km^3	5.5	7.7	22.2
progression	100 %	140 %	404 %

Potential water availability globally being unknown, guesses in circulation differ according to assumptions. The lowest is based on the assumption that a limit similar to existing use is imminent. (Brown 1996, Postel 1997) The highest anticipate that water will be able to be mobilised at twice the late twentieth century level.

There should be no anxiety in any region of the world, including MENA, concerning the availability of water for drinking and domestic use and for almost all industrial and service sector uses. Current and future tension will be about water for food production. Food production requires about ninety per cent of a community's water; and should there be insufficient water for local food needs, that is the predicament of the Middle East since 1970, then food water has to be imported. Domestic water may also have to be augmented by desalination.

While the underlying message in this paper is optimistic it must be very strongly emphasised that the types of adjustment anticipated by the optimists cannot be achieved quickly. Thirty years is a rather short transitional period for the necessary major adjustments in water policies to be developed in response to limited water availability. Adjustments such as the changes in the public perception of the value of water take time. The associated political discourses enabling fundamental changes in water policies take at least decades. So deep are the belief systems and so challenging any proposal that beliefs should change that politicians are loathe to contradict them, even though the measures are essential for the stabilisation of the political economy. Case studies from the Middle East will illustrate these processes (Allan 1996: 77-83, Feitelson and Allan 1998).

Table 1.5 Middle East and North Africa water availability (surface & groundwater) 1995

Country		Water				Population
		Actual km³/year				000
Middle East						
Arid Middle East						
Bahrein		0.116				564
Cyprus		0.900				742
Iraq	usable	35.420				20449
Iraq	unusable				35.000	
Jordan		0.880				5463
Kuwait		0.020				1547
Lebanon		4.407				3009
Oman		0.099				2163
Qatar		0.053				551
Saudi Arabia		2.400				17880
Syria	usable	10.260				14661
Syria	unusable				16.000	
UAE		0.150				1904
Yemen		4.100				14501
			water			
	Total		**58.805**			**83434**
Less arid Middle East						
Iran		137.510				67283
Turkey		183.762				61945
				water		
	Total			**321.272**		**129228**
					water	**population**
Total Middle East					**380.077**	**212662**
North Africa						
Arid North Africa						
Algeria		14.300				27939
Egypt		58.300				62931
Libya		0.600				5407
Malta		0.016				366
Mauritania		11.400				2274
Morocco		30.000				27028
Sudan-northern Nile		18.500				28098
Tunisia		4.120				8896
			water			**population**
	Total		**137.236**			**162939**
Less arid northern Africa				water		
Sudan - other				60.000		
	Total			**60.000**		
					water	**population**
Total North Africa					**197.236**	**375601**
				water	**water**	**population**
MENA total			**196.041**		**577.313**	**588263**

Source: FA0 1997: 14. With a reclassification of the countries by ecological zone and region.
With some additional comments on the actual availability of water for economic use: for example Turkey, Syria and the Sudan

How is it that the two camps, pessimists and optimists, can exist simultaneously and dispense such confusing contradictory interpretations? There are four main reasons, three on the supply side and one on the demand side.

The first supply side reason is the simple matter of the diverse assumptions on surface and groundwater availability adopted by the two groups. The second is that the most important variable of all, global soil water, is ignored by pessimists and is not well understood by the optimists. The third is the imprecision in the estimates of the other important components of the global hydrological system, and especially on climate change. Finally on the demand side there are so many factors affecting the demand of a community for water that it is possible to extrapolate demands for water which differ by four or five times between the low estimate and a high one. Pessimists tend to the high end of the range and optimists to the low end.

The divergence in assumptions between the water pessimists and the water optimists is so great that they cannot communicate. Meanwhile the arguments of **both** pessimists and optimists neglect the most important water of all in the water budgets quoted whether in MENA or other world economies.

Soil Water, 'Virtual Water,' and the 'Problemshed'

This silent unaccounted water is soil water located in the soil profiles of the MENA economies themselves, as well as in profiles elsewhere in the global system. The neglect is especially true of the pessimists (Brown 1996, Postel 1997). Soil water and soil moisture do not even appear in the indexes of their books, or if they do they refer to examples in some local irrigated circumstances (Postel 1997:103) and not to the pivotal role of naturally occurring soil water in feeding the world's future populations. In brief if at least half of the water needed to feed the Middle East and North Africa's people in the 1990s lies in the soil profiles of temperate humid environments in North America, South America and Europe it is surely scientifically derelict to ignore that water.

The intent here is not to discredit the inestimably important contributions of Lester Brown and Sandra Postel to international and local discourse on the under-researched and intuitively worrying state of the world's water resources. Their focus in highlighting the urgency of achieving major shifts in perception and policy is extremely important. However, by discussing only surface water and groundwater, a very partial perspective on the waters of importance to human populations is presented. In neglecting to address a comprehensive version of global hydrology including global soil water they deny themselves and their readers a balanced perspective. An analysis of the energy future of hydro-carbon short national economy would be as misleading if it neglected options to import oil and gas, or for someone wanting to get from Cairo to Khartoum to assume that the only travel options were on a boat on the River Nile. Even more neglectful is the de-emphasis of the impressive international trading systems which transfer commodities requiring high water inputs from water surplus areas to water poor ones. In practice more water flows into the Middle East each year in this 'virtual form', embedded in cereal imports, as is used for annual crop production in Egypt. Egypt is by far the most water rich country in the arid part of the Middle East and North Africa.

The main purpose of this paper is not to contradict the concern of the eco-pessimists and those afflicted with hydro-paranoia vis-à-vis the Middle East, but to enlighten that concern by refocusing the analysis at a higher and more appropriate level, namely at the level of the international political economy.

It is at the global level that explanation is to be found concerning why economies operate as they do and why water policies are as they are in the Middle East.
Explanations are not to be found via narrow analysis of catchments and water budgets at the national level or even at the regional level. Catchment hydrologies are not a complete source of explanation because they are not determining of the options available to those managing a national economy. If national hydrological systems restrict economic options then politicians have to find remedies in systems which do provide solutions.

United States water resource specialists have coined the term, the 'problemshed', to make the idea of the 'catchment' or 'system' in which solutions can be found more accessible. National economies operate in international political economic systems - in problemsheds - and not just in hydrological systems - or watersheds. The political economy of the global trade in staple cereals is the relevant 'hydrological' catchment for water deficit economies. Access to, and management of, the problemshed is not just via an environmental system but via an extremely powerful and flexible economic one.

The shared and limiting catchment hydrologies with all their troublesome international relations are dangerously misleading frameworks of analysis. The existence of solutions in 'problemsheds' enable politicians to avoid the stresses of inter-riparian relations in the 'watershed'.

In brief if half of the water needed to feed the Middle East and North Africa's people in the 1990s lies in the soil profiles of temperate humid environments in North America, South America and Europe it would be scientifically derelict to ignore that water. It would also be neglectful of scientists in general and the governments of water short economies in particular to ignore predictable future competition for this water. The scientific neglect is just as serious as the predictable devious and selective hydropolitics engaged in by political interests.

The coming fifty year transformation of the perceptions of the value of water (Allan and Radwan 1998) will be a tough environment for those looking for quick solutions. There is no reliable check list nor a handy tool kit with which to change the perceptions of large groups of people quickly. And people 'convinced against their will [tend] to be of the same opinion still'. Even when perceptions have transformed and shifted, the implementation of new water policies, especially water re-allocation policies, has to be gradual. These processes will all be slow; sometimes painfully slow for agency officials and for economists and engineers in a hurry because of limited funding and career horizons.

In addition the foundation scientific concepts for economically and environmentally sound water policies require reforms and adjustments which politicians can see will bring high 'political prices' (World Bank 1997:146). Politicians will defer for as long as possible paying these 'political prices', which can be so extreme that they would involve loss of power. It requires an inhuman level of political courage for a political leader of a country which for five thousand years has enjoyed water security to announce that water resources are no longer adequate.

To make the announcement would be political suicide. Those innovators purveying the economic and environmental facts of life which contradict the deeply held belief systems of whole populations will be ignored if they do not shape their message and pace its delivery to accord with political realities. The authors of the 1997 World Development Report (World Bank 1997: 144) put it another way, by quoting Machiavelli who captures the political flavour of innovation:

'The innovator makes enemies of all those who prospered under the old order, and only lukewarm support is forthcoming from those who would prosper under the new'.

Machiavelli, N, 1513, The Prince.

CONCLUSION

It is a paradox that the water pessimists are wrong but their pessimism is a very useful political tool which can help the innovator to shift the eternally interdependent belief systems of the public and their politicians. The water optimists are right but their optimism is dangerous because the notion enables politicians to treat water as a low policy priority, delay innovation and thereby please those who perceive that they are prospering under the old order. Pessimists also bring more sensational stories to the media. Optimists bring a version of unsensational good news. The good news is complicated and indigestible as well as unsensational.

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2.2.3. Political Experiments of the 1990s: The Use of Scenarios in the Public Domain

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INTRODUCTION: BREAKING NEW GROUND

This report about scenarios, economic development, and the evolution of government in the late twentieth century is the product of a six-month partnership between Barbara Heinzen and Alister Wilson and Campbell Gemmell of the Scottish Enterprise Strategy Team.[*1] While none of us understood it at the beginning, we now know that we have been exploring new ground in several directions simultaneously.

First, we needed to understand what was meant by "scenarios," both as an intellectual product and an organizational tool or political process.

Second, there was the goal of economic development. This phrase was first applied to "third world" countries in Asia, Africa, and Latin America that were seeking to industrialize and "catch-up" with the more "developed" countries of North America, Western Europe, and the industrialized communist bloc. In Scotland, however, we were working with a nation which has already industrialized, deindustrialized, and is moving (like many other societies) towards a new social and industrial structure. Economic development in this environment is pioneering work which can draw on some of the lessons of catching-up, but which is also a uniquely different experience.

Third, we began to explore the role of government. When we began asking who used scenarios in the public sector for economic development, we found that discussions of public issues, using many of the techniques scenario planners would use, were often led by the private sector and operated outside formal government structures. Government people were included, but often found themselves in new roles. So without having directly asked the question, we were - quite by accident - brushing against a redefinition of government's role and responsibilities at the dawn of a neo-industrial age.

[*1] Scottish Enterprise is a network of 13 Local Enterprise Companies and a national office (Scottish Enterprise National) located in Glasgow. As a whole, the network is responsible for economic, environmental and human resource development in lowland Scotland (the Highlands and Islands have a sister organization called Highlands ~ Islands Enterprise).

Scottish Enterprise receives its funds from The Scottish Office. Of its annual budget (around £400m per annum), 2 5 percent is spent on enterprise development, 20 percent on improving the environment, 40 percent on training and 15 percent on administration.

Scottish Enterprise was established by an Act of Parliament and has certain statutory powers; however, it also has discretionary powers. To achieve its objectives, SE needs to work in partnership with such other significant actors in Scotland's economy as companies, higher education institutes, banks, and local authorities.

THE WIDER CONTEXT: A NEW WORLD AND ITS UNCERTAINTIES

Over the past 20 years many people have believed that some form of "business as usual" would continue to define the future as it has defined the past. Even the response to the recession of the early 1980s, when the Thatcher and the Reagan revolutions began was more an exercise in liberalizing existing rules rather than changing rules and structures fundamentally. The policies during that recession looked back to an imaginary golden age of freer enterprise and were tailored to allow society and the economy to return to the high growth and predictable patterns of the early postwar decades. As a result, marginal adjustments, rather than radical change, were the dominant style, with high numbers of unemployed men absorbing most of the corporate shocks.

The recession of the early 1990s, however, has been very different. Every major economy has suffered and many of the policy responses of the 1980s are now criticized for bringing on the collapse of the 1990s - particularly the debts and insecurities of leading financial sectors around the world. This has led more people to see their own nations and organizations as vulnerable creatures in a sea of complex global shifts and transformations. There is also increasing speculation that what we are witnessing is not a cyclical business recession, but a deeper, structural depression leading towards uncharted ground. This sense of fundamental uncertainty has coincided with (and partially been created by) the collapse of the Soviet bloc and the discrediting of communist dogma. As a result, both private sector and state solutions seem woefully inadequate to cope with the scale and challenge of recent change. Instead, there is a sense of intellectual vacuum, an anxiety and uncertainty about the nature of current woes and the best responses to them.

GROWING MISTRUST OF GOVERNMENTS

Partly as a consequence of this threatening economic environment, there has been a noticeable increase in popular mistrust of politicians. A residual faith that national governments should *do something* has not been matched by any action that helps to justify that faith. Increasingly, national leaders are perceived as simply "not up to the task." Opposition politicians are often tarred with the same brush - offering little in the way of personalities or policies that inspire confidence. Some leaders recognize this fact. Vice-President Al Gore has noted that "only 20 percent of Americans trust the federal government to do the right thing most of the time - down from 76 percent 30 years ago, "[*2] and Prime Minister John Major has said that "if politicians fight...on every issue, is it surprising if the public turns away? Somehow we must break through the artificial frenzy that so often masquerades as political debate and focus attention once more on the essential concerns of the people we represent."[*3]

[*2] Vice-President Al Gore, *Creating a Government That Works Better and Costs Less: Report of the National Performance Review* (Washington: U.S. Government Printing Office, September 7, 1993).

[*3] Prime Minister John Major, Speech to the Scottish Conservative Party, May 13, 1994.

Simultaneously, there has been a noticeable growth in two important political phenomena. First, spontaneous local organizations are tackling local issues, often using democratic consultative processes that the national machinery is too large to handle. Several of these local responses will be explored in more detail in this report. Second, there has been increased interest in and development of supranational solutions - through the United Nations, the European Union, GATT, or sometimes regional organizations such as NAFTA. In Europe these two phenomena - local and supranational organizations - have frequently relied upon each other for their financial support and political legitimacy.

These trends have helped create a need and a space for the kinds of experiments we will describe here. Where they will lead is a separate question, but the phenomenon itself is of sufficient interest to be considered in its own right.

Vice-President Al Gore, Creating a Government That Works Better and Costs Less: Report of the National Performance Review (Washington: U.S. Government Printing Office, September 7, 1993). 3Prime Minister John Major, Speech to the Scottish Conservative Party, May 13, 1994.

ECONOMIC DEVELOPMENT: PIECES OF THE PUZZLE

Much has been written about economic development since the term first came into vogue. For our purposes here, however, we picture the major pieces of the puzzle as shown in Figure 1. This analysis is based on the experience of third world countries, but each component has an analogy with the emerging industrial structures of the advanced societies.

- An economy is only the sum of *individual activities*, the work or contribution made by individuals in society. These activities are, however, supported by a wide and complex set of other components.
- The most commonly mentioned and discussed aspects of development are *government macroeconomic policies* concerning government spending, interest rates, exchange rates, tariffs, trade rules, etc. However, these are not sufficient to promote economic development.
- All activities require some form of *infrastructure*, which may be one of two kinds:
  - ◊ ***hard infrastructure***, or the means by which goods can move and people can communicate, including roads, railways, sea ports, post offices, telephone lines, etc.; or
  - ◊ ***soft infrastructure***, or what can be called the rules of the game. Some of these rules concern the financial system, which will shape where investment money is found and how the risks of investing are shared. Other rules govern the management of technology. Some countries prefer rules that stimulate the adoption and spread of imported technologies, while others will protect new ideas and inventions. Soft infrastructure also defines the rules about labor and the rights of workers to sale working conditions and freedom from arbitrary dismissal.

Underlying these other aspects of economic development is *improved personal capacity*: the absolutely basic precondition that every individual in society have the necessary health and basic skills to participate in the emerging activities of a new economic structure. What is the point of having roads if there is no one with enough mechanical knowledge to keep vehicles running on them? Why have a stock exchange if too many people lack the basic mathematical skills of percentages and returns? How can any of these facilities be exploited if people are not healthy enough to work effectively during the day?

Even more fundamental is the shared *capacity for political agreement*. Many developing countries have found that investment in health and education for the whole population, or investment in a balanced distribution of roads, railways, and phone lines, becomes a matter of hot political dispute. Which groups or regions should receive this investment and who should receive it first? Who should benefit most or in what fashion from the rules of the game contained in the soft infrastructure? Where there are losers in the process, how can they be compensated for their loss? Moreover, because development is a process that stretches over several generations, this capacity for agreement includes the ability to think long term about the whole population and cope with the many unpredictable events that will emerge during that time.

Not surprisingly, the early stages of the development process often include a reworking of political beliefs and institutions to facilitate the molding of political agreement. Much of the rest of this paper will be concerned with experiments in achieving such agreement and learning to take account of both uncertainty and the long view. This brings us into the realm of scenarios.

EVOLUTION OF SCENARIO PLANNING: UNDERSTANDING FOR CHANGE

The evolution in scenario work can be pictured as a continuum in which subjective, personal, and organizational factors play an increasingly important role. Early scenario writers produced books that described alternative futures for the world economy, a national economy, a business sector or organizations. Later scenario planners realized that if scenario thinking were to change people's behavior and decisions, those who were expected to change needed to participate in the intellectual work itself. This realization led to an increased emphasis on the process of building and understanding scenarios using interviews, workshops, and a variety of analytical and facilitation techniques. The engagement of managers in the identification of issues and the analytical process was seen to contribute to a changed view of history and the present. This new viewpoint could then lead to changes in everyday thinking, and finally to changes in behavior, decisions, and actions. Only the accumulated impact of these changes would lead to a change in the overall performance of a firm or economy.

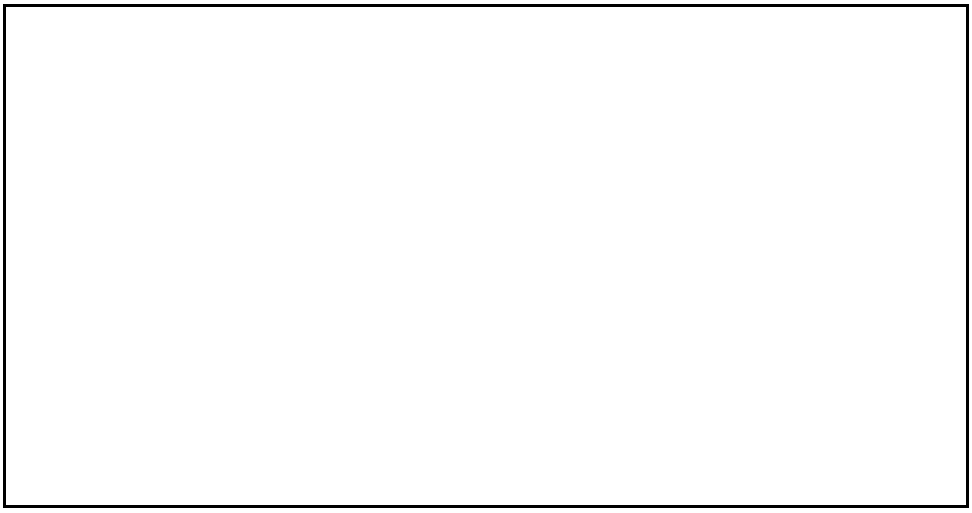
This analysis led us to identify two aspects of "scenario" work: (1) the intellectual task of studying driving forces and trends, creating alternative futures, and (2) the consultative learning process, which embeds scenario thinking in an organization or group.

SCENARIOS IN ECONOMIC DEVELOPMENT: HOW THEY WORK

In the private sector, scenarios look at the interaction of social, political, technological, environmental, and economic forces to imagine two or three different ways the business environment might evolve in coming years. Since the future is uncertain and unknowable, the company will be best able to survive if it can imagine in advance some of the possible twists and turns it might meet and "rehearse" the different decisions that it might have to make.

Those in economic development face many of the same uncertainties that are faced by a large multinational company, but in a broader context. In addition, an economic development agency needs to secure a measure of political agreement among competing interests on the goals and on the means by which development is to be achieved. In this sense, economic development can be defined as having three important components, as illustrated by the Development Triangle (Figure 2):

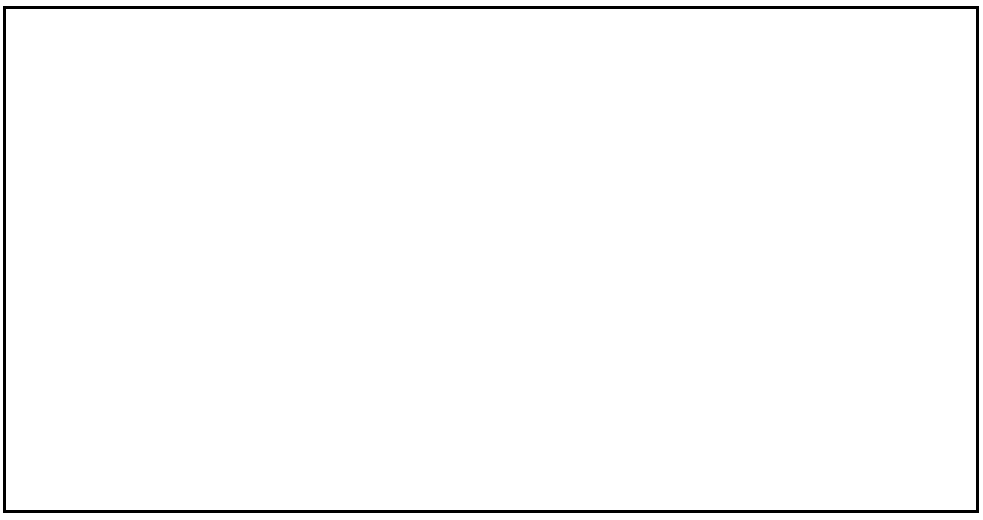
- a *political* task: achieving agreement
- an *intellectual* task: identifying policies for agreement
- a *managerial* task: implementing the policies which have been agreed



Scenarios help understand the environment within which these development tasks are accomplished. To the extent that they are developed in consultation with competing interest groups, they also help achieve political agreement. By distinguishing between the certain and uncertain developments of the future they can help define appropriate policies and options as circumstances change. Finally, if those who manage policies are involved in the scenario process, their ability to react to changing circumstances is improved, and successful implementation of agreed policies is more likely. Theoretically, therefore, a good scenario process could be a useful way of mediating the "development space" between the intellectual, managerial, and political tasks, as illustrated in Figure 3.

SCENARIOS IN ECONOMIC DEVELOPMENT: THE SEARCH FOR EXAMPLES

Because of the theoretical "fit" between a good scenario process and a good economic development process, it was logical for us to suppose that somewhere we would find examples of groups that had used scenario building techniques to manage the dilemmas of development.



During much of 1993, we went looking for these experiences. We were particularly interested in experiences where the public sector took the lead, since Scottish Enterprise is a public sector body. In our search we sent letters to several development studies centers in Britain and asked everyone we knew if they had heard of the use of scenarios in economic development.

Oddly enough, the development studies centers had barely heard of the word "scenarios," and usually thought it meant a set of options for policy. Our personal networks were more fruitful, and eventually 107 people offered information. But even here, 40 percent knew of "nowhere" that scenarios had been used, and another 15 percent knew that they had been used "somewhere, but not here." In the end we identified 28 examples where scenario thinking, or a consultative learning process, or both, had been used either in development or in the public sector.

In about half the cases, scenario studies had simply been read with varying degrees of interest and then filed away - products separated from any process involving those who were expected to use the scenarios. In other cases stakeholders were involved in a consultative economic development or public planning process, but no scenario thinking about future possibilities was done. We found half a dozen examples of scenarios produced from a stakeholder process, but only two of these, both in Sweden, were interested in economic development and led by the public sector, and only one was still functioning in 1993.

In sum, out of 28 public uses of scenario and consultative learning techniques, only one currently in operation was closely analogous to the position of Scottish Enterprise. For us, this meant that any public sector body hoping to use a scenario exercise in economic development would be working at the frontiers of a new political and economic process.

EIGHT SUCCESSFUL EXPERIMENTS IN THE PUBLIC DOMAIN

Although there was only one organization in a similar position and role to that of Scottish Enterprise, eight of the 28 examples can be described as successful experiments in the public domain. Four of our eight examples have come from Northern Europe, three from North America and one from South Africa. The following are brief summaries. More detailed stories of the experiments are presented in the Appendix.

- *Brittany*: The Institut de Locarne brought local businessmen together to define the issues of economic development in the region.
- *Connecticut*: Organization of meetings between bank managers and neighborhood activists to address "redlining" - the practice of banks to refuse mortgages in poor neighborhoods - provided a model for the resolution of other disputes, including timely agreement on a state budget.
- *Canada*: Response to a paper, "Governing in an Information Society," led to the formation of a Round Table that eventually developed scenarios on the future of Canada.
- *Rijkswaterstaat (RWS):* Management introduced scenario exercises to redesign the approach to planning in a major Netherlands ministry.

- *Silicon Valley*: A group of CEOs created a public/private joint venture to consider the social and economic future of Silicon Valley.
- *SIFO Multiclient Study*: Swedish consultancy introduced a multiclient scenario exercise on the future of Sweden, culminating in a day-long television broadcast.
- *Södermanland County Administration (Sweden)*: Scenario seminars concerned with the layout of a railway infrastructure expanded to include such issues as industrial development, research, and education.
- *South Africa*: Three separate scenario exercises on the future of apartheid in South Africa built on each other and involved business groups, government officials, labor, and the political opposition, with the results presented to the general public.

COMMON ACHIEVEMENTS OF THE EIGHT SUCCESSES

In one way or another, all eight of these experiments created a widening debate which changed perceptions and thinking in a significant way. They also facilitated long-term thinking, shifted the geographical boundaries of the imagination, and enabled people to recognize the uncertainties around them without losing hope. In each of these examples, those involved also came to share a common language and understanding of the world they live in and the tasks they are confronting. This made it much easier for them to function creatively and collaboratively in a time of rapid change and considerable insecurity. Finally, in each of these examples the process is continuing, having created a dynamic that is either self-sustaining or has had the effect of inspiring others to pursue similar work.

Strictly speaking, not all eight were directly concerned with economic development: several are more accurately described as experiments in developing the capacity for political agreement. Nor were all eight examples organized around a comprehensive scenario study of the future social and economic environment in its broadest meaning. Yet, in their use of collaborative processes and their concern for redefining issues of wide public importance, they are appropriate examples of emerging forms of political agreement.

Another striking feature of all eight is that contrary to the notion that "politics drives out learning," each example has managed to put learning at the center of politics.

COMMON PATTERNS IN THE EIGHT SUCCESSES

Although these eight stories come from widely different parts of the globe and have been motivated by very different circumstances and needs, they follow surprisingly similar patterns, which we have organized by phases: "Beginnings and Initiations," the "Full Swing," and "Spinoffs and Continuations."

Beginnings and Initiations

- Taking a personal risk
- Drawing on personal networks
- Non-governmental lead, but government partners
- Endorsement of respected figures - leadership from the top

Most of our eight successes began roughly between 1989 and 1991, all involved someone taking a personal risk who then drew on his or her own personal networks for support. Most began outside of government structures, but drew in government partners, and all required the endorsement of respected figures from either the public or private sector.

While the wider uncertainties of the times might explain why so many of these experiments began in the last five years, they do not quite explain why, in all eight, someone took a personal risk to begin or lead the exercise. In each case, we found a single individual who decided it was time for a new approach, or took on the risk of implementing such an approach in his organization. "You must be willing to take personal risk to get things moving," said SIFO's Bo Ekman in November 1993. However, these individuals did not set out to work alone. Instead, they first contacted people they knew who would be open to a new approach. In Connecticut, Wick Sloane of Aetna phoned the man he had campaigned for in state politics; in Brittany, Josef le Bihan of the Institut de Locarne contacted the people he had taught in business school or knew from other areas of his work; others took similar initiatives.

In five cases, people from the private corporate sector took the lead. And in four of these instances, the corporate sector provided the first financial support. In a sixth case, a private Canadian institute - the Institute for Research in Public Policy, comparable to the Brookings Institution in Washington, D.C. - took the initiative. But in all six private sector initiatives, government was quickly drawn into the process as a key participant and sometimes as a financial supporter.

The important role of the private sector in both business and voluntary organizations raises a variety of issues. First, many people believe that governments are constrained by electoral cycles from thinking long-term about complex problems. The lack of thought has forced others to protect their own interests by taking a lead on issues normally seen as the competence of government. This does not mean that people have been seeking to replace government. Quite the contrary: government has consistently been drawn in as a vital partner. But participants have wanted to reopen and refashion political space so that new solutions could be found. Simultaneously, financial and ideological reliance on the state to solve social and economic problems has declined. In response, businesses have been increasingly asked to help: the private sector now provides more leadership than it did when solutions to public problems called for state intervention exclusively.

Another important feature of all these cases is that a respected figure or institution has endorsed the process and given it legitimacy. This endorsement has come from both private sector and public sector leaders. In Connecticut, the politician's backing was critical, since he was in a position to say, "If you agree on a solution, I can implement it," a promise largely accepted and believed by participants. In other cases, however, the endorsement came from the private sector. In South Africa, a subject that had previously been taboo, the future of apartheid, was first brought into the open by Harry Oppenheimer, head of the Anglo American Corporation. Not even a repressive government in South Africa would silence a business leader whose personal stature is legendary and whose company controls a large part of the South African economy.

The Full Swing

- Building support
- Gathering the right people
- "Inform yourself" - "Know yourself"
- Using outsiders
- Clear tasks, schedules, and deadlines

There were many common features about getting these experiments up and running: the need to gather support, to involve good people, to engage in shared learning, and to set a good pace of work with clear goals and deadlines.

Building support included raising finances and gaining administrative approval. Instead of the slow slog encountered by many voluntary efforts, in most cases fundraising seems to have been the logical consequence of having decided to respond to the first call, the initiative of the individual. In this sense, it was simply the backing of a commitment that had already been made. It still took some time, as did the process of administrative approval: six to eight months in the case of the Canadian Round Table.

In all eight examples an effort was made to involve the right people. The word "right" actually has several meanings here. One concerns the quality of individuals - choosing people with ideas, imagination, and the ability to work collaboratively. "Look for good people," we were told; "Create a network of people who can continue to work together." Choosing the right people also means ensuring that all stakeholders have an opportunity to participate in the discussion. This was an important aspect of the Mont Fleur scenario exercise in South Africa. The 22 people on this team were not only multidisciplinary in their training, but also represented nearly the entire political spectrum in the country. Choosing the right people can also have a less formal meaning. In the Rijkswaterstaat it meant interviewing not just top level management, but managers two or three levels below the top. And it meant talking with both "club thinkers" and eccentrics in the organization, as well as seeing that the voices of both older and younger generations were heard.

This process of finding the right people was dynamic and renewable. As the work expanded, as new questions and issues arose, new people were drawn into the discussions and exercises others had begun.

The next step involved learning. "Inform yourself" and "Know yourself" were the watchwords at this stage of activity. Becoming informed included attending seminars about the external world or specialized topics, studying books about useful working tools (such as *Getting to Yes* by Roger Fisher and Bill Ury), gathering relevant statistics, and identifying people with useful knowledge. "Knowing yourself" included interviews with relevant people, sharing deeply held views, writing "future biographies" of your own career from the perspective of your old age, or simply (in the case of groups in conflict) shouting until the noise died down. Both kinds of learning - about the outside and the inside of one's own issues - have been important in these experiments.

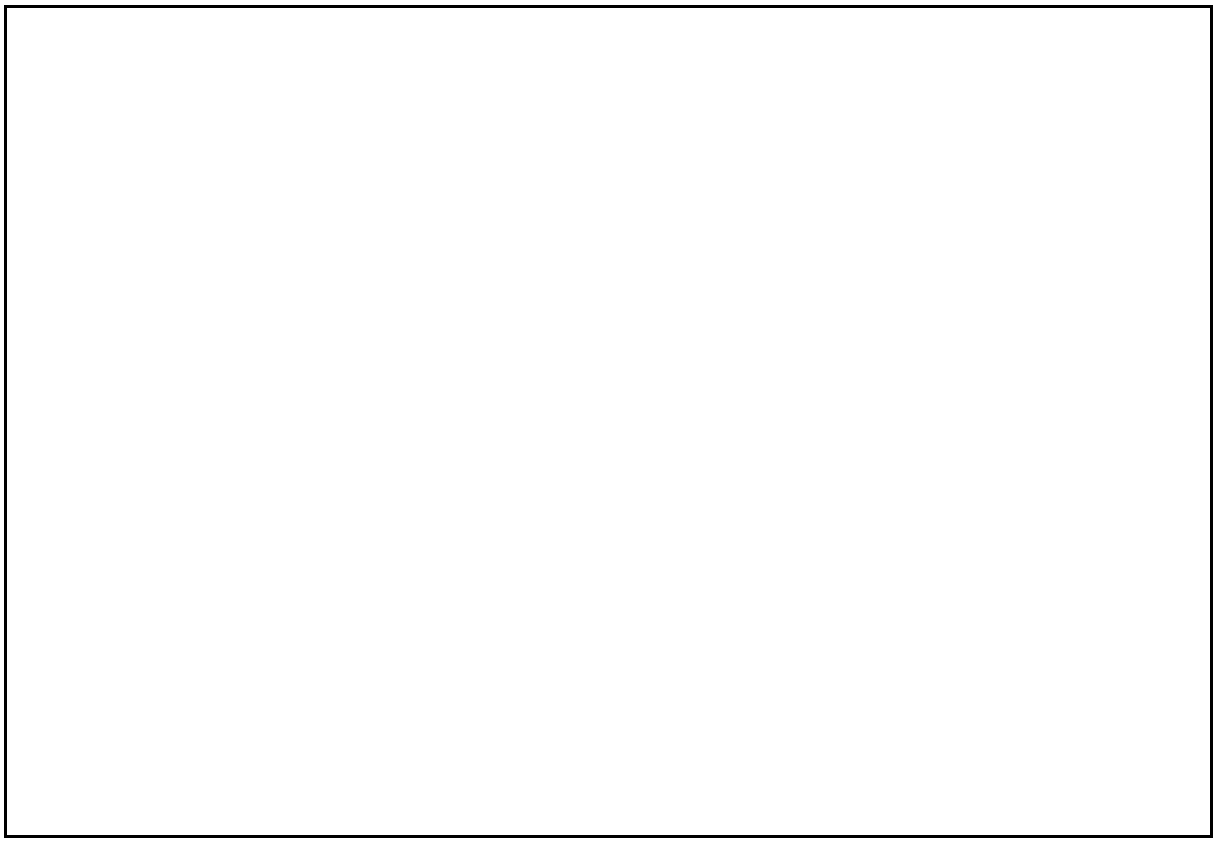
All eight experiments also used outside advisors or facilitators - people who had managed such processes before or who had specialized knowledge in particular fields. These outsiders not only kept the discussion from becoming too introspective, but brought a degree of neutrality and professionalism to the proceedings, since their own personal interests were not directly at stake.

Finally, all eight involved some combination of regular meetings, high information content, clear goals, and deadlines to create and sustain the momentum of shared intensive learning. The pacing created by regular meetings was important, since without regularly scheduled work and accomplishments interest in the process might have been lost.

Spinoffs and Continuations

In the absence of any statistical measures of success, we agreed on one simple criterion: does the process continue? All eight of our successes are still functioning in one form or another, and the results for each one are described in this section. The spinoffs and continuations have taken a variety of forms, which we have roughly captured in the matrix diagram of Figure 4.

There are a number of pathways through this matrix. One, represented by the oval, is simply to continue the original debate among the original participants by deepening the discussion among them. However, it has also happened that the original group has moved on to explore new issues. Some of these discussions have then progressed further towards concrete actions and the early stages of new institutions - labeled here as "Frontier Outposts." Alternatively, the debate may have continued on the original issues, but with new audiences. In some cases, this broadening of the debate to new participants has been taken into the mass media, especially television. This necessarily alters the form and process of the discussion, but serves to take ideas which had not circulated beyond a small number of people into a wider audience. Another spinoff of these experiments has been their imitation, where the process itself has been taken and applied by new participants to new problems. Both the narratives (see Appendix) and our diagram show that none of these experiences has simply come to an end; all continue to explore new frontiers of understanding and action.



NEW POLITICAL PROCESSES AND CONTEMPORARY POLITICS

Not only did each example demonstrate the role of leadership and individuals, the importance of shared collaborate learning, and the ability to move forward in new directions, but in some cases the exercises have even led to new institutions. It is therefore tempting to suggest from these eight experiences that we are witnessing the birth of new political forms and social institutions. We must stress, however, that these are, for the most part, ad hoc initiatives, created in response to difficult and uncertain times. To what extent they will evolve into something other than transitional vehicles remains to he seen. In considering the possible evolution of this kind of exercise - which is not limited to these examples, but can be found elsewhere as well - this last section will consider the relation of this approach to some of the existing features of Western democratic systems.

Who Is This For?

In September 1993, I asked Clem Sunter, who had led the Anglo American scenario study of South Africa, about using scenarios in Scotland. His immediate response was, "Who is this for?" and identified three possible audiences: policy makers, groups in conflict, and what he called "the road show," or a more popular audience.

In our eight examples, the principal client in every case has been policymakers, with wider audiences being reached more gradually. The definition of policymaker has, however, varied from one circumstance to another. In the Canadian example and the Rijkswaterstaat, it was senior civil servants and senior managers. In South Africa, if we look at the three scenarios exercises as a single process, the work began with the senior managers of major businesses, expanded to draw in members of government, and later included members of the principal opposition parties. In each exercise, the initial work was directed to the leaders of organizations, but was later broadcast to a wider public. The third exercise, the Mont Fleur scenarios, was also a good example of an exercise involving groups in conflict with each other.

A similar pattern of moving from a policy leading group to a broader audience can be seen in the two Swedish examples as well as in the Institut de Locarne and Silicon Valley. In these cases, leaders from key groups in society - government, industry, academia, and trade unions- participated in collaborative discussions, with the media being used at a later stage to involve a wider public. In Silicon Valley, the working groups were also open to anyone. Thus, even before television was used, more popular voices could be heard and incorporated into the thinking. This wider democracy also influenced the approach taken in Connecticut, where policy makers were defined to include both those who had historically formed policy and those who had been subject to such policies. In that sense, the Connecticut experience could be described as the most "radical" in traditional political terms.

Role of Press and Politicians

In several Western democracies the press appears to function as a self-appointed opposition to whatever government is in power, a role that may well have increased popular distrust of government, politicians, and the press itself. Many people feel that both journalists and politicians have failed to define contemporary issues in a realistic and credible fashion and failed to find appropriate means to address those issues successfully. It is therefore not surprising that our eight examples demonstrate a certain ambivalence towards both of these mistrusted, but influential elements in society.

In our eight examples, the press and politicians each played three different roles:

Press

- absent, or non-interfering
- use the medium, not the messengers
- as publicists and partners

Politicians

- ignored or surrounded
- asked for endorsements or ratification
- involved as partners in full

These roles run from one that ignores both groups to one that treats them as full partners in the process. This variety reflects the fact that both the press and politicians are still powerful, despite the disillusionment of the public. Since both are capable of destroying any collaborative work that gets done, it makes sense to include them constructively wherever possible.

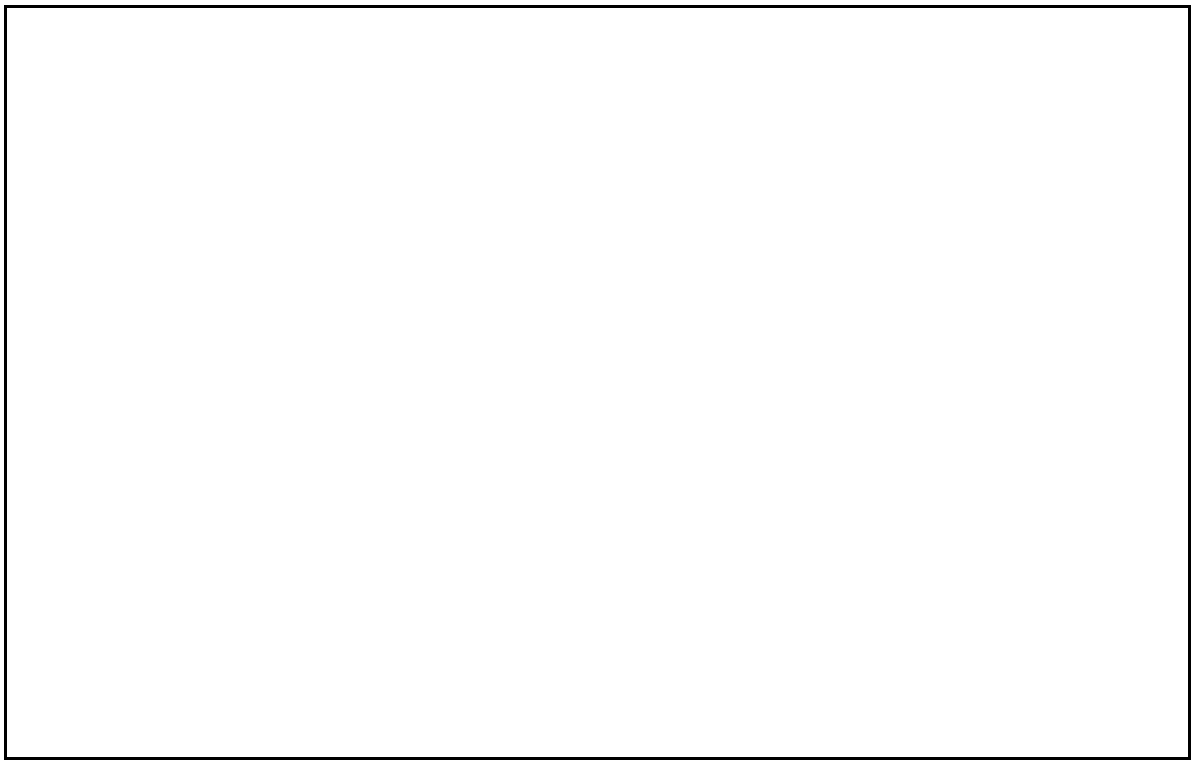
Furthermore, given the inclusive style of all eight successful exercises, it is likely that the partnership model is the one that will be developed further. Steve Ellis, Director of the African Studies Center at Leiden, the Netherlands, and an astute political commentator observed of politicians that "if you don't include them, you lose."

A Creative Stew

As shown in Figure 5, at least four strongly flavored ingredients are stewing in the political pot right now:

- A *theoretical need* to redefine the nature and process of political agreement in order to build a new social and economic system.
- Growing *evidence of process* revisions like those described in this paper. One person we interviewed in Washington said that this kind of thing "is happening a lot more than people think...but people think of it differently."
- These experiments are taking place at a time when *government at all levels is mistrusted* and believed to be, if not the whole problem, then certainly only one small part of the solution.
- These shifts in the political ground are occurring while the *existing rules of the political game* are still in place and still functioning, however imperfectly.

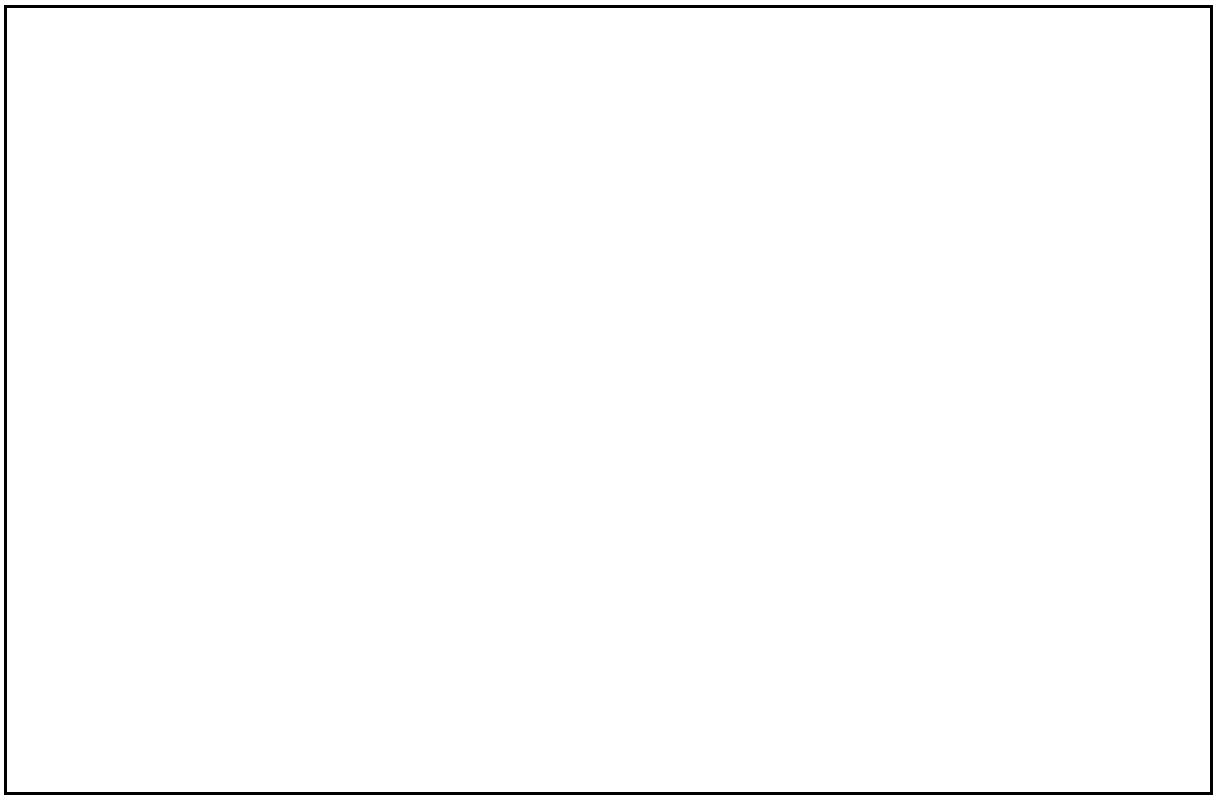
These four ingredients create a tension between emerging political processes and the existing rules which is likely to confuse and perplex us for some time to come.



Deeper Paradoxes of an Evolving Political Process

However, this tension is more than simply a struggle between the old and the new. There are some revealing. - even troubling - paradoxes in the experiments we have described which force us to question both the legitimacy of our eight quite exciting examples and the merits of existing constitutional agreements. A few of these paradoxes appear in Figure 6.

- **Inclusive/Elitists**. These experiments have sought to be inclusive of representative interests and ideas, but have also been elitist in seeking to choose the best people to include.
- **Spontaneous/Long-Term**. These groups have also been formed *spontaneously* but are seeking to work on issues concerning the long-term future of their regions and societies.
- **Volunteers for the General Good/Self-Selected for Self-Interest**. All of our examples also show people giving up their time in order to work *as volunteers for the general good*. Yet, it must be recognized that this voluntary participation also means that individuals are *self-selected for self-interest*. Indeed, if people's own hopes and ambitions were not involved it is unlikely that they would participate so willingly.
- **Mistrust of Grand Ideas/Search for Useful Ideas**. Perhaps because of this acknowledged personal interest on the part of those involved, these groups show a great *mistrust of grand ideas* and theories. This also reflects a natural reaction to the failings of both the purely communist and capitalist ideologies. The lack of an intellectual structure, however, has led to a more pragmatic *search for ideas*. The pragmatism is quick and flexible, but may not always have an intellectual coherence.



Finally, at least two directly constitutional points force us to question the geographical basis of our representative democratic structures.

- **Interest Group Constituencies not Traditional Geographical Constituencies.** Those who participated in these experiments have usually not represented geographical areas, but may represent a body of learning, a business interest, or a social group (like the unemployed) that is entitled to claim some attention from the wider society. As such, our political experiments have been based on *interest group constituencies not geographical constituencies*. This approach recognizes that complex problems must be addressed from several perspectives simultaneously so that an integrated response can be designed. It is less about dividing up existing resources than about learning to use those resources in a coordinated way.
- **Large Issues/Small Spaces**. Finally, all these experiments have concerned *large issues*, discussed in *small spaces*: a county, a region, a state, a government department, etc. Even where a national issue has been involved - the future of South Africa, Sweden, or Canada - the conversation first took place within a small self-defined group of people gathered together in a single room. Again, this limitation may be necessary if complex questions are to be understood from multiple perspectives, since in difficult times such an understanding can only develop first among people who have learned to trust each other.

CONCLUSION: POLITICS, TRUST, AND ECONOMIC DEVELOPMENT

Relevant Academic Research: Making Democracy Work

That raises a final, vital issue: the importance of trust in times of great change. I am indebted here to research by Robert Punt and his colleagues which was recently published in a book titled Making Democracy Work. [*4] This study began about 20 years ago when the Italians decided to decentralize local government and granted to all the Italian regions the same budget and the same responsibility for providing local services. Punt and his academic colleagues realized this was an ideal opportunity to study one of the perplexing questions of political science: how much is the effectiveness of any government determined by the roles of the game? Would they be able to see any appreciable change in the effectiveness of Italian local government following decentralization?

What followed was a rare longitudinal study of government. Briefly summarized, the researchers found that government everywhere did become more effective, but that the northern regions were more effective than the southern ones. They then looked for some explanation of the difference -political philosophies, wealth, education, etc. Only one correlation stood out: areas that had a large number of civic associations - mutual societies, trade unions, choral societies, football clubs, and the like - had more effective government.

In seeking to understand the importance of civic associations, Punt and his associates built an argument around the role of associations in creating trust.

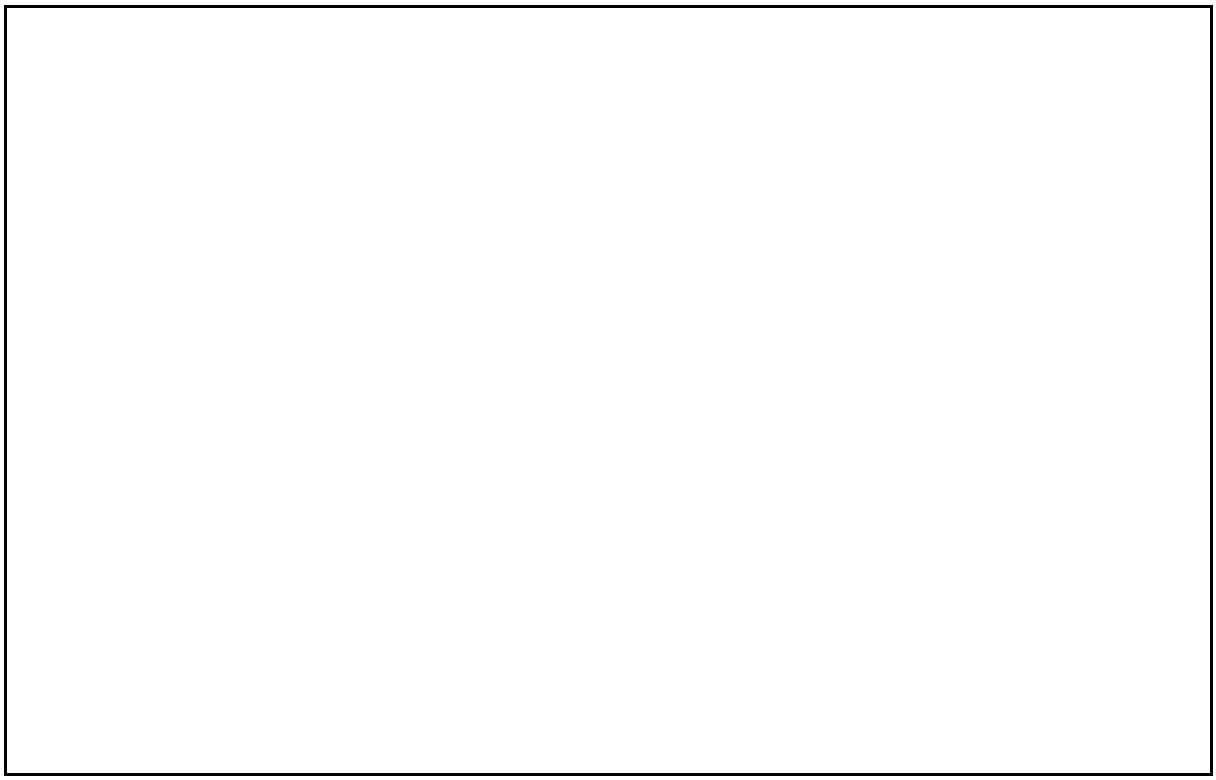
As people work together voluntarily to accomplish a specific task (organizing a football league or training a choir) they come to know each other and build up a level of trust based on experience and observation. The relationships formed in one society are then multiplied in a network of relationships with people in similar societies, creating a strong web of xperience, acquaintance, and trust. This trust is then provided, abstractly, to more distant.

In a more hierarchical society, however, the basic metaphor is not a web, but a maypole (see Figure 7), where each political relationship is based on the patronage accepted and offered between a strong individual and his or her followers.

The lines of trust in this system are vertical, not horizontal. As a result, when men gather in the village square looking for a day's work, they do not league with each other to find or create better opportunities for themselves. Instead, they compete with each other for the attention of the patron handing out the day's jobs. Instead of depending on a network of interlocking relationships, one's support is dependent on attracting the attention of one's patron in the hierarchy.

This record of effectiveness in government, built on a culture of civic associations and a network of knowledgeable relationships, had one important additional distinction: it was not only associated with more effective government; it was also, in the twentieth century, associated with more prosperous economies. If that correlation is more than accidental, then Putnam's research is particularly important in the context of the experiments in political process we have just described.

[*4] Robert D. Putnam, with Robert Leonardi and Raffaclla Y. Nanetti, *Making Democracy Work: Civic Traditions in Modern Italy* (Princeton, NJ: Princeton University Press, 1993); a GBN Book Club selection for August 1994



Final Thoughts

This essay began with a discussion of economic development and the underlying need for social and political foundations that included the capacity for political agreement. We then discussed eight experiments in political processes which were working, in a novel fashion, to develop that agreement around complex public issues and areas of conflict. While all eight were effective at creating such agreement, they also threw up a number of political paradoxes: inherent internal contradictions as well as fundamental departures from existing political frameworks in democratic societies. However, in Putnam's framework, these experiments can also be seen as civic associations creating networks of trust which may prove to be particularly suited to the complex social economies of the twenty-first century.

Since doing our research in 1993, we have been hearing of more and more experiments in political process similar to those we have described here. They all seem to have been born of a sense of frustration with existing political institutions and a hope that more effective mechanisms for understanding public issues can be found. But at this point, how they will develop is anyone's guess. Over time, these informal experimental groups could degenerate into new political factions or crystallize into secretive, self-selected guilds of people who have declared - like medieval burghers - that they know what is best for society at large. Alternatively, they could be the precursors of a more articulate democracy: one where information is shared widely and used to develop responsible decisions about public goods, rights, and requirements. Historically, there are probably more examples of fracturing factions and rigid oligarchies than there are of widening democracy. And yet, it is possible to imagine that political processes which are organized around the two requirements of "know yourself" and "inform yourself" could create capacities for political agreement that will help to redefine our society and economy for many years to come.

APPENDIX: THE EIGHT EXAMPLES IN DETAIL

Connecticut: "Getting toYes"

In Connecticut, the state government had failed to pass its 1989-90 budget and the political discussion was increasingly polarized and unproductive. At that point, Wick Sloane, an executive with Aetna Insurance in Hartford (the state capital) and a GBN WorldView member, telephoned Tom Ritter, a state legislator. Wick suggested that negotiation and meeting techniques developed in the business world might be used to address public issues. Because a neighboring state, Massachusetts, had nearly come to blows over "redlining" (banks' refusal to mortgage properties in poor neighborhoods), they decided to test Wick's proposal on the question of mortgages in pour neighborhoods of Connecticut. Tom Ritter chaired the state banks committee and also represented the city of Hartford, so he saw the problem from both sides.

Together they arranged for five meetings between bank managers, neighborhood activists, Tom, and Wick. They hired a professional facilitator to run the meetings and sent all participants two books: *Getting to Yes*, which is about negotiating techniques, and *How to Make Meetings Work*, by David Strauss and Michael Doyle. These were the tools the participants would use. After considerable mistrust and hesitation in the first meeting, participants were thrilled with their own success and "high" on the experience by the third session.

A common language had developed, legislation to increase information about mortgage lending had been passed, and considerable conflict had been avoided. The process was so successful that it was used again on other issues, most notably by Tom Ritter, who was elected Speaker of the House and used facilitated processes in his own party to get agreement on a state budget one month before the 1993 deadline.

Canada: Governing in an Information Society

In Canada, Steve Rosell organized a dinner for senior civil servants in the Canadian government and presented a paper, "Governing in an Information Society." Steve had been in the Canadian cabinet office for many years, but was working with the Institute for Research into Public Policy. He was not at all certain what reception he would get to his paper, but the response was tremendous. The conversation continued quite late, and six to eight months later, Steve had established a round table discussion where the issues he had first raised could be more thoroughly explored. The original mandate for this work was for two years, but it was recently renewed and there is now a waiting list of people who would like to participate. In July 1993, the Round Table developed scenarios of Canada's future, drawing on the learning they had done in the previous two years.

Brittany: Institut de Locarne

The Institut de Locarne in Brittany, a rural area of northwest France, was begun by Josef le Bihan. Josef had been both a Green Beret in the French army and taught strategy at one of France's leading business schools. Several years ago he returned to Brittany and formed a club of local businessmen to look at ways they could improve the regional economy. They decided to form the Institut de Locarne and turned to Edouard Parker, among others, for advice. Edouard has been using scenario work for many years to help clients understand political risk in their overseas investments.

His scenario work led to the identification of two possibilities for countries seeking economic growth: "Colombianization" - a form of anarchy and disorder - and the "High Road," in which high economic growth meets social aspirations in a virtuous circle.

Edouard Parker had also identified roles for successful economic development - which he calls The Ten Commandments. He has now given several series of seminars for members of the Institut de Locarne and others in the region. His work has helped them define what they can do in Brittany to improve their own economic position and has brought a global view of economic developments to local businessmen. In February 1994, the Institut de Locarne opened its doors to a locally focused business school based in one of the poorest villages in the center of Brittany.

The Netherlands: Rijkswaterstaat

The Rijkswaterstaat is a two-hundred-year-old organization in the Netherlands known in English as the Ministry of Transport, Public Works, and Water Management. For years it had been planning its activities the way engineers would plan the assembly of sufficient bricks to build an old-fashioned viaduct - as an exercise in ordering materials to specification which arrive at the appropriate time. However, managers were increasingly dissatisfied with this approach as they realized that values and expectations for their work were changing in society around them. They therefore decided to initiate an experimental scenario exercise among the senior management teams, who were described as the "key strategists" of the organization. This was largely an internal exercise for a major infrastructure bureaucracy in the Netherlands. It also represents some of the leading thinking in scenarios and organizational learning, as well as being an example of the use of scenarios by a public sector organization.

Silicon Valley Joint Venture

In the Silicon Valley, Jim Morgan, Chief Executive Officer (CEO) of Applied Materials, called a lunch meeting of other chief executives in the region. They were concerned that businesses were leaving the area and that they were not maintaining the quality of life many had moved to Silicon Valley to find. They launched a public/private partnership to consider the future of Silicon Valley. The companies contributed $1 million, the Stanford Research Institute was commissioned to write a study of the Valley, including scenarios, and within a year and a half the process had begun. A number of task forces were assembled to look at particular social, business, and infrastructure issues, and by March 1993 each task force presented its ideas to an assembled board of public and private sector leaders. Fourteen of these ideas were chosen for further development and there are now groups looking for ways of promoting these initiatives.

Sweden: SIFO Multiclient Study

This exercise was begun by Bo Ekman, the President of SIFO, a Swedish consultancy firm in Stockholm which has long used scenarios in its work. Several years ago, Bo became convinced that Sweden was facing a crisis and began by delivering a talk to the clients he knew. They decided to share the cost of a multiclient scenario exercise about the future of Sweden. This work eventually included representatives from local government and from some of the trade unions.

As the work was finished, the group decided it should receive wider publicity and arranged with Swedish public television for a day-long program on a Sunday in April 1993. It was watched by one million people, half of whom viewed it for over an hour. Another program, broadcast in November 1993, was also a great success. The team is now assembling a Group of Eminent Persons to take things another step further.

Sweden: Södermanland County Administration

Södermanland is a rural county south of Stockholm. This work began in 1987 when Peter Eklund of the county administration began holding a series of seminars. This led to a Structure Sketch for the Year 2010, a scenario study involving many different interest groups in the region, to examine the best layout of a high-speed railway infrastructure between Sweden and the mainland of Europe. Gradually, more and more people were involved in this work, from both surrounding counties as well as from other government bureaus and local industry. Peter's teams have also undertaken and led similar work on the development of industry in the region and on the research and educational resources of the area. This is the oldest, continuous exercise in our group and the only current example led by a government body.

South Africa: Scenarios of the Future

This example is really three scenario exercises. However, each one built on the one before, so they are considered as a single experiment. The work began in 1983 when Harry Oppenheimer, the head of the Anglo American Corporation of South Africa, asked Edouard Parker to present his 1976 scenarios for South Africa. Anglo had already begun to develop global scenarios, but this was the first look at the more volatile environment of South Africa itself. Following Edouard's presentation and a week of discussions, Clem Sunter (now head of Anglo's Gold Division) was appointed to develop a set of South African scenarios for the company. He worked closely with Pierre Wack, the man who had first introduced scenarios to Shell. When these scenarios were finished, Clem spent another year giving presentations to members of the government and anyone else who asked for a talk - whether these were radical groups in Soweto or ladies clubs in the Kahroo.

In 1990, following President de Klerk's speech unbanning the African National Congress (ANC), two financial houses, Nedcor and Old Mutual, decided to develop a new set of scenarios. They called on the advice and help of Clem Sunter and others involved in the earlier Anglo American work. Although it began with a focus on the financial sector, it gradually drew in many members of the business community and government. This workwas also widely presented to both government and opposition groups in the country.

A year or two later, another group was begun at the University of Cape Town to develop scenarios that would reflect the thinking of people from outside the business community. While the first two scenario exercises had involved considerable academic research, this work was very different. Here, the various groups in conflict in South Africa met at Mont Fleur and everyone proposed the scenarios they thought or hoped might develop. This gave people a chance to express their own visions of the country's future. Eventually, with facilitation by GBN associate Adam Kahane, 30 stories were winnowed down to nine, which were further refined to four very powerful expressions of how South Africa might develop. [*5]

More recently, many other localities and groups in South Africa have begun to develop scenarios of their own.

[*5] The Anglo American and Nedcor-Old Mutual Scenarios are described in: *South Africa: Prospects for Successful Transition*, Bob Tuckey and Bruce Scott, eds. (Kenwyn, South Africa: Juta & Co., 1992); and two books by Clem Sunter: *The World and South Africa in the 1990s* (Capetown: Human & Rousseau Talelberg, Ltd., 1987); and *The New Century, Quest for the High Road* (Capetown: Human & Rousseau Talelberg, Ltd., 1992). *The Mont Fleur Scenarios*, a newspaper supplement published by the Weekly Mail and the Guardian Weekly (Bellville, 1992), is available from GBN.

2.2.4. The Need To Alleviate Palestinian Fears Of A Dry Peace

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INTRODUCTION

Much has been written about water in the Middle East especially during the past few years. Most of the writings focused on hydropolitics and tended to create a hydrophobic environment towards the subject. Many speculate that the region's next war will be fought over water. Others focused their efforts to assert whether the water situation is acute, severe, chronic or catastrophic. Few went beyond that and offered a wide array of solutions to solve the water "crisis" ranging from peace canals or pipelines from Turkey, Yugoslavia, Lebanon, Egypt to medusa bags, icebergs, desalination etc. The regional parties met in both official and unofficial capacities to advocate the need for solving the water issue and included several aspects including joint management, data exchange, human resource development, enhancing water supplies, water conservation, equitable utilization, water banking, reallocation of water and prevention of environmental degradation.

After all these meetings and negotiations, the gap in the positions among regional parties is still as wide as ever. The region's hydrologists and politicians are still talking on different wavelengths. In the coming few pages, we shall muddle in the waters of the Middle East focusing on the Israeli-Palestinian dimension in light of the recent political developments. We realize that water is a particularly critical, as well as emotional, point of dispute for both Israelis and Palestinians. We also strongly believe that finding a common understanding of water issues in the Middle East would go far to enhance the possibilities of achieving stability in the region. Conversely, failure to reach consensus will, most definitely, obstruct any efforts to attain this goal. We realize that many will find this article provocative, but patronization and sweet talk will not solve the inequity in water distribution, allocation and usage among the regional parties which threatens the sustainability of the peace process. Neither will fantasies and hydrofictions.

The Hydro-geological setting

Topographically, Israel and Palestine are characterized by three zones: (1) a coastal plain which rises up to 200 m above sea level, and stretches from northwest of Israel to Gaza; (2) a limestone mountain ridge, reaching elevations of up to 1000 m, most of which lies within the West Bank; and (3) the Jordan Rift Valley, located on the eastern rim of Israel and the West Bank, which drops to almost 400 m below sea level. Palestine and Israel have Mediterranean climates, which are characterized by dry summers and cool wet winters. On average, 70% of total annual rainfall falls in December, January and February, of which 75% of rainfall is immediately lost through evaporation (Isaac & Selby, 1996). Highest rainfall is recorded where the land rises from the coastal plain, and on the mountain ridge's western rim. The eastern highlands and the Jordan Valley are rain shadow areas.

Table 1: Water Flow in the Various tributaries of the Jordan River System

Source or Body of Water	Average Flow (mcm/y)
Hasbani River	157
Dan River	258
Banias River	157
Upper Jordan River	640
Jordan River outlet from Lake Tiberias	538
Yarmouk River near confluence with River Jordan	475
Wadis on east side of Jordan River below Lake Tiberias	123
Wadis on west side of Jordan River below Lake Tiberias	145
Jordan River at Allenby Bridge	1250
TOTAL	**3743**

Source: Main, 1953

Surface Water

The Jordan River international drainage basin offers precious water resources to all its riparians: Palestine, Israel, Jordan and, to lesser extents, Syria and Lebanon. The chief headwaters of the Upper Jordan are the Dan, Hasbani and Banias Rivers, which rise in Israel, southern Lebanon and the Golan Heights respectively (Table 1). These sources feed Lake Tiberias, below which the lower Jordan flows into the Dead Sea. Hydrologically, Lake Tiberias is the major regional water reservoir in the international Jordan River basin. It has a storage capacity of 4,000 mcm and receives an average annual replenishment of about 840 mcm from the Upper Jordan, local runoff, adjacent springs and local rainfall. The Yarmouk River is also an integral part of the Jordan River international drainage basin. Its headwaters join the Jordan River 10 km below Lake Tiberias. In addition, a number of minor tributaries and springs in Jordan, Israel and Palestine feed the lower Jordan and the Dead Sea, from which there is no outflow. Figure 1 shows a map of the Jordan River basin as well the various surface water sources that contribute to the Jordan's discharge.

Figure 1: Sources and Consumers of Water Resources in the Occupied Arab Territories and Israel

Source: Modified after USIS, 1991

Groundwater Resources

Groundwater is the most important source of fresh water supply in the area and consists of the main aquifer systems that are located and recharged from rainfall in the West Bank. The annual rainfall in the West Bank is estimated at 2,597 mcm. Around 600 mcm of this rain is estimated to infiltrate the soil to replenishes the aquifers annually. The remainder is lost either through surface runoff or evaporation.

The system of aquifers under the West Bank comprises several rock formations from the Lower Cretaceous to the Recent age. The system is divided according to flow direction into the following three units:

- The Western Basin which is the largest and has a safe yield of 350 mcm per year;
- The Northeastern Basin which has an annual safe yield of 140 mcm; and
- The Eastern Basin whose safe yield is 125 mcm per year.

The West Bank aquifers vary spatially in the quantities and quality of groundwater they yield. The hydro-geology determines the spatial distribution, quantity, quality and extraction cost of ground water. The Western and Northeastern basins contain two aquifers, while the Eastern basin contains six. In each case, aquifers differ in their depth from the ground surface and in the quantity and quality of water they contain. In these aquifers groundwater flow is dynamic, always moving down the anticline that constitutes the mountain range. Groundwater that is not extracted from an aquifer flows through that aquifer either leaving the system through springs or by entering an adjacent aquifer system.

The Gaza Aquifer

Gaza Strip receives an annual average of 325.7 mm of rainfall, totaling over the Strip's area to 117.25 mcm per year (Table 2). The groundwater system is composed of a number of sub-aquifers made up mainly by Quaternary sands, sandstones and pebbles. The annual capacity of Gaza's aquifers is estimated around 65 mcm.

Table 2: Fresh groundwater balance of the Gaza Governate (1995)

Inflow Component	MCM/Y	Outflow Component	MCM/Y
Average recharge by rain	21	Domestic abstraction	32
Recharge from wadis	0	Irrigation abstraction	40
Groundwater from Israel	7	Industrial abstraction	1
Return flow (domestic)	13	Settlements abstraction	6
Return flow (irrigation)	18	Groundwater outflow	2
Brackish water inflow	20	Evaporation in ay area	0
		Drop in groundwater table	-2
Total	79	**Total**	79

Source: **Ministry of Planning and International Cooperation, 1996**

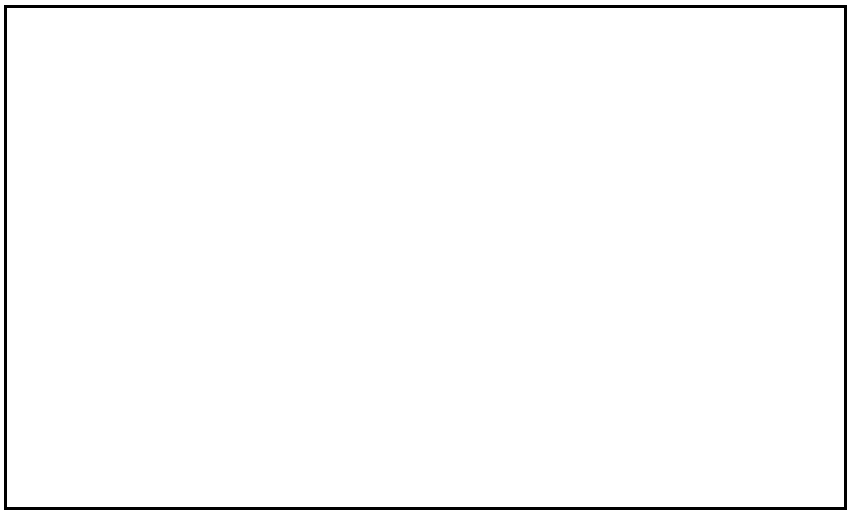
THE ROOTS OF THE WATER CRISIS IN PALESTINE

Water allocations

The riparians of the international Jordan River Basin are Lebanon, Syria, Palestine and Jordan. At present, Israel has control over the major part of the Jordan basin waters (Figure 1). Through its control in southern Lebanon, Israel is able to limit Lebanese exploitation of the Hasbani River. Through its occupation of the Syrian Golan Heights, Israel controls the Banias River and minor eastern tributaries of Lake Tiberias. Israel siphons 470 mcm of its waters off at Lake Tiberias into the Israeli National Water Carrier and another 450 mcm are siphoned by the Israelis, Syrians and Jordanians from the Yarmouk River, leaving the downstream Jordan but a fetid trickle. Redirecting the greatest part of the Yarmouk river to the Eastern Ghour canal and pumping the rest to Lake Tiberias resulted in a major drop in lower Jordan. Palestinians are denied their rightful shares of the water in the Jordan River as riparians.

Following the 1967 occupation, Israel applied stringent policies that prevented Palestinians from fully exploiting the West Bank's groundwater. These included the expropriation of wells belonging to absentee owners, denial of granting permissions for new wells, and imposing rigorous water quotas. Figure 3 shows the current extraction from the West Bank aquifers.

Figure 3: Extraction of Water from Groundwater Basins in the West Bank



Ground water in Gaza, which is estimated to have a potential of 65 mcm per annum is the only source for fresh water. At present, more than 100 mcm are pumped from these shallow aquifers which resulted in the gradual invasion of seawater into Gaza aquifers (Table 2).

The current allocation of the shared water resources in the region are not the outcome of agreements, negotiations or equitable principles. Rather they reflect the asymmetries of power in existence and the abilities of the strong to impose their wills on the weak. The full control of Israel over the headwaters of the Jordan River has led to the reduction of the Arab water shares in the River basin far beyond those that any rational allocation system consistent with basic international law governing transboundary resources would entitle them to. Israel has restricted Palestinian water usage and exploited Palestinian water resources.

Presently, more than 80% of the Palestinian water from the West Bank aquifers is taken by Israel, accounting for 25.3% of Israel's water needs (use). Palestinians are also denied their right to utilize water resources from the Jordan and Yarmouk Rivers, to which both Israel and Palestine are riparians. West Bank farmers historically used the waters of the Jordan River to irrigate their fields, but this source has become quite polluted as Israel is diverting saline water flows from around Lake Tiberias into the lower Jordan. Moreover, Israeli diversions from Lake Tiberias into the National Water Carrier have reduced the flow considerably, leaving Palestinians downstream with only effluent.

Water in the Peace Process

It is now five years since the initial peace conference at Madrid was inaugurated. Upon Israel's insistence, the peace process was divided into two tracks namely the bilateral negotiations and the multilateral talks. The bilaterals were intended to lead to peace treaties between Israel on one hand and each of the regional parties, namely Jordan, Lebanon, Palestine and Syria on the other. The multilateral track was intended to complement and support the bilateral track by promoting regional cooperation. A special working group was established for water resources in the multilateral negotiations.

So far, a peace treaty has been accomplished between Israel and Jordan in which the water dispute between the two states was resolved based on mutual recognition of the "rightful allocations" of both parties to the Jordan and Yarmouk Rivers as well as the Araba ground waters. The agreement allows for the use of Lake Tiberias for storing Jordanian surplus rain flows from the Yarmouk and to be redrawn during the summer. It also maintained the right of Israeli farmers to draw water from the Nubian sandstone aquifers from the Jordanian territory in the Araba. Israel and Jordan are now working on constructing two dams in the lower Jordan River Basin. There is no doubt that this bilateral agreement will not be a substitute for an integrated and comprehensive one that should include all riparians to the Jordan River basin.

On the Israeli-Palestinian track, water was one of the major sticking points in the negotiations leading to the signing of the interim agreement (Oslo B) in Washington D. C. in September 1995. Water is referred to under article 40 of Annex 3" Protocol concerning Civil Affairs." The first principle in the article dealing with water and sewage states that " Israel recognizes the Palestinian water rights in the West Bank. These will be negotiated in the permanent status negotiations and settled in the Permanent Status Agreement relating to the various water resources." There is no doubt that this may be considered as a historical breakthrough as it is the first time that Israel has recognized the Palestinian water rights. While the agreement did not go into the details of the Palestinian water rights, the use of the term "various water resources" in the second sentence is very significant. For the Palestinians, they define their water rights as follows:

- a fair share of their riparian rights in the River Jordan basin
- a fair share of the Western and North Eastern Aquifer
- full rights in the Eastern aquifer storage and fishing rights in the lake of Tiberias
- full right to the Gaza coastal aquifer

While this recognition is a very important step forward, the second and third principles in the agreement attempt to undermine the significance of this issue by talking about maintaining existing utilization and recognizing the necessity to develop new resources, tacitly accepting that more water is needed to satisfy the needs of both populations. The agreement states that " all powers currently held by the civil administration and military government relating to water and sewage will be transferred to the Palestinians, except for those specified as issues for the "final status negotiations." Nevertheless, the Israeli authorities have not transferred the authority of the West Bank Water Department to the Palestinian Water Authority until now. Work on the agreed upon drilling of new wells to meet the needs of the Palestinian community are stalled. So far, the Palestinians in the West Bank and Gaza have not seen the translation of this agreement to water in their taps, but are witnessing sever water shortages.

PALESTINIAN FEARS OF A DRY PEACE

There is a growing fear among Palestinians that the Israeli government is not serious in its peace aspirations. Israel has not implemented its commitments stipulated in the interim agreements, while at the same time, it is continuing its unilateral steps of swallowing more Palestinian land for settlements and bypass roads. There is very little that the Palestinian layperson can point out to indicate visible fruits of the peace process. Over the past three years, the GNP per capita in Palestine declined by 30 % and unemployment rose to record levels of up to 40 %. Restrictions on movement and closures are becoming the norm rather than the exception. In the field of water, the peace process did not translate into continuous supply or additional waters in the taps. On the contrary, water shortages especially during the summer months are exacerbating. While the PWA is doing its utmost to rehabilitate the water infrastructure, its efforts are being impeded by Israel's practices. The Herodion, Ramallah and Jenin wells that have been agreed upon in OSLO II are still not operational.

The Palestinian bureau of statistics have just completed the population census which revealed that the total Palestinian population in the West Bank and Gaza strip including Jerusalem is 2.8 million persons. This figure is far beyond the estimated figure which the Israeli authorities used to float. Based on the new figures, it becomes apparent that on average, a Palestinian is allocated less than 25 cm of water for domestic and industrial purposes annually. This means that Palestinians need immediately an additional 70 mcm of water per year in order to bring the domestic consumption per capita to 50 cm per year which is the minimum requirement for basic water needs. This also shows that the 9.5 mcm of water which Israel agreed to provide the Palestinians according to Oslo II are simply too little.

The basic problem is that Israel so far has refused to approach the water conflicts with its Arab neighbors in an integrated manner. Israel's strategy is to strike a separate deal with each of its neighbors without any consideration to the geohydrological nature of surface and groundwater basins.

Since Israel is holding all the water cards in its hands, it is using this tactic to ensure that it will have the overall control and responsibility for managing the water resources and providing its neighbors with certain quantities of water that are agreed upon. Certainly, such an approach is neither acceptable nor sustainable.

Israeli policy on final status issues has begun to be debated publicly during the past several months. This marks a change, as the delineation of Israel's territorial demands had not been openly debated before. Regrettably, the outcome points toward the peace process being transformed from negotiations between two parties to an internal Israeli debate with the goal of determining unilaterally the land areas they choose to retain and the areas they might return to the Palestinian people.

These Israeli deliberations have primarily taken place via three distinct but related maps: the Allon-Plus Map devised by the Israeli Inner Ministerial Cabinet; the Security Interests Map devised by the Planning Branch of the Israeli Defense Forces; and the Sharon Map devised by the Israeli Minister of Infrastructure Ariel Sharon. Although only the Allon-Plus Map has been published, on 4 December 1997 the Hebrew-language newspaper *Ma'arev* printed a map detailing the common areas between the three. This strategic combined map reveals the basic land scheme that Israel would propose as a final status solution during the upcoming negotiations. In addition, a hydrostrategic map was printed in the same newspaper which is very similar to the strategic combined map. None of these maps address the situation in the Gaza Strip.

- *Israeli Proposed Final Status Maps*

The Security Interests map was submitted for Israeli cabinet discussion by the Israeli Defense Forces (IDF) Planning Branch nearly one year ago. An initial version of this map was prepared at the request of the late Prime Minister Rabin during the Taba talks in September 1995. Similar to the Allon Plus map, this map leaves 40-45% of West Bank land to the Palestinian Authority and divides it into three disconnected areas separated by colonies and areas under Israel Defense Force (IDF) control. According to Israeli Minister of Defense Yitzhak Mordechai unspecified 'special arrangements' would be made for the approximately 45 of the 196 West Bank Israeli colonies remaining in the Palestinian Authority areas. The Sharon map allows for the Israeli annexation of between 64-70% of the West Bank. All Israeli colonies would be included in a specially devised security zone and additional areas would be slated for their expansion. The Hdyrostrategic map, published in the Israel *Ma'arev* newspaper on 4 December 1997, outlines Israel's strategic groundwater interests. A large portion of the West Bank, mainly the Jordan Valley and the Eastern Slopes, are not even designated on the map and thus presumed to be completely under Israeli control.

- *Implications of the Strategic Combined Map*

Common areas between the above described maps are represented in a strategic combined map made public on 4 December 1997. According this map, 60.5% of the West Bank is to be placed under Israeli control and 39.5?% is to be designed for the Palestinian Authority. This 39.5% is divided into three separate and distinct cantons. The Jordan Valley, the 'food basket' of the West Bank, is completely out of Palestinian reach, as are the Eastern Slopes which serve as natural grazing areas and host hundreds of endemic flora and fauna species. No free and unencumbered access is provided between the southern canton and the northern two cantons.

Absolutely no sustainable and integrated development of Palestinian infrastructure could take place, essentially rendering a Palestinian state physically unattainable and unsustainable.

In regard to the issue of water, under such a final status situation Palestinians would not only be left with their water rights undefined and therefore, in essence, non-existant, but they also would not have access to enough water for domestic, agricultural or industrial uses. Again, this proposed scheme deprives Palestinians of their own natural resources which are crucial to building a sustainable future. For example, Palestinians would have no physical access to the Jordan River Basin even though they are riparians of this international water system. Under the Johnston Plan of 1955, a West Ghour canal was to be constructed to provide Palestinians with their rightful share from the River Jordan. The vast majority of West Bank Palestinian wells fall within the areas designated for Israeli control, according to the strategic combined map. It is expected that those wells remaining in Palestinian controlled areas may continue to be subject to current Israeli imposed drilling restrictions. All of the approximately 58 Israeli groundwater wells which serve Israeli colonies will remain under Israeli control, as even those located in areas to be returned to the Palestinians lie within the boundaries of Israeli colonies.

However and perhaps most importantly, it is critical to point out that such a final status proposal directly contradicts the Oslo II Interim Agreement, as well as international resolutions, namely United Nations Resolutions 242 and 338 and the principle of land for peace. One should reiterate here that the Palestinian leadership has rejected even discussing these maps.

LOOKING AHEAD

While in principle, the resolution of the Middle East water allocations and disputes will be based on the principles of international law, there is no mechanism for this issue to be institutionalized. If the issue of water allocation continues to be addressed with an eye for might rather than justice, Palestinians will remain the thirsty partner to an unjust peace. And, as is so often pointed out, an unjust peace is no peace at all. It is clear that the question of controlling the region's waters is basically related to various perspectives of different parties to their 'legitimate national rights'. As a matter of fact, all parties involved in the region's confrontation over water invoke a variety of legal principles to establish their claims: first-in-use equals first-in-right, customary or equitable utilization, absolute sovereignty, beneficial use, basic justice and fairness, good neighborliness, prior use, etc. In making their claims, these parties are merely selective, so that each riparian in the conflicted basin chooses the legal principles that buttress its claims. This raises questions about the explicitness/ambiguity of international law in respect to settling disputes of this kind. Actually, there is at this time no regular system of a binding international law that can supply clear-cut principles (rules) for resolving the situation of conflict between nations that share water resources. This is particularly true when the shared resources of water are subterranean.

Now with conflicting parties finally negotiating a lasting and sustainable political solution, the question of the egg and the chicken is being increasingly raised: which should come first, consensus over the use and control of the region's vital water resources or settling the area's political contention? Since the two issues are utterly inseparable, it is believed here that the two questions should be addressed simultaneously on parallel tracks.

After all, a political settlement should involve the question of distributing the waters available to the region over its inhabitants, and an agreement on the use and distribution of the region's waters would, most certainly, enhance the chances for ending the region's political confrontation.

To alleviate Palestinian fears of a dry peace, the following steps are needed:

- Israel to freely provide Palestinians with water data. It is regrettable that although Israel committed itself to such an undertaking, it has so far done very little.
- Israel to immediately satisfy Palestinians needs for water. Assuming

  that a Palestinian immediate water demand per capita to be 50 CM, then the Palestinians should be allocated an additional 70 MCM per year.
- Israel should lift the restrictions imposed on Palestinians to utilize the land and water resources especially in the Jordan Valley. Israelis and Palestinians should start working immediately clearing the heavily mined areas in preparation for the future. The international community is asked to assist in this task.
- Israel, Jordan and Palestine need to start the process of constructing the West Ghour Canal which was agreed upon by the Johnston plan.
- The international community need to start the process of building a basin wide regional authority for the Jordan River basin. All riparians need to be involved. I hope that this workshop will initiate such an important step.
- A mechanism must be established to ensure that negotiations on Palestinian water rights between Israelis and Palestinians take off seriously. So far, there has been no progress on this front and it appears that Israel is attempting to impose its will on the Palestinian.

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2.2.5. Models For Private Sector Participation In Water And Waste Water

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BASIC MODEL OF WATER INDUSTRY STRUCTURE

In considering the basic institutional structure of the provision of water and waste water services, three fundamental questions need to be addressed:

- is the delegation of obligations and powers to provide water and waste water services done by statute or by contract?
- are the boundaries of the areas served based on political/administrative (e.g. municipal) or geographical (e.g. river catchment) principles?
- how is the provider of water and waste water services regulated for price and quality?

STATUTORY OR CONTRACTUAL

If the water industry in a given country has a statutory model, then the obligation for the provision (i.e. the actual carrying out) of services is given by law to a particular agency or company for a defined geographical area. If the model is contractual, then the public sector body with the legal responsibility for the provision of services can (if it chooses) delegate all or part of that responsibility by way of a contract to a private sector company. In Great Britain, the basic model is a statutory one. In England and Wales, the law (by way of Act of Parliament and Licence) delegates responsibility to ten large regional water and waste water service providers which are now private. There are also several other smaller private companies which only provide a water service. In Scotland, the law delegates this responsibility to three large publicly owned regional water and waste water authorities. In France by contrast, the basic model is contractual. Each municipality may delegate by way of a contract to a private sector service provider all or part of its service obligations.

BOUNDARIES OF SERVICE AREA

In many countries around the world, the basic provider of water and waste water services is the municipality. It may be possible for several smaller municipalities to combine together for the provision of such services in order to achieve some economy of scale. In Germany such an association of municipalities is called a Zweckverband (ZV) and such ZV's have a defined legal status. In Belgium, municipalities may combine to create a publicly owned (intercommunal) company with semi-private sector legal status.

In other countries the basic provider of services is a large regional organisation which may serve hundreds of thousands or even millions of people and where the boundaries of the area served are largely independent of the political and administrative boundaries. In England and Wales, the boundaries between what are now the large water and sewage companies were originally decided on the basis of river catchment basins and not on the basis of administrative boundaries. For example, the company Severn Trent plc derives its name from the two large rivers in its area.

REGULATION

Regulation of price and quality of water and waste water services is a key topic. This service is a classic natural monopoly and as such needs careful regulation. There are many regulation models around the world in use. For levels of service (i.e. quality) it can often happen that there is little formal regulation other than the expectations of the public. Water is sometimes regarded as a foodstuff and is regulated by the ministry of health on a reactive basis. Sometimes it may be encompassed in the ambit of an environmental protection agency. For price of the service, it is perhaps inevitable that moral suasion will play a part but it is not the classic model to create a fully independent price regulator of water and waste water services. The establishment of such a regulator was perhaps one of the key elements of the privatisation of the English and Welsh water industry in 1989. In many situations where the municipality is responsible for delivery of the service, the price regulation will be determined on the basis of a mayoral decision. In other situations, especially where the private sector participates, use is made of a price formula which may be one of several options e.g.:

- rate of return
- price cap
- cost based etc.

In order to obtain PSP on a contractual basis where the private partner can be able to evaluate the commercial risk he faces, a formula approach is needed to give clarity for several years to come.

In many of the formally centrally planned economies, the nature of regulation of both levels of service and price have not been finally settled. It can happen for instance that several government ministries have roles to play in regulating the water sector and it can also happen that these roles can conflict and cause unnecessary pressures on the service provider.

DRIVERS FOR PRIVATE SECTOR PARTICIPATION (PSP)

Some of the key drivers to cause a government to consider the use of PSP include:

- need for future capital investment and the desire to fund this not from public sector resources; access to capital markets
- independence of the service provider to manage the provision of services
- achievement of operating efficiencies
- financial independence and self-sufficiency.

It is probably not too much of an exaggeration to say that almost all large regional water and waste water service providers in the formerly centrally planned economies are under pressure for all the four headings above. However, in the rush to privatisation, it can easily be forgotten to address all of these points, all of which are fundamental to a successful PSP.

PRE-REQUISITES FOR SUCCESSFUL PRIVATE SECTOR PARTICIPATION

In summary of the foregoing, the following could be said to be pre-requisites for a successful PSP in the water sector:

- creation of an independent method of regulation both for price and quality issues
- correct identification of the key drivers for PSP and addressing them in the model for PSP chosen
- addressing the main issues affecting the wider consequences of the involvement of PSP in the water sector including issues of monopoly, water as a merit good, economies of scale, externalities and excludability.

RANGE OF OPTIONS FOR PRIVATE SECTOR PARTICIPATION

- **Flotation or trade sale of full water and waste water utility**

If there already exists a water and/or waste water utility company which is reasonably well, even if there is scope for improvement, there is the potential simply to privatise this in the sense of selling it as a going concern. In order to achieve such a situation, the following steps (which do not have to happen in the order shown) are *de minimis* required:

◊ regionalisation
◊ corporitisation
◊ commercialisation
◊ incorporation and privatisation.

This is the process that was followed by the English water industry. Ten large water authorities were established in 1974 by devolving the legal obligation to provide the service from the municipalities to the authorities. In one step, the water industry was regionalised and corporatised. Over a period of 15 years, these water authorities became more efficient but were subject to constraints being part of the public sector. It was judged that by 1989, they have become sufficiently commercial in their approaches that they could be incorporated as private companies and they were privatised by way of a public flotation on the London stock exchange. It is very important to note, that even in a mature market economy, the process for a realistic privatisation took a considerable period.

- **Mixed economy company**

An option for part privatisation is the use of a mixed economy company (typically 51% public and 49% private) as the service provider. This arrangement can retain many of the advantages of the public sector (e.g. cheaper finance) while being able to achieve some of the benefits of private ownership (e.g. greater operational efficiency). However, ultimately these remain public sector organisations. This arrangement has been used in France and also in Germany in recent years where it is known as the *Kooperationsmodell*.

- **Concession**

Under a concession arrangement, a contract is given to a private company by a municipality, typically for 20-30 years to provide water and/or waste water services. While the infrastructure assets nominally remain the property of the client, the concessionaire is required to carry out all the capital investment required to provide an adequate service. This arrangement is very well known in France and is increasingly being used in countries such as Spain and Portugal.

- **Build-Operate-Transfer (BOT)**

Where a specific piece of new infrastructure is required, it may be appropriate to consider the use of the BOT model. This is basically a concession, but where there is a new asset to be constructed and operated and a BOT contractor undertakes to design, build, finance and operate this new asset and to transfer it to the client, usually after 20-30 years. This arrangement is typically used as a project finance vehicle for individual plants to be constructed.

- **Affermage/Leasing/Utility Service contract**

Where a contractor is required to provide not the capital investment required but only the working capital investment (i.e. all the operation and maintenance of existing infrastructure as well as replacing infrastructure which becomes defunct during the contract), this contractual arrangement can go by the name *Affermage* in French which is often translated into English as Leasing contract. However, this term 'leasing' can often cause confusion with financial lease contracts. There is no generally accepted single term in English for this kind of contract, but in essence it is a utility service contract, with working capital investment requirements. The duration of such contracts (typically between a municipality and a private service provider) is in the region of 12 years or perhaps 15 years.

- **O&M contract/Gerance**

Under a full hands on operation and maintenance (O&M) contract, known in French as a *Gerance* (management) contract the private contractor provides all the staff and expertise required to run a system (typically a single treatment plant) but is not required to provide working capital investment. Widely used in France as well as the USA, the typical client is a municipality which itself does not have the expertise to run one of its treatment plant. Contracts are often about 5 years in duration.

- **Management Services Contract/Regie Interessee**

Under a management services contract (MSC), a private contractor provides the know-how and the managers to run a plant or system according to pre-agreed standards. However, the client provides the infrastructure, the finance and the staff. Payment is often on a paid input basis, not unlike consultancy. However, it is possible to base part or all of the contractor's payment on measurable results. In France this is sometimes a profit-sharing arrangement when it is known as *Regie Interessee*.

- **Outsourcing**

Another strategy for PSP which an existing water utility can opt for is to outsource some of its activities. For instance, it might be possible to give a contract for the service of meter reading or maintenance of the water distribution network. In this way the water utility can benchmark its own performance or simply achieve a cost reduction by introducing an element of competition into its activities.

- **Corporate Partnerships and Twinning**

Although strictly speaking not an example of PSP, the use of twinning or corporate development partnerships can be a useful precursor to PSP.

CONCLUSION

Once the basic drivers for PSP have been identified, the client should equip himself with the best advice in choosing and implementing the arrangement.

The above list is not exhaustive, but should provide at least a guideline for selection of a preferred option.

2.2.6. Efficiency of Water Use in Agriculture - A Crucial Factor of Water Equilibrium

Prof. Samuel Pohoryles

The Andreas Agricultural Development Trust
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INTRODUCTION

With your permission I would like to draw your attention to the Efficiency of Water Use and Development of New Water Sources and New Water Technologies. As you know, this topic is of major importance in the Middle East.

Within this framework, I will address three main subject:

- Structural readjusment of water use policy;
- The interaction between land water and technology; and
- Regional cooperation

STRUCTURAL READJUSTMENT OF WATER USE POLICY

I have in mind a structural readjustment of water use policy and technology of the dominant water consumer - agriculture, reducing the pressure of agriculture on the general water-population equilibrium.

This developmental emphasis is of course a built in component of three other revues of action. They are as follows:

- Political efforts or interregional cooperation, including cooperation between former enemies. We succeeded, together with Egypt to develop in agriculture a prototype of such cooperation with universal significance
- International assistance, and
- Joint Ventures.

The main conclusion of our analysis is that unless they drastically change the way they manage their water resources, the Middle East and North African countries will suffer from severe water shortages and economic decline in the next 30 years. The growing water shortage could lead to a vicious cycle of under development, to stagnant economic growth. The water crisis can be averted. If steps are taken immediately, water availability for domestic and industrial use could be increased by 50% and municipal water losses, now accounting for about 50% of supplied water could be halved in the next 10 years. The main steps are: increasing efficiency of water use, reducing pollution, controlling ground water extraction, recycling and reusing treated wastewater, securing alternative sources of water through import and at a later stage, affordable desalination.

The scarcest resource in the Middle East and North Africa is water and the overwhelming challenge is to increase the efficiency of water use. Scarcity of arable land and the severity of soil erosion and the indifference of many governments pose another major challenge. There is little investment in watershed management. Many of the regions' poorest people live in upper watersheds, eking out livelihoods from forests, rangelands and steppes and contributing to watershed degradation in the process.

Of all the regions in the world our Middle East region faces the most severe water shortage. With about 5 percent of the world's population, it has less than 1 percent of all renewable fresh water. The children of the great ancient great civilization, on the banks of great rivers - the Nile in Egypt and Tigris and Euphrates of Mesopotamia which built large irrigation systems, are required today by the history to reclaim their failed water supplies.

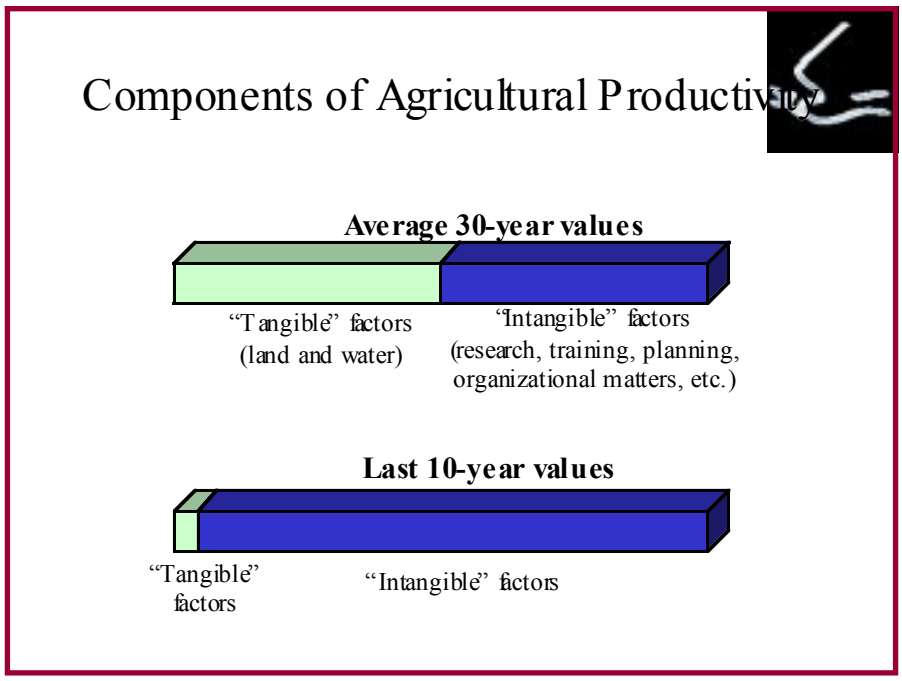
Irrigated agriculture accounts for over 70% of developed water use, contributing significantly to increase of yields and output. However, irrigation is extremely water intensive, using 1,000 tons of water for one ton of grains and 2,000 tons of water for one tone of rice.

If technological, institutional and organizational changes will occur here, accelerating simultaneously agricultural growth - as a *conditio sine qua non* to reach food-population equilibrium - reserves of fresh water will be released for transfer to human consumption, urban and municipal uses.

This could be done, creating a new "factor mix" in agriculture as a substitute for water as a physical category.

THE INTERACTION BETWEEN LAND, WATER AND TECHNOLOGY

It was agricultural technology - in its widest sense - that exerted the greatest influence on agricultural development in Israel, largely off-setting the problems of water shortage. Reference here is to mix of research agro-technology, genetic engineering extension and mechanization. All these raised the share of productivity not explained by water and land in Israel's agriculture, i.e. the share of what Hicks calls "neutral technological changes of productivity". This share in the first 20 years stood at around 50 percent of total productivity. Throughout the recent decade the intangible "factors of accumulated experience and research benefit" contributed 96 percent of total productivity rate, whereas the "tangible" factor contributed 4 percent only. This is an expression of high level of technology based on human capital and intellectual investment.

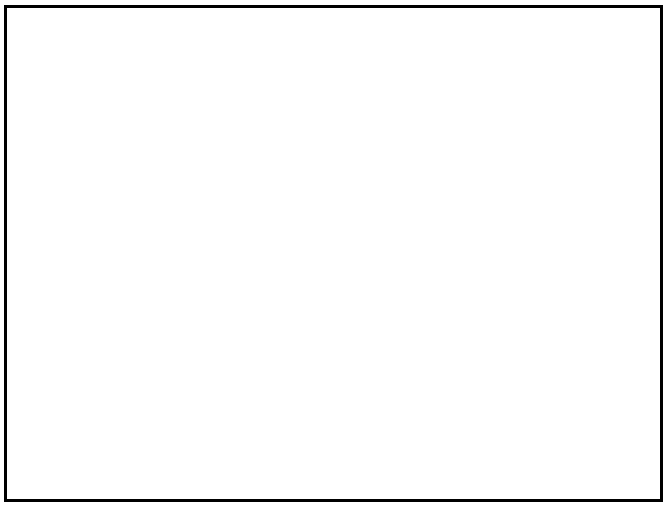


A sort of substitution was thus created between water, a tangible factor and the "intangible" productivity, which largely counteracted the basic constraints on land and water. The technology of water use is undoubtedly an integral component of any agricultural technology, and it encompasses a broad range of irrigation innovations (such as drip irrigation, irrigation equipment, technical adjustment of irrigation systems of particular crops).

The water quantity available for agriculture has been static or decreasing throughout the recent 18 years 1.0 - 1.2 billion cubic meters. Nevertheless, agricultural production value, in real terms, has gone up during this period 2.9 times, as a result of improved resources utilization and technological progress.

In the Negev desert we found a very interesting phenomena of disconnection between physical quantities of water and the level of farmer's income: A 10% reduction of water leads to 5.7% only reduction in net income. This result is a ceteris paribus result - which means a result in the condition of static technology.

However, it we suppose a more realistic approach of dynamic technology (improvement of mechanization, fertilization, more efficient organization, more adequate adaptation of crops to the relative advantage of the region) the income drop will be 1% only. This means a significant water-income disconnection. This is of course a very tangible expression of agricultural emancipation.

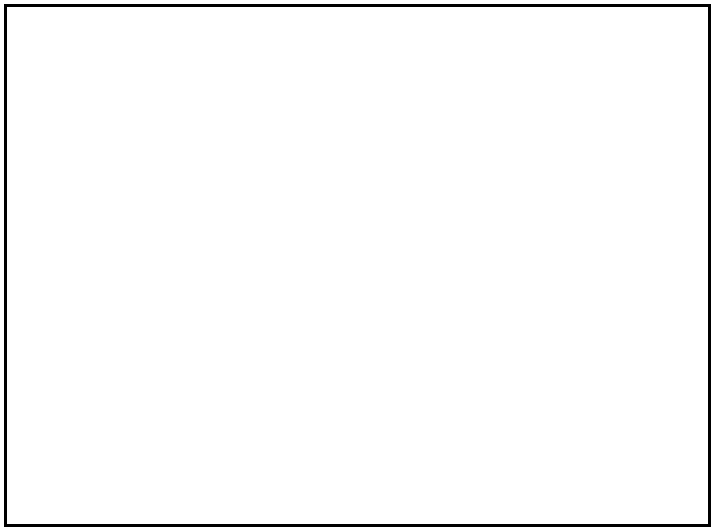


To achieve results such as these in a land burdened with a chronic water stress, it is crucial that a mix of technology, genetic engineering, agrobiology and management be substituted as much as possible for water. In this readjustment, the dominant role in agricultural development shifts from the natural production factors - and water. As explained before, in the last decade, "unexplained productivity" contributed to 96% of Israel's agricultural output, while natural production factors, land and water contributed only 4%. The results of this readjustment are tangible.

According to FAO experts, a desert area such as ours requires an entire generation - 25 years - just to double its agricultural output. However, sophisticated technologies made possible the intensive irrigated farming that increased Israel's agricultural production twelve-fold during a single generation, thereby poking holes in the classic Malthusian theory.

Physical, demographic and economic sources of stress are common to many countries of our Region. However, the difference is the dominance of agricultural use of water, mainly irrigation. However, some projections suggest that by the year 2025 domestic uses of about 100 litres per person per day (so called Minimal Water Requirements - MWR) plus municipal and industrial uses will require all the freshwater available, leaving non for agriculture in the countries of Lower Jordan (Shuval 1992, Assaf, 1993). Therefore, it is clear and unquestionable that apart of desalination - which is still very expensive - and import, the only way to improve the situation is to improve water efficiency in agriculture and shift in agriculture from low marginal to high marginal value output per cubic meter of water. This could be done through controlled environment system of cultivation including greenhouses, which the marginal output per m^{-3} is 3-4 times higher than the conventional one. This means a clear linkage with food market variations.

Finally this leads to a dramatic shifting in the agricultural water basket from fresh water to recycled water which will replace more than 50% of fresh water in Israel. Recycled water with primary treatment is restricted to non-food crops. Recycled water with secondary treatment can be used for crops that are eaten after cooking. Tertiary treatment permits to use water for all crops.



The main conceptual approach of the Middle East and the Mediterranean Desert Development Program is based on a unique developmental philosophy. This calls the less favored areas of the world to compensate their inferior natural constraints - such as desert infertile lands, water scarcity, soil erosion, salinity, etc. - through the gradual introduction of modern technologies. Such are drought and salinity resistant crops and livestock, controlled environment, post harvest systems, aquaculture, and so on. In this way, natural obstacles will be substituted by agro-technology and agro-high tech.

The compounded impact of such an approach will be a double one, anti-desertification in its essence, and food producing in its output. This approach will stop the spread of desertification, make the desert bloom, and increase the production capacity of foods.

A greenhouse unit, based on computerized drip irrigation, genetic varieties of crops, seedlings and nurseries, is part of a prototype of a controlled environment, as vital inter-branch integration expands the radius of modernization and development and its impact.

Integration of additional diversified economic activities: infrastructure, transportation, processing, tourism, etc. will enlarge the impact's radius and create a significant multiplying effect. In such a way a heterogeneous, multi-sectoral regional development project will be established, based on the agricultural and agro-technological primary initiative.

This approach is universal, inevitable and could be adapted in any region, focusing on its specifics and uniqueness through adequate substantial and modular adjustments. This development modality will replace the former homogeneous cultivation efforts and will facilitate the sustainability target. The program will place special emphasis on subjects relevant to conflicting parties by stimulating professional and institutional cooperation between former enemies.

Each region and ecosystem described below will be verified in detail after the first reconnaissance in order to prepare a plan of action. It is clear that this region will be of high priority for the Peres Center for Peace. The activities here include the Middle East and the Mediterranean Desert Development Program for Israel, The Palestinian Authority, Egypt, Jordan, Morocco, Tunisia, Qatar, Turkey, Oman and Bahrain. It was initiated in 1993 by Shimon Peres, supported by Vice President Al Gore and leaders of the region and administrated by the Fred J. Hansen Institute for World Peace in San Diego. A satellite mapping of water resources and land used and remote sensing is under preparation. The program was presented on the Casablanca, Amman and Cairo Economics Summits, is approved by the US Congress Appropriations House Bill signed by President Clinton, and is in its organization phase. The main subject of this program is Water Development.

Other considered projects in this region are linked to the establishment of regional projects of biotechnology and genetics, directed to arid zones development using modern genetic tools to develop new engineered plants in the region. On the Red Sea near Aqaba, oriented on improvement of marine resources for human purposes, increasing the food supply; and on the shores of the Mediterranean Sea near the Gaza and Egypt, based on aquaculture and genetic improvement of the yields.

A very important and tangible potential challenge for the region could be the decision of Deputy Prime Minister and the Minister of Agriculture of Egypt to create a Desert Development Excellence Center. It will be based on integration of the International training Center of Mariut with the Agro-industrial Complex of Mariut (Abou Masoud) into one multilateral entity for the Middle East Desert development which could also provide services to the New Nile Delta project in Upper Egypt. At the core of this ambitious project is a plan to take Nile water from Lake Nasser through a canal to an arid area of land with the agricultural potential of 3.3 million feddans (3 times more than the agricultural land of Israel). The Toshka Canal (which runs through the area of low land called the Toshka Depression) covering a distance of 310 km in the first stage will make an additional 5 billion cubic meter of water available.

This project could be of great interest to future Middle East desert development plans and integrates water development with regional settlement programs of university graduates on desert land.

REGIONAL COOPERATION

Our common ecosystem intrinsically demands the highest possible degree of cooperation among us who inhabit the area. Our comprehensive application of human inventiveness, our liberal exchange of know-how, and our joint efforts in extensive development projects can convert even desert into green, fertile fields. It is an ambitious goal, yes, but it can be achieved by mobilizing the available scientific, technological, educational and organizational resources.

Israel's experience has shown that arid and semi-arid zones can support a high level of agriculture - as high or higher than the achieved in temperate climates. In the context of regional cooperation, Israel can contribute several of the necessary components: seeds, semen and embryos of high genetic quality, tissue cultures, irrigation equipment and new varieties of desert-resistant crops and livestock. The natural and economic aspects of agriculture cannot be separated. Resources such as land and water must be integrated with human and technological factors. Agricultural development in an arid or semi-arid zone requires:

- Redistribution of the water supply
- Optimization of the factor mix through the selection of appropriate crops and the substitution of other inputs in place of water
- An institutional framework to develop and manage the resources of agricultural production on a planned, long-term basis.

Engineering ingenuity can overcome obstacles of distance and elevation - moving water from areas of relative plenty to those of chronic shortage.

Innovative agro-technology can come up with crop varieties, irrigation techniques and cultivation methods to maximize productivity.

Macroeconomic policy can give priority to overall sociopolitical considerations in the early years of development, but eventually should allow market forces and local management to be phased in.

An investment in a rational and responsive institutional system which enable the most efficient use of water supplies and agro-technological innovations while still achieving national objectives is no less important than is an investment in the resources themselves.

A comprehensive rural development, based on sustainable natural resources management, poverty reduction and food security, directed to less favorable desert areas, should be the main strategy of the Middle East and the Mediterranean Ecosystem Development.

The main criteria for classification of less favored areas, according to FAO Council Directives are as follows:

- Considerable limitations of the possibilities for using the land and an appreciable increase in the cost of working it
- Infertile land, low population predominantly dependent on agricultural activity
- Areas affected by specific handicaps and in which farming must be continued in order to conserve the countryside and to protect the coastline.

The multiplicity of defining criteria is mutually integrated: physical, demographic, ecological and economic - and each criterion characterizes a different type of less favored areas. The arid (and semi-arid) type of favored area is affected by all three features and seems to be the most complicated.

Heterogeneous Transformation of Arid Lands

In this sense, our model of activity should be a heterogeneous transformation of arid areas through compensation and natural constraints (infertile land and water shortage) by technology planning, drought and salinity resistant varieties, etc. In other words, creating a new factor mix, which will reduce the quantity of water per unit of production introducing into the desert contemporary agricultural technology and irrigation techniques. A clear linkage between desert development and human well being is crucial in all desert development programs due to the following:

- More than 1.3 billion people are compelled to live on less than one dollar a day
- More than 800 million people are hungry
- We can see a clear correlation between the hungry people and desert inhabitants.

Future increases in good supplies must come primarily from using biological yields rather than from area expansion and more irrigation. Land and water are becoming increasingly scarce. Most new lands brought under cultivation are marginal and ecologically fragile. Therefore, production on existing land will need to be nearly double, which means a significant agricultural intensification.

The technological challenge is enormous, requiring development of new high productivity environmental sustainable production systems. Environmental degradation must be reversed. Unsustainable agricultural practices are major contributors to non-point source pollution. Deforestation remains a critical issue, with 25 hectares of forest being lost every minute. The global changes of desertification, climate change and loss of biodiversity require major effects.

ADVANCED AGRICULTURAL TECHNOLOGIES OF THE 21ST CENTURY

Today, at least a dozen advanced technologies are having considerable impact on productivity in agricultural development in general, and in a desert ecosystem in particular:

1. Enhancement of photosynthetic efficiency, including: Improvement in carbohydrate formation through genetic selection, physical and chemical modification Enhanced nitro-absorbing capacity for protein synthesis Enhanced growth rates through elevated levels of carbon dioxide
2. Water and fertilizer management
3. Pest control
4. Greenhouses (controlled environment)
5. Multiple and intensive cropping
6. Reduced tillage
7. Bio-regulators (natural and synthetic compounds which regulate the ripening and aging of plants)
8. New crops
9. Bio-processing
10. Anti-transpirants
11. Plants resistant to drought
12. Embryo transplant, genetic improvement and multiple births in beef cattle.

THE ELEVENTH COMMANDMENT

This modality of development will lead to the Eleventh Commandment:

Thou shalt inherit the holy earth as a faithful steward, conserving its resources and productivity from generation to generation.
Thou shalt safeguard thy fields from soil erosion, thy living waters from drying up, thy forests from desolation and protect thy hills from overgrazing by the herds, that thy descendants may have abundance forever.
If any shall fail in this stewardship of the land, thy fruitful fields shall become sterile stony ground of wasting gullies, and thy descendants shall decrease and live in poverty or perish from off the face of the earth[*6]

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[*6] "The Eleventh Commandment" written and broadcast over the radio by Dr. Lowdermilk in Jerusalem during June 1939 was dedicated to the Palestinian Jewish villages whose good stewardship of the earth inspired the idea.

2.2.7. A Reevaluation of Conventional Wisdom on Water Security, Food Security and Water Stress in Arid Countries in the Middle East

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THE WATER RESOURCES DIMENSION OF SECURITY

The concept of security is moot and often vaguely defined. Those who subscribe to *political realism* in international affairs define security mainly as the capacity of a state to secure its safety and perceived national interests from violence or harm by means of such assets as: military power (projectable or defensive), population (size and competence), and vital resources (oil, ores, water, etc.) (Romm, 1992). Naff (1995) has pointed out that to give any degree of precision to the meaning of security one must always ask "Security of, from, or against what?" He argues that security fundamentally means being secure from harm or annihilation--being safe from something or someone that can damage.

While the conventional point of view often sees security issues strictly as ones having military dimensions, involving potential or actual use of armed force that might threaten a nations *stability, integrity or independence,* some political scientists would argue for a broader definition of security (Martin, 1998).

The concept is changing and evolving to include other forms of threats. These would include other less dramatic but no less threatening issues such as the loss, depletion or diversion of a nation's natural resources, including water resources, and threats to life and well being from transboundary water or air pollution or from radio-active wastes or accidents (Mathews, 1989; Gleick, 1990). This broader grasp of security issues might also include regional and global ecological threats such as the potential increase of the sea level and flooding of low lying coastal areas that might result from global warming, increases in exposure to cancer caused by ultra-violet radiation from the decrease in protection resulting from the depletion of the ozone layer and even the resulting regional and global instability and the possible collapse of the world economy and social system that might result from the global population explosion and the depletion of the world's natural resources. All of these may result in very real threats to a nation's, group of nations', or the world's, *stability, integrity or independence,* thus impinging on their *security*.

While conventional security threats are normally met by a nation's or coalition of nation's mobilization, initiatives and interventions of various kinds, mainly of a military nature, for these newly perceived, less conventional security threats, the interventions would be of a different nature. These security interventions might, for example, include an agreement between two countries on joint environmental monitoring and control of water pollution on a shared water resource or global initiatives to reduce CO_2 generation by negotiating international conventions limiting fossil fuel combustion. Even conventional definitions of security would normally include threats to vital water resources as among the potentially important dimensions of security.

Dr. Sandra Postel (1996) Director of the Global Water Policy Project has stated that "The increasing scarcity and diminishing quality of fresh water jeopardizes human security in four fundamental ways: through threats to food security, human health, ecological integrity, and political stability..." She has pointed out that " Tensions over water exist in three of major river basins in the Middle East-the Jordan, the Nile and the Tigris-Euphrates, and they are poised to develop in others. In addition tensions are likely to arise locally and regionally between different ethnic groups, societal classes, and water-use sectors within the same country as competition increases for scarce water and as water quality deteriorates."

In light of the above considerations and as a result of the widespread press and electronic media's highly dramatized coverage and even scare stories on *water wars* and global and regional water crises, the terms *water security* and *food security* give rise to deep emotional fears and reactions in the collective conscience of major sections of the population in most countries.

CONCEPTS OF FOOD SECURITY, WATER SECURITY, WATER STRESS,

Does "Food Security" Mean That Every Country Must Grow All of its Own Food at Any Cost?

A number of authors refer to the importance of *food security* (Falkenmark, 1992; Postel, 1997) although its exact meaning is not clearly defined. Some countries profess that their national agricultural and water resources policy is based on a concept of *food security* which dictates self-sufficiency in most food products as a matter of *national security*. They claim that this is necessary in case of a threat of a long term embargo, siege or blockade which would prevent food imports. A few oil rich, but water short countries have embarked on a program of seawater desalination and ground water mining by over pumping for intensive agricultural use on the basis of just such a "food security" policy. It has been reported that in part, the motivation of one such oil rich country, to initiate their program of "food security" based on desalinated water and/or severe mining of limited ground water, may have resulted from an unofficially reported statement by someone in one of the main oil importing countries, which also is one of the main wheat exporting countries, suggesting that there might be *a grain export embargo in response to the oil embargo* initiated by the oil exporting countries during the late 1960's. Such a grain embargo was never actually initiated.

It is not clear whether those countries who initiated programs to grow grains with desalinated sea water and by the rapid mining and pumping down of very limited ground water resources, to meet local grain demand, so as to achieve *food security,* carefully evaluated the alternatives for achieving the same goal. One alternative, might be to build cold storage warehouses and grain silos capable of storing most of the food requirements to meet periods of need, such as a food import embargo. The Bible records, that one of the Pharaohs of Egypt, on Joseph advice, did just that when he built grain silos to store food for seven year periods of drought, well over 3 thousand years ago.

It is indeed difficult to comprehend the rationale of those countries that built seawater desalination plants or deplete and destroy their ground water potentioal in a matter of years, to produce water for irrigation and to achieve the illusion *food security*, that now have become a major grain exporting country, at a tremendous cost to its weakened national treasury which subsidizes the grain. It is reported that one such country is currently deeply in debt as a result.

What about those less prosperous countries lacking in rich deposits of oil, or one time reserves of expensive "fossil" water, that do not have enough renewable fresh water supplies for such an illusion of self sufficient irrigated agriculture? Is it economically and socially rational or necessary, from a security point of view, to desalinate seawater so as to grow crops, including wheat for local consumption, when the actual cost of the locally grown subsidized wheat is 5 times that of the world market price? Is it rational for such a country to aspire to acquiring additional water resources through a confrontation or *water war* with one of its more water rich neighbors?

How Much Water is Required to Achieve Complete Food Security?

How much water is really needed to grow all of the food needs of an individual? A few selected examples from the FAO Production Yearbook (FAO,1989) of the water input required in liters/kg of water to produce various foods based on data from the generally water efficient agriculture of California are presented in Table 1 below:

Table 1: **Water input in various foods produced in California in liters/kg (FAO,1989)**

WHEAT	**1,273**
RICE	**2,005**
MAIZE	**978**
POTATOES	**147**
SUGAR	**2,731**
SOYBEAN OIL	**21,692**
BEEF	**16,193**
PORK	**5,760**
POULTRY	**5,730**
EGGS	**3,740**
MILK	**971**
BUTTER	**22,274**

The FAO has estimated that the total water input in the human diet varies from country to country depending, of course, on the consumption of food products that require very high water consumption per unit, such as meat, oil, and butter and the efficiency of the local agriculture, in water use in food production.

What follows are a few examples of total water requirement to supply the complete food requirements of an individual in m^3/person/year (m^3/p/yr) (FAO, 1989):

CALIFORNIA	**2,156 m^3/p/yr**
EGYPT	**1,540 m^3/p/yr**
TUNISIA	**1,082 m^3/p/yr**

From the above, it is obvious that those countries with a total water resources potential of significantly less than 1000 m^3/p/yr. can never approach total food self-sufficiency based on locally grown food.

Import of Low Cost *Virtual Water* in the Form of Food Staples

The modern, rational, economic approach to this question is that countries with little water should import what Professor Tony Allen of the University of London (Allen,1995) has termed *virtual water*. That is importing the high water consuming food they need, particularly the staples which can be shipped easily and stored for longer periods, from those countries with plenty of water from natural renewable sources and sufficient areas of arable land. Import of staple foods such as grains, dried beans, oil and even frozen meat and fish and their storage in local warehouses and cold storage facilities is a much more economical way of assuring an adequate supply of food while avoiding the irrational implications of the misguided goal of *local self-sufficiency in food* under the *food security* concept. The growing of limited amounts of fresh vegetables and salad crops for local consumption requires very little water per person. My own estimate is that with some 25 m^3/p/yr a country can grow most of the fresh vegetables and salad crops used locally.

What about those arid countries in the transition stage that cannot yet generate enough foreign currency to purchase their food needs in the world market? The international community should create institutions such as a *World Food Bank*, to assure that all countries, including the weakest of the those in the third world, are assured adequate food supplies from the reserves of the surplus food producers in the world. The water and land rich countries should be supplied with the motivation to assure that the world is supplied with a sufficient amount of low cost basic food to assure realistic global *food and water security*.

Naff (1955) has suggested a differentiation between "*Food Security*" and "*Food Sufficiency*": *Food security*, according to Naff, requires a guarantee of enough food to satisfy a population's minimal needs over a long period of time, a policy usually expressed as self contained, domestically produced sufficiency. In the water short areas of the Middle East, insisting on a national policy of *food security* often implies generating a perceived need to assure local irrigated agricultural production even if the country does not have sufficient local water resources to sustain such a policy.

While public policy insistence on assuring *food security* and *water security* may appeal to national pride and be politically popular, it has often resulted in the perception of unrealistic needs for greatly increased water resources. This often means increased demands for the reallocation of shared water resources from limited transboundary water resources and the resulting exacerbation of water conflicts. It has also led in some cases, as mentioned above, to the problematical production of expensive huge water projects or desalinated sea water for agricultural irrigation, regardless of costs and benefits. Naff (1995) correctly points out that the *food security* concept "in the arid Middle East will always be a wasteful and ill-fated policy".

"*Food Sufficiency*," according to Naff, on the other hand, only requires that there is on-going sufficiency of food for the needs and development of a society, attained chiefly *by trade*. *Food sufficiency* does require an economy that generates enough exports to cover the cost of the needed *virtual water* imports in the form of food staples. In the arid areas of the Middle East there is, in the long run very little alternative to developing the economy based on low water consuming industry, trade, commerce, and tourism which will provide employment and a higher standard of living rather than an economy based mainly on agriculture. Such an economy will be able to provide sufficient financial resources to import all the food required to assure for *food sufficiency*.

Under such an urban/industrial economy, the main needs for water are limited to that amount required to assure adequate supplies to meet all urban, commercial and industrial needs, with possibly some minimal amounts allocated to growing fresh vegetables and salad crops for immediate local consumption.

It is one of the fundamental premises of this paper that the concept of *food security* in the arid areas of the Middle East cannot be seen as a realistic one and can only lead to unnecessary increased conflict over very limited water resources or the irrational waste of economic resources, which in the long rum can lead to a decrease in security. Middle Eastern countries facing current and/or future severe water shortages must carefully consider the more realistic and less conflict arousing policy of *food sufficiency* as an acceptable long-term policy with important political, economic and security advantages. _____

The Debate Over the "Water Stress" Index of Falkenmark

The question of the amount of water required by peoples living in arid zones has been widely discussed and debated. Falkenmark (1992) has proposed the concept of a "*water stress index*" based on her estimated minimum level of water required per capita/year to maintain an adequate quality of life in a moderately developed country in an arid zone.

Falkenmark estimates that while only 100 liters/person/day (or 36.5 cubic meters/person/year (m^3/p/yr) are the rough minimum for basic household needs required to maintain good health, that a water efficient, and moderately developed country requires at least 30-45 times that quantity of water to satisfy all the requirements of agriculture, industry and energy production.

Thus, according to Falkenmark, a level of 1700 m^3/p/yr is required. She holds that when fresh water availability falls below 1,000 m^3/p/yr, countries experience "*chronic water stress*" and when countries fall below 500 m^3/p/yr, they experience "*absolute water stress*." Falkenmark's pioneering concept of "*water stress*" has been much debated and the numerical levels suggested have been challenged. However, a number of authorities including the World Bank (1992) have accepted the 1000 m^3/p/yr level as a benchmark which they claim can serve as a general indicator of water scarcity. Gleick (1991,1993,1994) has called it the "approximate minimum necessary for an adequate quality of life in a moderately developed country."

However, all of these authors assume that a major allocation of water is necessary for agricultural purposes both to supply local food requirements (*food security*) and/or assure employment for those who have traditionally lived in rural areas and made their livelihood from agriculture.

In some countries, in arid areas, such as Egypt, for example, where supplemental irrigation is required and sufficient water is still available, as much as 80-90% of the water supply is currently utilized for such agricultural purposes and some 70-80% of the population derive their livelihood from agriculture, directly or indirectly. Can this ratio of water allocation to agriculture continue as populations grow, along with rapid urbanization and industrialization, with the water resource potential remaining the same?

It is difficult to accept these concepts of *water stress* and *food security* as being politically sound, economically rational or applicable for the really water scarce areas of the Middle East. For the arid countries of the Middle East the concept of *adequate amounts of water* must be quite different than that of countries with plentiful amounts of year round rainfall, rivers for hydroelectric power production and transport, and copious sources of low cost water for supplemental irrigation.

The 1,000 m^3/p/yr year *benchmark* level supported by some authors from the countries with more temperate climates assumes that major amounts of water must be used for agriculture and food production. This may be fundamentally correct in that *some place in the world the water must be available to grow enough food for all of the population in the world.* However as pointed out above, it is a serious error to imply or suggest that each country can, should, or must have at its disposal enough water to be self sufficient in agricultural food production. This can and has led to irrational and often dangerous perceptions and demands concerning national water needs. This is the fundamental fallacy of the Falkenmark *water stress index or the World Bank's water benchmark.*

There are a number of Middle Eastern countries who are already well below the 500 m^3/p/yr level. Bahrain, Kuwait, Jordan, Israel, and Palestine are at, or are approaching, the 100-200 m^3/p/yr level (Engelman and Leroy, 1993). After *the urban and industrial demand is fully met, such countries will eventually have little* or no water left over for agriculture. With time that list will grow.

The question that must be asked is: Can countries facing such severe water shortages, whose main options for increasing water supplies are confrontations with neighbors over limited shared water resources or seawater desalination costing about $1.00/m^3, consider agriculture as an essential to their security or an economically rational way to use such expensive water? We have already pointed out that *food security* at any cost is an irrational societal and/or security option. Most experts agree that the growing of basic food crops with desalinated water can never be expected to be economically feasible, even if the cost of desalination is reduced by 20%-30% in the future to as little as $. 70/m^3. The experience today indicates the costs of such food can be as high as five times that of the same food staple on the world market.

When water is really scarce the first task from the point of view of real *water security* is to meet the needs for domestic and urban use as well as the water needed by commerce and industry, so as to supply employment for the population. In Jordan and other countries of the region, lack of water or irregular supply to urban areas has led to social unrest and political tensions and to water "insecurity." What then is the real minimum amount of water for community and national survival under arid area conditions?

THE "MINIMUM WATER REQUIREMENT" (MWR) FOR URBAN USE IN ARID ZONES.

A number of Middle Eastern countries are already facing situations under which the available water supplies are now sufficient only to support most of the population in urban settings where trade, commerce, tourism, and industry are the main sources of employment, similar to the situation in such water and land scarce places as Bahrain, Kuwait, Hong Kong and Singapore. As populations grow in the future, and the urban/industrial demands for water increase, the relatively limited quantities of water available for agriculture, whose economic return per unit of water consumed is relatively low, will, by the nature of things, be diverted to cope with the growing demands of the urban/industrial sector which can pay a much higher price for water. Unless water is supplied to meet these urban, commercial and industrial needs there is likely to be serious unemployment as well as social and even political unrest.

How much water is required for a reasonable standard of living to meet domestic/urban/ industrial demand? In the United States the USEPA reported that in 1981 (USEPA,1981) that the mean annual household water use was about 90 m^3/p/yr. A 1994 survey of 159 utilities serving the 100 largest metropolitan areas in the USA (Environmental Engineering News, 1995) found that the average water usage per month was 7000 gallons per household, which, assuming three persons per household, can be estimated as being equivalent to 310 liters/person/day or 114 m^3/p/yr for household use only. Total urban use including water for schools, hospitals, hotels, parks, commerce, and industry is about twice that figure, or about 180 m^3/p/yr. Some urban areas consume as much as 300 m^3/p/yr. In the areas of Europe which support a high standard of living, domestic / urban / industrial demands for water are lower than in the United States and range between 100-150 m^3/p/yr.

According to the Ben Gurion University/Tahal report to the World Bank (Braverman,1994), Israel's domestic/urban water supply consumption averaged in 1993 some 100 m^3/p/yr Industrial consumption averaged 23 m^3/p/yr. The report assumes that under proper conditions of highly effective programs of water conservation including the use of water saving devices in the home and water recycling in industry, urban/industrial water consumption in Israel can be held firm at its present level over the next 30-40 years or even reduced by some 10%. They also assume that Palestinian domestic water, which now averages some 35 m^3/p/yr will eventual rise to almost the same level as Israeli consumption.

Experience in Israel indicates that a high standard of life can be maintained with a domestic/urban/industrial water consumption of about 100 m^3/p/yr (Braverman, 1994) This has been achieved by water metering, charging for the full combined cost of water supply and wastewater collection and disposal as part of the urban water bill, punitive increases in prices for overly high, domestic water consumption, as well as public education on water conservation. Water conservation measures such as the introduction of water saving fixtures in the home, and requiring all industries to recycle cooling water and process water, wherever technologically feasible has contributed to this conservation conscious water consumption level. It has been estimated in Israel that this figure might possibly increase to about 125 m^3/p/yr within a 30 year period (Braverman, 1984)

In one study in the United States (USEPA,1981) it has been estimated that the potential water savings that would result from the rigorous introduction of optimal water saving devices in the home could be as great as 33% resulting in a mean household water use of 60 m^3/p/yr. For example with proper water saving devices the amount of water used for toilet flushing alone could be reduced by 50%, or by about 16 m^3/p/yr. These studies indicate that domestic water consumption can be kept low while maintaining a very high standard of living. The total urban/commercial water use would still reach a level of about 120 m^3/p/yr.

However there is the question of whether or not the urban population will have the economic motivation to invest in water saving devices if it is not required by law. The 1994 survey in the United States (Environmental Engineering News, 1995) found that the total average charges per household for water supply and wastewater disposal together was about $120/person/year. Thus, for example, in the United States the total charges for water are less 0.5% of the mean annual personal income and thus hardly an economic factor that might lead to a strong motivation for major water saving efforts in the urban sector. While this might also be the case for Israel with its high annual GNP/Capita, the high cost of urban water supply in the other countries on the Jordan Basin would most likely be a major factor keeping down urban water consumption or preventing it from rising rapidly. However, this may well change as the socio-economic conditions improve in the Middle East.

Nevertheless, the MWR proposed for consideration for the purposes of this study is a total of 100 cubic meters/person/year (m^3/p/yr) for domestic, urban and industrial use (Shuval,1992). In addition we propose that there might be a symbolic allocation of 25 m^3/p/yr of fresh, good quality water for minimal growing of fresh vegetables (such as in vegetable gardens adjacent to homes) livestock and chickens that require the use of fresh water of drinking water quality.

Based on fresh vegetable consumption patterns in Israel and data on crop requirements for water, 25 m^3/p/yr would be sufficient, using modern irrigation techniques, to meet the water requirement for the irrigation of the supply of most of the fresh vegetables crops for local consumption.

The MWR calculation will not include any other direct allocation of fresh water for agriculture, but does assume that additional water for agriculture and/or other industrial or urban non-potable uses can be made available through the *recycling and reuse of some 65% of the water allocated for domestic / urban / industrial use*. In other words, there will be, in effect, the possibility of generating an additional 65 m^3/p/yr if an effective, total water recycling program is introduced. Thus, the total effective allocation of water could reach 190 m^3/p/yr (125 m^3/p/yr from fresh water sources and 65 m^3/p/yr from recycled wastewater).

In the case of the Middle Eastern water conflicts we have proposed as a matter of principle that the ultimate (year 2030) Minimum Water Requirement (MWR) of 125 m^3/p/yr for all nations on the Jordan River watershed be assumed to be equal, since the concept of equity (meaning, in this case, equality only for domestic/urban water requirements) is the cornerstone of the Helsinki Rules and UN International Law Commission's proposal (Shuval, 1992). The concept of equity is an essential element in achieving a just and lasting peace and in resolving the water conflicts of the Middle East in a manner that would be perceived as being equitable and fair to all.

CONCLUSION

In conclusion there needs to be a fundamental revision in the understanding of such concepts as *water security, food security, water stress,* and *water benchmarks* in relation to the really arid countries of the world, such as those in the Middle East, that can only achieve the needed levels of water and food security by developing economies based on commerce, tourism, and industry which can earn sufficient cash to enable them to import low cost *virtual water* by purchasing all the required food stables on the world market. A World Food Bank may be required to help poorer countries in transition to meet these needs, while the countries rich in water resources and arable land must be encouraged to grow the food for those countries that will never have enough water to grow all of their own food.

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2.2.8. Integrated Systems Approach to the Water Problematique: Use of Computer-based Reasoning to Resolve Conflicts and Engender Cooperation

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INTRODUCTION

Scarcity of fresh water resources globally is expected to become a major factor in limiting the development of regions and cause conflict between regions sharing the same water resource (Postel 1997, Gleick 1993). It is well known that the security and development of a region or a nation is tied in a fundamental way to the availability of replenishable water resources. Waters shared across many borders either could be a major source of conflict, or alternately could force, nurture, engender, and enhance cooperation. This paper discusses the application of integrated assessment for support in policy analysis, negotiations and conflict resolution. A case study of the Nile focusing on Egypt and two of its upstream riparian Nile countries of the Sudan and Ethiopia is discussed as an illustration. A detailed discussion on the case study is given elsewhere (Sreenath, Mesarovic, and Vali, 1997).

METHODOLOGY AND APPROACH

Future studies using the methodologies described here are meant to furnish trends, generate a feel for the magnitudes involved, and also provide a way to blend science, vision and decision making. Such approaches are different from forecasting methods in that here we recognize the existence of alternate futures (scenarios), since the future is dependent on decisions yet to be made. It is also important to note the distinction between the approach used here to analyze "possible or feasible futures" vs. analysis of "probable future".

Many challenges need to be overcome in the formulation of successful development of policies as indicated below:

- *Human dimensions of development*
- *Social transformation,* and,
- *Globalization*

The inter-relationship between differing dimensions of developments which have to be taken into account simultaneously; the so-called *development problematique* (population, economy, agriculture, food consumption needs, sustainability, environment and water resources)

The approach developed to address these challenges for policy formulation and analysis is based on the multi-level methodology to managing complexity and an interactive human/ computer assessment process to deal with uncertainty. The quantitative aspects - scientific facts and data - are represented on the computer using models that mirror major relationships and subsequently have an acceptable level of validity. The qualitative or the non-numerical aspects (national, social and individual aspirations and visions) are accounted for using reasoning with the approach based on *human-in-the-loop* with the computer.

The approach and the results delineated here should serve as a first step for a more detailed set of iterative and interactive policy formulation exercises involving experts and decision-makers working as a team in order to provide the necessary degree of blending the subjective and the objective. The methodology and approach outlined here would be useful in negotiation support and in developing foresight. The underlying objective is thus to bridge the gap between science and decision-making.

CASE STUDY: FUTURE DEVELOPMENT OF SELECTED NILE RIVER BASIN COUNTRIES

We now discuss a methodology to study the policy formulation for development of Egypt and Ethiopia as constrained by growing population, increased global pressure for economic development, and, the shared, annually finite, water resource - the Nile (Howell and Allan, 1993). The intent of this work is not to recommend specific policies but to illustrate a case study methodology and its application for assessment of the long-term alternative developments that has not been reported in the literature. To be specific, we investigate policy formulation and analysis between the years 2000-2050.

We have constructed a mathematical model reflecting known scientific facts and relationships between different segments of the problematique: population, food consumption, agriculture and land use (arable land and food production), economy, and water resources (supply, demand and flow). This has been implemented on the computer-based reasoning support system GLOBESIGHT.[7] Using a "human-in-the-loop" approach with the human portraying the qualitative knowledge and the computer representing the quantitative and scientific knowledge (i.e., modeling only what can be modeled), we look into the effect of various policy issues into the future via scenario analysis.

[*7] GLOBESIGHT (for GLOBal forESIGHT) is a reasoning support and scenario analysis computer based tool for use in policy formulation and also for reasoning about the future. GLOBESIGHT consists of an *information base* (non-numerical information such as historical, political, cultural, etc.), a *models base* (population, economy, etc.), an *issues base* (water scarcity, global climate change, carrying capacity, etc.), and, *functionalities base* (graphing, goal seeking, etc.). The database consists of data from World Resources Inst., Worldwatch Inst., World Bank, UN, CIA World Factbook, etc., spanning 196 countries with possible regional aggregation. GLOBESIGHT runs on multiple platforms (PC- MS Windows, Solaris, and Linux; SUN - Solaris and SUN OS). The models can be coded in C, C++, FORTRAN, Pascal and Basic. A description of GLOBESIGHT and the multi-level hierarchical approach that it is based on is given elsewhere (Mesarovic et al., 1996).

Population growth pressure is the primary driving force for potential problems. [*8] Increase in food production to feed the growing population would require that the food be provided through a combination of domestic production and import (buying from the world market or through aid). Water for irrigation comes from the Blue Nile, the Atbara, and the Sorbat, and other non-Nile sources in case of Ethiopia and the Nile in the case of Egypt. If water consumption from Nile sources is increased in Ethiopia, the available water in Egypt (86% of the Nile water flowing into Egypt originates in Ethiopia) will consequently decrease leading to water shortage. This affects the irrigation and so crop production in Egypt (since 100% of agricultural land is irrigated), leading to increased import. If on the contrary Egypt should not have water shortage, then there is a large population in Ethiopia that needs to be fed. In the absence of economic wherewithal and domestic production, Ethiopia will have to rely heavily on aid for a significant amount of its population resulting in a clearly unsustainable situation.

Policy objectives for the scenario analysis are based on the principles of (i) keeping the *dependence of food import or aid* to the countries at a *tolerable* level, and (ii) assuring an *acceptable* level of water supply to Egypt. Realism in line with sociological, economical, and, practical limitations of policy implementation should be a factor in the policy analysis. To address these complex interrelationships, the benefit of specific access to experts in the specific areas is needed.

Using the computer based scenario analysis tool GLOBESIGHT we investigated the implications of different policy types applied at different levels (at low, medium or high level): (a) limit population growth in Ethiopia, (b) increase food production in Ethiopia by converting pasture land to agricultural (cereal) land, (c) food supply increase through increase in irrigated land in Ethiopia, and, (d) increase in agricultural water use efficiency in Egypt, and, (e) a combination of all of the above. Various policies were examined based on extensive scenario analysis, but policy implementation specifics are not discussed here. In the scenario analysis we show that any of the policies applied individually would be unacceptable either to Egypt the downstream country, or Ethiopia, or to both.

We have demonstrated that policy options (a)-(d) are not feasible to be implemented "stand alone" since one or more of the objectives cannot be fulfilled. However, we show that a combination of the above policy types at appropriate level could lead to an acceptable solution. The last policy option that is a combination of the other four would thus be acceptable, since it satisfies the objectives. Primarily, this assures that the population in both countries are fed by a combination of domestic production and import (*food security* instead of *food self-sufficiency* as emphasized by Prof. Hillel Shuval of Israel at the workshop), allows Egypt to avoid water shortage by deploying technology to increase agricultural water use efficiency. However, there is room for improvement in choice of policies even in this scenario.

[*8] According to the World Bank's *Population Projections 1995-96*, between 1990 and 2050, the population of Egypt will double to 104 million, while the Ethiopian population will rise from 48 million to 225 million.

Various aspects of the model could be improved. In addition, the scenarios that we have studied clearly do not cover the complete range of possibilities, both good and bad. For example, estimates by experts (see Abu-Zeid and Rady, 1991 as reported in Whittington and McClelland, 1992) indicate that the industrial use of water is going to increase by a whopping 33% from a 1990 level of 4.6 cu. Km to 6.1 cu. Km in 2000, and the agricultural (irrigation) water use will increase by more than 10 cu. Km by the year 2000.
This clearly indicates a problem for Egypt beyond what the effects of development policies in Ethiopia would be. Another area for exploration is the feasibility of increasing water use efficiency for domestic and industrial need. For example, 55% of the sewage water in Israel is recycled which could result in higher efficiency (Postel, 1997).

CONCLUSION

Assuredly, in the hands of a team of experts (scientists and decision makers) in the region, the methodology delineated here could provide a basis for policy making, blending science with decision making. It is obvious the future development of these two countries is irrevocably tied to each others actions.

Other approaches also exist that focuses on the Nile basin. Some consider effects of global climate change (Yates and Strzepek, 1996). An integrated look for Egypt is given in Conway et al. 1996. A look at water resources and future use in Egypt is given in Abu-Zeid and Rady, 1991.

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2.2.9. Regional Socioeconomic Development And Water: The Southeastern Anatolia Project (Gap) Of Turkey

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SOUTHEASTERN ANATOLIA PROJECT

The Southeastern Anatolia Region is a part of Upper Mesopotamia, the cradle of the ancient Mesopotamian Civilization. The project area, with a population of some 6 million and a surface area of over 75 000 square kilometers, corresponds to one tenth of Turkey. It has been endowed water and soil resources: Tigris and Euphrates Rivers represent over 28 % of the national surface water supply, and the total economically irrigable area in the Project Region accounts for over 20 % of that for the Country. GAP is implemented in the nine south-eastern provinces of Turkey.

The main issue in the utilization of this potential is the "mismatch" of these two resources. The recognition of this potential led to plans for an integrated development of the Region's water and soil resources for irrigation, hydropower generation and controlling floods and droughts. The work, which was originally planned as a water resources development package was later transformed into an integrated, multisectoral, regional development program.

GAP, a regional development project carried out with the human element at its focus, aiming at the comprehensive development of a whole region offers a significant example for the world.

THE MAIN OBJECTIVES OF GAP

The Project comprises not only of water resources projects, but also of investments in all development-related social and economic sectors such as agriculture, energy, transportation, telecommunications, healthcare, education, urban and rural infrastructure, in an integrated manner.

GAP is one of the largest of its kind in the world. The water resources development program includes 22 dams, 19 hydropower plants and the irrigation network for 1.7 million hectares of land.

The ultimate aim of GAP is to create an environment in which the people of the Region can fully translate their potentials and preferences into actual life. Thus, besides investments geared towards the development of water and land resources and running parallel to them, such social principles as fairness, equity and participation; environmental protection, improvement of land-use and integrated provision of infrastructural services which contribute to the quality of life are integrated within the scope of the Project.

The aims and the main features of the integrated project are outlined in the GAP Master Plan (1989), and their operationalization set in the GAP Action Plan (1993-1997).

WATER RESOURCES DEVELOPMENT PROGRAMME

The GAP Area is rich in water and soil resources. The Euphrates and Tigris rivers represent over 28% of the nation's water supply by rivers, and the economically irrigable areas in the region make up 20% of those for the whole country. The development of the region was originally conceived as relating to its water resources, which were later combined in a comprehensive water and land resources development package (GAP-RDA,1997). For this purpose, 13 groups of projects were planned on the Euphrates and Tigris rivers and their tributaries by the General Directorate of State Hydraulic Works (DSI):

Euphrates projects :

1. Karakaya Project;
2. Lower Euphrates Project;
3. Border Euphrates Project;
4. Suruc-Baziki Project;
5. Adiyaman-Kahta Project;
6. Adiyaman-Goksu-Araban Project;
7. Gaziantep Project.

Tigris Projects :

8. Dicle-Kralkizi Project;
9. Batman Project;
10. Batman-Silvan Project;
11. Garzan Project;
12. Ilisu Project;
13. Cizre Project.

The package included the construction of 22 dams, 19 hydroelectric power plants and the irrigation facilities to serve 1.7 million ha of land.

The Euphrates basin projects have 5304 MW installed capacity, will generate 20 billion kWh of energy and will irrigate 1 million ha of land. 14 dams and 11 hydroelectric power plants are planned for this basin. Among the Euphrates basin projects, the largest is the Lower Euphrates project which covers the following seven schemes:

1. Ataturk dam and hydroelectric power plant;
2. Sanliurfa irrigation tunnels;
3. Sanliurfa hydroelectric power plant;
4. Sanliurfa-Harran plains irrigation;
5. Mardin-Ceylanpinar plains irrigation;
6. Siverek-Hilvan pumped irrigation;
7. Bozova pumped irrigation.

The Tigris basin projects have 2172 MW installed capacity, will generate 7 billion kWh of electric energy and will irrigate 700 000 ha of land. Eight dams and eight hydroelectric power plants are planned for this basin.

"GAP" AS AN INTEGRATED REGIONAL DEVELOPMENT PROJECT

The GAP Master Plan was prepared to determine the region's potential, identify the bottlenecks, in the development process, and to set the development objectives, goals and strategies. A three-phase program for development was initiated. The GAP Action Plan then was established for implementing the Master Plan proposals, taking into account the interactions between sectors, population projections and spatial development forecasts on the basis of relevant studies. Macro-level planning and management, coordination, monitoring, evaluation and implementation in selected areas are carried out by the GAP Regional Development Administration as well as other respective state agencies.

The strategy adopted in the GAP Master Plan for the region's development has the following four basic components:

- develop and manage soil and water resources for irrigation, industrial and urban uses in an efficient manner;
- improve land use through optimal cropping patterns and agricultural practices;
- promote agro-industry and other types of industry based on indigenous resources;
- provide better social services, education and employment opportunities to control migration and to attract qualified personnel to the area.

The GAP Master Plan's basic development scenario is to transform the region into an agro-related export base.

For spatial development of the region, three main cities, Gaziantep, Sanliurfa and Diyarbakir are considered to form the main development axis. Investments are to be concentrated along this corridor for improving infrastructure and for attracting agro-industry and other employment-generation opportunities. For the medium-to-long term, this corridor will be expanded by promoting economic interaction with other sub-regions.

When the project is completed, the ratio of irrigated land to the total GAP area will increase from 2.9% to 22.8% while that for rain-fed agriculture will decrease from 34.3% to 10.7%.

As a direct result of irrigation, agricultural production and crop variety will increase substantially. While under the dry farming system, field crops such as wheat, barley, lentils, pistachios and grapes are widely cultivated, with irrigation, the cropping pattern includes cotton, maize, soybeans, vegetables and the like. Cropping intensity with irrigation increases from 89% to 134%. The most striking change is in land used for cotton cultivation, which typically increases from 2.8% to 25% when irrigation is introduced.

As a direct result of the GAP investments, the living standards of many inhabitants have already started to increase. With progressive implementation, more and more people have become direct beneficiaries of the project. Rural-urban interactions have increased following the construction of transportation and communication networks. The region is becoming more open to the outside world and thus attracts additional investments. The population is expected to increase from six million in 1998 to 9 million by 2005, with 66% living in urban centers. Urbanization in the region has received a boost, and rural migration should slow down considerably. Employment opportunities which will have been created by GAP are estimated to amount to some 3.8 million in various sectors.

Table 1: Main Social and Economic Indicators of Intermediate and Eventual Development

		1985		*1990*		*2005*	
		GAP	**Turkey**	**GAP**	**Turkey**	**GAP**	**Turkey**
I.	**Composition of Crops: Domestic Product:**						
(1)	**Agriculture (%)**	39.56	10.37		16.8	23.2	
(2)	**Industry (%)**	15.69	12.34		24.8	29.8	
(3)	**Services(%)**	44 75	77.29		58.4	47.0	
II.	**Population:**						
(1)	**Total population (millions)**	4.3	50.5	5.2	56	10	71.7
(2)	**Urban population (millions)**	2.14	26.8	2.9	33	6.6	
(3)	**Rural population (millions)**	2.15	23.7	2.3	2.3	3.4	
(4)	**Percentage Urban**	49.9	53	55.7	58.9	66	
III	**Employment:**						
(1)	**Total (millions)**	1.5	20.5	1.7	23.3	3.8	
(2)	**Agriculture (%)**	71	59	67.2	53	51	
(3)	**Industry (%)**	5	11	6.1	12.4	10	
(4)	**Services (%)**	24	30	26.7	34	39	
IV	**Per capita GRP:**						
	TL (thousands)	860	1 822			1 784	
	1988 prices ($)	637	1 350			1 320	
V	**Age-group (%)**						
(1)	**0-14**	48.77	37.52	47.16	34.96		27.55
(2)	**15-64**	48.17	58.09	50.16	60.68		66.59
(3)	**65&over**	2.76	4.20	2.62	4.28		5.86
VI	**Number of Students Per school:**						
(1)	**Primary**	128.5	134.6	132.8	134.4		
(2)	**Secondary**	415	362	374	364.8		
(3)	**High school**	427	478	501	449.6		
VII	**Number of Students Per teacher**						
(1)	**Primary**	39.9	31.1	42.8	30.4		
(2)	**Secondary**	48.4	37.5	60.8	45.6		
(3)	**High school**	15.4	12.2	17.9	12.5		

		1985		*1990*		*2005*	
		GAP	**Turkey**	**GAP**	**Turkey**	**GAP**	**Turkey**
VIII	**Enrollment ratio (%)**						
(1)	**Primary**			79	96	100	100
(2)	**Secondary**			33	60	80	100
(3)	**High school**			18	25	44	75
(4)	**Tertiary**			3	12	15	19
IX	**Literacy rate (%)**						
(1)	**Total**	55	77	60	80.4	100	100
(2)	**Male**	71.7	86	75.5	88.7	100	100
(3)	**Female**	39	68	44.7	71.9	100	100
X	**Hospitals:**						
(1)	**Total**	45	722	53	857	730	
(2)	**State**	37	607	49	732	600	
(3)	**Private**	8	115	4	125	120	
XI	**Number of beds:**						
(1)	**Total**	5 026	10 3918	5 658	12 0738	24 680	
(2)	**State**	4 854	99 044	5 517	114 508		
(3)	**Private**	172	4 874	141	6 230		
XII	**Number of health Personnel:**						
(1)	**Doctor**	1 185	36 427	2 397	50 639	12 656	
(2)	**Nurses**	1 544	30 854	2 169	44 904	15 821	
(3)	**Midwives**	1 149	17 987	1 885	20 415	9 492	
XIII	**Number of Persons:**						
(1)	**Per Doctor**	3 631	1 391	2 152	1 115	750	750
(2)	**Per Nurse**	2 758	1 630	2 353	1 249	600	600
(3)	**Per bed**	847	484	854	453	370	370
XIV	**Fertility rate**	4.02	2.59	4.37	2.65	2.49	2.49
XV	**Infant mortality rate** (Per 1 000)	111	109	66	67	31.8	31.8
XVI	**Rural electricity (%)**	66.8	85	99.7	99.9	100	100
XVII	**Rural drinking water:**						
(1)	**Has (%)**	35.6	50.8	44.7	60.7		
(2)	**Has not (%)**	41.5	32.5	38.9	26.1		
XVIII	**Consumption of electric power (MWh)**						
(1)	**Industry (%)**	60.5	66.9	59.5	62.4		
(2)	**Home**	19.9	17	19.8	19.4		
XIX.	**Cotton production** (1000 tons)	61.7	518	137.3	654.6	1 453	

Education and health services in the Region will be improved to at least the current national average by 2005. Specifically, the enrollment ratios in schools and the levels of health facilities are planned to exceed the current national average by 2005.

The project is socially essential as it is intended to significantly improve the living standards and quality of life of the local people, increase their per capita income, create new employment opportunities, and protect the environment. It is also economically viable as it will radically change the economic structure, increase production and more than quadruple the GRP.

THE IMPACT OF IRRIGATION (IN A PILOT AREA IN HARRAN PLAIN)

The Lower Euphrates Project is one of the GAP schemes on the Euphrates river and consists of Ataturk Dam and HEPP, Sanliurfa tunnels, Sanliurfa hydroelectric power plant, Sanliurfa-Harran irrigation, Mardin-Ceylanpinar irrigation, Siverek-Hilvan pumped irrigation and Bozova pumped irrigation. Main public investments in the Lower Euphrates projects have now been completed. One of them comprised Ataturk Dam and Sanliurfa tunnels. Ataturk Dam was completed in 1990 with a reservoir capacity of 48.5 BCB. Water reaches the Sanliurfa-Harran plains via the Sanliurfa tunnels system, which consists of twoparallel tunnels each 26.4 km long and 7.62 m in diameter. One of the tunnels was completed in 1995, and irrigation is now practiced in a 50 000 ha area.

Sanliurfa-Harran plain has two main canal systems. Sanliurfa main irrigation canal will irrigate 43 000 ha of land by gravity and 5000 ha by pumping. The Harran main irrigation canal will irrigate 98 500 ha by gravity.

A pilot area selected from the Sanliurfa-Harran irrigation scheme is used here to show the impact of irrigation. The pilot area is located on S. Sanliurfa main irrigation canal system. Land consolidation activities have been completed in 20 000 ha. There are 62 villages, and 4000 families, totaling over 26 000 population.

When irrigation was introduced in 1995, major changes in cropping patterns occurred in the pilot area. The most striking change has been in the land used for cotton, from 21% to 45%. This area is now monitored by the GAP Administration via a socioeconomic monitoring project to assess the impact of irrigation on different facets of life and economy.

Table 2: Crop production in the pilot area prior to irrigation.

Crops	Land (ha)	(%)
Wheat	14 700	49
Barley	6 000	20
Cotton	6 300	21
Lentils	2 400	8
Vegetables	600	2
Total	**30 000**	

SUSTAINABLE DEVELOPMENT AND BASIC STRATEGIES OF GAP

Early in the next century, GAP's physical facilities will have been completed. Nineteen power plants will be humming to produce 27 billion kW of electricity annually, and farmers will be tilling 1.7 million ha of irrigated land, producing bountiful crops. Agro-industrial factories will dot the land, some 9 million people will be living in the region, mostly in the towns and there will be employment for almost everyone who asks for it. Extremes of misery will no longer exist, and prosperity will be evident for everyone except the most prejudiced and opinionated.

There is little doubt that all the dams and power plants will be built, and all the irrigation facilities will be completed, if not by the planned dates then not very much later. So long as financial resources are forthcoming, these physical facilities can be put in place almost like clockwork. But once the physical facilities are in place, unless the necessary measures are taken, there is no guarantee that there will be much prosperity or even if there is prosperity that many will share in it, or that prosperity will not be a transient affair. The guarantees for such can be provided only if development is human-oriented, and if it is designed and implemented with an emphasis on sustainability. Sustainable development is that which "meets needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). Under this broad concept, there is a plethora of issues: social, economic, cultural, gender, educational, health, physical, agricultural, environmental etc. At the hub of all this is the human being either as the object or as the agent or both. Hence, human development in various dimensions is a *sin qua non* for sustainable development, and the draft strategy for Turkey's 7th Five Year Development Plan (SPO[*9], 1995) recognizes it as such. It is also an integral part of the UNDP's "Fifth Country Program 1995-1999 for the Republic of Turkey" (UNDP, 1994) either in the form of explicit programs such as "Gender and Development", "Social Development and Disparity Reduction" or implicitly.

In a seminar sponsored by the UNDP and the GAP Administration held on March 1995, and attended by people from a wide spectrum of institutions including universities, government agencies, non-governmental organizations and local bodies there was a consensus on the principals of the components of sustainable human development in the GAP Region.

[*9]SPO: State Planning OrganizationThe construction of the following projects has now been completed: Karakaya Dam and hydroelectric power plant (HEPP); Ataturk Dam and HEPP; Sanliurfa Hancagiz Dam; Derik-Dumluca Dam; Hacihidir Dam; Devegeçidi Dam; Çinar-Goksu Dam; Çag-Çag HEPP; Sanliurfa STOL Airport; Gaziantep l, Gaziantep 2 and Mardin Organized Industrial Districts; and 18 small-scale industrial districts.

Based on the consensus of "Sustainable Human Development and GAP Seminar", a program titled "Sustainable Development Program in the GAP Region" was adopted by GAP Administration and UNDP and put into effect in March 1997.

The program will support the implementation of some 29 sub-projects classified under the following sub-themes:

- Promoting social sustainability and enhancing social services,
- Promoting agricultural sustainability and improving rural productivity,
- Promoting local enterprise and industry development for economic viability,
- Promoting sustainable human settlements,
- Ensuring optimal sustainable use of natural ressources.

CURRENT STATUS OF GAP DEVELOPMENT

GAP is the most comprehensive, integrated regional development project ever attempted in Turkey, or for that matter in any developing country. The total project cost is estimated at $32 billion, of which $ 12.6 billion had already been invested by the end of July 1997 (GAP-RDA, 1996c; 1997b).

The construction of dams, hydropower plants and irrigation networks is underway. The project, when completed, will generate 27 billion kWh of electricity per year. Hydroelectric energy production in 1997 from the GAP schemes was 19.4 billion kWh. Over 154 080 ha of land are now under irrigation, and another 200 000 ha are currently being prepared to receive irrigation.

The following GAP Projects are presently under construction: Kralkizi Dam and HEPP; Dicle Dam and HEPP; Batman Darn and HEPP; Çamgazi Dam and HEPP, Kayacik Dam and HEPP; Birecik Dam and HEPP; Sanliurfa HEPP; Sanliurfa-Harran irrigation; Kralkizi-Dicle irrigation; Batman Left Bank irrigation; Çinar-Goksu irrigation; Garzan-Kozluk irrigation; Sanliurfa water treatment and supply project; Gaziantep water treatment and supply project; Diyarbakir water treatment and supply project ad other 47 urban water projects; 16 urban sewerage and wastewater projects; 10 Organized Industrial Districts and 15 Small Scale Industrial Estates; Gaziantep-Sanliurfa motorway; Adiyaman airport; mass housing projects for the cities of Gaziantep, Sirnak, Diyarbakir, Batman, Mardin and Sanliurfa agricultural land consolidation project.

Over 98% of all villages have now been connected to the road networks, and 99.7% of villages were electrified by 1990. By 1990, all the villages had been provided with telephone connections. Television and radio broadcasts now reach rural areas extensively.

Since the initiation of the project, healthcare facilities have been significantly upgraded. There were 53 hospitals, and 5658 beds in the region in 1990, and 2397 doctors and 2169 nurses. The person/bed ratio has been improved to 854, the person/doctor ratio to 2152 and the person/nurse ratio to 2353. Health services are still below national levels and an ambitious program is under way, with World Bank financing, to further improve them rapidly.

Even though the literacy rates have improved markedly they are still below national averages. The literacy rate increased from 55% in 1985 to 69% by 1990. Male and female literacy rates increased from 71.1% to 75.5% and from 39 % to 44.3%, respectively. The enrollment ratio was 79% in primary school, 33% in secondary, 18% in high school and 3% in tertiary education, as compared with 96%, 60%, 25% and 12% respectively in the country as a whole, indicating room for further development.

Municipal infrastructure services were still largely inadequate in the region. The rapid urbanization and limited financial resources have resulted in low capacities and unmet demand. In 1987, out of the total of 89 municipalities, only two had adequate sewerage services and 15% adequate municipal water networks, but 80% of them had maps and development plans. While conditions have improved, still out of 174 municipalities, 33% have water supply networks and 18% water networks under construction, but only four adequate sewerage systems.

PROGRAMS TOWARDS SUSTAINABLE DEVELOPMENT

The GAP Regional Development Administration has carried out a wide spectrum of projects using multi-sectoral and multi-disciplinary planing approaches. Within the scope of a macro economic and social development program GAP Master Plan defined small and medium-scale investment and socio-economic development projects ranging form educational and health infrastructure to environmental protection, irrigation systems, management development, transportation, reorganization and resettlement programs. Tourism and cultural heritage preservation are also among the programs carried out by the Administration.

In accordance with the sustainable development approach and strategies of GAP, some special programs and projects have been initiated in the GAP Region to emphasize the human dimension of development through project implementations concerned with basic social services (education, health, housing), gender equity, urban management, irrigation facilities, agricultural and environmental sustainability, institutional and community capacity-building, and public participation.

Examples from Implementation Projects;

- Regulation of Water in Irrigation Canals and Determination of Water-saving Irrigation Methods
- Management, Operation and Maintenance of GAP Irrigation System (GAP-MOM)
- Pilot Implementation Modern Irrigation Technology
- Recycling of Urban Wastewater
- Reuse of Irrigation Return Water
- Transfer of Irrigation Systems to Farmers
- Eastern Anatolia Erosion Control and Watershed Rehabilitation Project
- Protection of Biodiversity
- Institutional Capacity Building
- Development Plans and Infrastructure Projects in the GAP Region
- Environmental Studies in the GAP Region
- GAP Region Environment Study-Tigris Basin
- Environmental Impact Assessment Study
- Agricultural Research and Development Project
- Farmers' Training and Extension Activities

- Agricultural Commodities Marketing Survey Planning of Crop Pattern and Integration of Marketing and Crop Pattern Studies
- Employment and Income-generation Projects Geared towards Non-irrigated Areas
- Consolidation of Agricultural Lands to Improve Efficiency
- Redistribution of State-owned Agricultural Lands to Landless Farmers
- Participatory Urban Zoning and Planning
- Participatory Resettlement and Sustainable Redevelopment as a Result of Dam Reservoirs
- The Ataturk Dam Reservoir Sub-regional Development Plan
- Establishment of Multipurpose Community Centers for Women (CATOM)
- GAP Entrepreneur Support and Guidance Centers (GAP-GIDEM)
- Eco-city and Eco-village Planning and Development on Pilot Areas
- GAP Geographic Information System (GIS) Feasibility Study and Pilot Project Implementation
- Investigation of the Climatological Conditions of the GAP Region for the Present and Near Future

CONCLUSION

The Southeastern Anatolia Project is a significant opportunity for the Southeastern Anatolia Region, and reflects Turkish Governments' determination to achieve a balanced regional development focused on the improvement of social and economic indicators.

The basic philosophy of the Project is that of forming and overall environment in which human welfare and happiness can be assured. Ever expanding recognition of its human centered development philosophy brings along ever increasing desires for international cooperation.

I believe that GAP has a distinct place among the universal efforts in the history of civilization for creating a better world to live in.

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2.2.10. Trends In Transboundary Water Disputes And Dispute Resolution, Aaron T. Wolf[*10] and Jesse H. Hamner

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BACKGROUND

"Water" and "war" are two topics being assessed together with increasing frequency. The approximately 250 international watersheds cover more than one half of the land surface of the globe, and affect 40% of its population. Water is a resource which ignores political boundaries, fluctuates in both space and time, has multiple and conflicting demands on its use, and whose international law is poorly developed, contradictory, and unenforceable. As a consequence, recent articles in the academic literature (Cooley 1984; Starr 1991; Gleick 1993; and others) and popular press (Bulloch and Darwish 1993; World Press Review 1995) point to water not only as a cause of historic armed conflict, but as *the* resource which will bring combatants to the battlefield in the 21st century.

The historic reality has been quite different from what the "water wars" literature would have one believe. In modern history, only seven minor skirmishes have been waged over international waters - invariably other inter-related issues also factor in. Conversely, over 3,600 treaties have been signed historically over different aspects of international waters, many showing tremendous elegance and creativity for dealing with this critical resource.

Despite the fact that countries seem not to go to war over water, the relationship between historic water scarcity and acute conflict still needs to be assessed. However, such an investigation should focus on more subtle relations between water and its users: historic evidence *does* suggest, for example, a relationship between access to clean water supplies and political stability. No better example exists, perhaps, than the Bangladeshi relationship with the Ganges - as the river's flow decreased as a consequence of Indian diversions, not only did severe environmental degradation result, but farmers and town-dwellers whose water supply became salinized formed a wave of environmental refugees, many thousands of whom flooded into India. This water-induced instability has recurred throughout the Middle East, Africa, and Asia.

Once cooperative water regimes are established through treaty, however, they turn out to be tremendously resilient over time, even between otherwise hostile riparians, and even as conflict is waged over other issues. International water regimes continued to function in the Mekong basin since 1957, despite the Vietnam War; the Jordan basin (between Israel and Jordan) since 1955, even as these riparians until only recently were in a legal state of war; and along the Indus, even through India-Pakistan warfare.

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Given this critical role of transboundary water agreements, the processes which lead to their necessity, negotiation, and structure have been surprisingly poorly studied. This paper describes three components of transboundary water issues. The first section investigates the history of transboundary water conflicts and suggests that the "water wars" literature simply is not based on an historic reality. The second section offers insight into the much richer history of water dispute resolution as exemplified in water treaties which have been negotiated over time. The major findings of the Transboundary Freshwater Dispute Database are presented as evidence for the cooperation-inducing characteristics of transboundary waters. Nevertheless, an argument for the future based on the past would be disingenuous. Moreover, as Lowi and Shaw describe, security issues are much broader than "simple" questions of war and peace. Lowi shows in detail how water, while not leading to warfare, has tremendous impacts on regional security issues. In light of this, the third section describes possible indicators to anticipate future water-related tension, based on fourteen detailed case studies of the Database.

"WATER WARS" AND WATER REALITY[*11]

As mentioned earlier, there is a growing literature which describes water both as an historic and, by extrapolation, as a future cause of interstate warfare. Westing (1986) suggests that, "competition for limited freshwater leads to severe political tensions and even to war"; Gleick (1993) describes water resources as military and political goals, using the Jordan and Nile as examples; Remans (1995) uses case studies from the Middle East, South Asia, and South America as "well-known examples" of water as a cause of armed conflict; Samson and Charrier (1997) write that, "a number of conflicts linked to freshwater are already apparent," and suggest that, "growing conflict looms ahead"; Butts (1997) suggests that, "history is replete with examples of violent conflict over water," and names four Middle Eastern water sources particularly at risk; and Homer-Dixon (1994), citing the Jordan and other water disputes, comes to the conclusion that "the renewable resource most likely to stimulate interstate resource war is river water."

A close examination of the case studies cited as historic interstate water conflict suggest some looseness in classification. Samson and Charrier (1997), for example, list eighteen cases of water disputes, only one of which is described as "armed conflict," and that particular case (on the Cenepa River) turns out not to be about water at all but rather about the location of a shared boundary which happens to coincide with the watershed. Armed conflict did not take place in any of Remans' (1995) "well-known" cases (save the one between Israel and Syria, described below), nor in any of the other lists of water-related tensions presented.

The examples most widely cited are wars between Israel and her neighbors. Westing (1986) lists the Jordan River as a cause of the 1967 war and, in the same volume, Falkenmark (1986), mostly citing Cooley (1984), describes water as a causal factor in both the 1967 war and the 1982 Israeli invasion of Lebanon.

[*11] The material for this section was drawn from a paper presented at a NATO Advanced Research Workshop on Environmental Change, Adaptation and Human Security, Budapest, Hungary, 9-12 October, 1997

Myers (1993), citing Middle East water as his first example of "ultimate security," writes that "Israel started the 1967 war in part because the Arabs were planning to divert the waters of the Jordan River system."

In fact, in the years since Israel's invasion of Lebanon in 1982, a "hydraulic imperative" theory, which describes the quest for water resources as *the* motivator for Israeli military conquests (both in Lebanon in 1979 and 1982 and earlier, on the Golan Heights and West Bank in 1967) was developed in the academic literature and the popular press (see, for example, Davis et al. 1980; Stauffer 1982; Schmida 1983; Stork 1983; Cooley 1984; Dillman 1989; and Beaumont 1991).

The only problem with these theories is a complete lack of evidence. While shots were fired over water between Israel and Syria from 1951-53 and 1964-66, the final exchange, including both tanks and aircraft on July 14, 1966, stopped Syrian construction of the diversion project in dispute, effectively ending water-related tensions between the two states - the 1967 war broke out almost a year later. The 1982 invasion provides even less evidence of any relation between hydrologic and military decision-making. In extensive papers investigating precisely such a linkage between hydro-strategic and geo-strategic considerations, both Libiszewski (1995) and Wolf (1995) conclude that water was neither a cause nor a goal of any Arab-Israeli warfare.

To be fair, I should note that I am only describing the relationship between interstate armed conflict and water resources *as a scarce resource*. I exclude both internal disputes, such as those between interests or states, as well as those where water was a means, method, or victim of warfare. I also exclude disputes where water is incidental to a the dispute, such as those about fishing rights, access to ports, transportation, or river boundaries. Many of the authors which I cite, notably Gleick (1993), Libiszewski (1995), and Remans (1995), are very careful about these distinctions. The bulk of the articles cited above, then, turn out to be about political tensions or stability rather than about warfare, or about water as a tool, target, or victim of armed conflict - all important issues, just not the same as "water wars."

In order to cut through the prevailing anecdotal approach to the history of water conflicts, we investigated those cases of international conflict where armed exchange was threatened or took place over water resources *per se*. We utilized the most systematic collection of international conflict - the International Crisis Behavior (ICB) dataset, collected by Jonathan Wilkenfeld and Michael Brecher (citation needed of their forthcoming work). This dataset contains only those disputes which were considered to be international crises by the principal investigators. Their definition of an international crisis is any dispute where (1) basic national values are threatened (e.g. territory, influence, or existence), (2) time for making decisions is limited, and (3) the probability for military hostilities is high. Using these guidelines, they identified 412 crises for the period 1918-1994. Joey Hewitt, of the University of Maryland at College Park, searched the text files of the ICB dataset for water-related key-words, and found four disputes where water was at least partially a cause. These have been researched and supplemented by three others at the University of Alabama. The complete list includes seven disputes:

1948 - Partition between India and Pakistan leaves the Indus basin divided in a particularly convoluted fashion. Disputes over irrigation water exacerbate tensions in the still-sensitive Kashmir region, bringing the two riparians "to the brink of war." Twelve years of World Bank led negotiations lead to the 1960 Indus Waters Agreement.

February 1951 - September 1953. Syria and Israel exchange sporadic fire over Israeli water development works in the Huleh basin, which lies in the demilitarized zone between the two countries. Israel moves its water intake to the Sea of Galilee.

January - April 1958. Amidst pending negotiations over the Nile waters, Sudanese general elections, and an Egyptian vote on Sudan-Egypt unification, Egypt sends an unsuccessful military expedition into territory in dispute between the two countries. Tensions were eased (and a Nile Waters Treaty signed) when a pro-Egyptian government was elected in Sudan.

June 1963 - March 1964. 1948 boundaries left Somali nomads under Ethiopian rule. Border skirmishes between Somalia and Ethiopia are over disputed territory in the Ogaden desert, which includes some critical water resources (both sides are also aware of oil resources in the region). Several hundred are killed before cease-fire is negotiated.

March 1965 - July 1966. Israel and Syria exchange fire over "all-Arab" plan to divert the Jordan River headwaters, presumably to preempt the Israeli "national water carrier," an out-of-basin diversion plan from the Sea of Galilee. Construction of the Syrian diversion is halted in July 1966.

April - August 1975. In a particularly low-flow year along the Euphrates, as upstream dams are being filled, Iraqis claim that the flow reaching its territory was "intolerable," and asked that the Arab League intervene. The Syrians claim that less than half the river's normal flow are reaching *its* borders that year and, after a barrage of mutually hostile statements, pull out of an Arab League technical committee formed to mediate the conflict. In May 1975, Syria closes its airspace to Iraqi flights, and both Syria and Iraq reportedly transfer troops to their mutual border. Only mediation on the part of Saudi Arabia breaks the increasing tension.

April 1989 - July 1991. Two Senegalese peasants were killed over grazing rights along the Senegal River, which forms the boundary between Mauritania and Senegal, sparking smoldering ethnic and land reform tensions in the region. Several hundred are killed as civilians from border towns on either side of the river attack each other before each country uses its army to restore order. Sporadic violence breaks out until diplomatic relations are restored in 1991.

As we see, the actual history of armed water conflict is somewhat less dramatic then the "water wars" literature would lead one to believe: a total of seven incidents, in three of which no shots were fired. As near as we can find, *there has never been a single war fought over water.* [*12]

This is not to say there is no history of water-related violence - quite the opposite is true - only that these incidents are at the sub-national level, generally between tribe, water-use sector, or state. Examples of internal water conflicts, in fact, are quite prevalent, from interstate violence and death along the Cauvery River in India, to California farmers blowing up a pipeline meant for Los Angeles, to much of the violent history in the Americas between indigenous peoples and European settlers. The desert state of Arizona even commissioned a navy (made up of one ferry boat) and sent its state militia to stop a dam and diversion on the Colorado River in 1934 (Fredkin 1981).

[*12] This in not quite true. The earliest documented interstate conflict known is a dispute between the Sumerian city-states of Lagash and Umma over the right to exploit boundary channels along the Tigris in 2,500 BCE (Cooper 1983). In other words, the last and only "water war" was 4,500 years ago.

Too, one need look no further than relations between India and Bangladesh to note that internal instability can both be caused by, and exacerbate, international water disputes. At issue is a barrage which India has built at Farakka, which diverts a portion of the Ganges flow away from its course into Bangladesh, towards Calcutta 100 miles to the south, in order to flush silt away from that city's seaport. Adverse effects in Bangladesh resulting from reduced upstream flow have included degradation of both surface and groundwater, change in morphology, impeded navigation, increased salinity, degraded fisheries, and danger to water supplies and public health. Environmental refugees out of affected areas have further compounded the problem. Ironically, many of those displaced in Bangladesh have found refuge in India (Biswas and Hashimoto 1996).

So, while no "water wars" have occurred, there is ample evidence that the lack of clean freshwater has lead to occasionally intense political instability and that, on a small scale, acute violence can result. What we seem to be finding, in fact, is that geographic scale and intensity of conflict are *inversely* related.

THE TRANSBOUNDARY FRESHWATER DISPUTE DATABASE[*13]

The UN Food and Agriculture Organization has identified more than 3,600 treaties relating to international water resources dating between AD 805 and 1984, the majority of which deal with some aspect of navigation (UN FAO 1978; 1984). Since 1814, states have negotiated approximately 300 treaties which deal with non-navigational issues of water management, flood control, hydropower projects, or allocations for consumptive or non-consumptive uses in international basins**.** Including only those signed in this century which deal with water *per se*, and excluding those which deal only with boundaries, navigation, or fishing rights, the authors have collected full and partial texts of 145 treaties in a Transboundary Freshwater Dispute Database at the University of Alabama**.** The collection efforts continue in an ongoing project of the Department of Geography and the Center for Freshwater Studies, in conjunction with projects funded by the World Bank and the US Institute of Peace.

Negotiating notes and published descriptions of treaty negotiations are also being collected in the Database - at present the Database includes fourteen detailed case studies. These cases include nine watersheds - the Danube, Euphrates, Jordan, Ganges, Indus, Mekong, Nile, La Plata, and Salween; two sets of aquifer systems - US-Mexico shared systems and the West Bank Aquifers; two lake systems - the Aral Sea and the Great Lakes; and one engineering works - the Lesotho Highlands Project.

At present, few authors have undertaken systematic work on the body of international water treaties as a whole, although some use treaty examples to make a point about specific conflicts, areas of cooperation, or larger issues of water law (see for example Vlachos 1990; Teclaff 1991; McCaffrey 1993; Eaton and Eaton 1994; Housen-Couriel 1994; Dellapenna 1995; and Kliot et al. 1997). In two of the most thorough exceptions, Dellapenna (1994) describes the evolution of treaty practice dating back to the mid-1800's, and Wescoat (1995) assesses historic trends of water treaties dating from 1648-1948 in a global perspective.

[*13] This section is drawn from Hamner and Wolf (in press).

In addition, McCaffrey (1993) offers theories about trends in treaty-making, specifically the move towards integrated management from unilateral development, the move away from navigation as the primary use, and the trend towards "equitable utilization." Hayton (1988, 1991) has argued that international law should account more for hydrologic processes.

Treaties can tell about regional hegemony, about how and which water needs are met, about the relative importance of water in the political climate, about development issues, and whether earlier treaties have successfully guided or guaranteed state behavior. To organize and analyze these treaties, Jesse Hamner has developed a systematic computer compilation which catalogs the treaties by basin, countries involved, date signed, treaty topic, allocations measure, conflict resolution mechanisms, and non-water linkages. [*14]

MAJOR FINDINGS

The contents of the Database are qualitatively and quantitatively assessed for their provisions regarding the following criteria: basin involved; principal focus; number of signatories; non-water linkages (such as money, land, or concessions in exchange for water supply or access to water); provisions for monitoring, enforcement, and conflict resolution; method and amount of water division, if any; and the date signed. Preliminary descriptions of our findings follow:

Treaty Signatories:

One hundred and twenty-four of the 145 treaties (86%) are bilateral. Twenty-one (14%) are multilateral; two of the multilateral treaties are unsigned agreements or drafts.

It is unclear whether so many treaties are bilateral because only two states share a majority of international watersheds or because, according to negotiation theory, the difficulty of negotiations increases as the number of parties increases (Zartman in Kremenyuk, ed., 65-77).

In multilateral basins, this preference towards bilateral agreements can preclude the regional management long advocated by water resource managers. One who ignores the watershed as the fundamental planning unit, where surface- and groundwater, quality and quantity are all inter-related, also ignores hydrologic reality. The Jordan basin, for example, has been characterized by bilateral arrangements - the only regional talks on the basin, the Johnston negotiations of 1953-55, went unratified. As unilateral development in the basin proceeded in the absence of agreement, each state's goals and plans abutted against those of the other co-riparians, leading to inefficient development and even to exchanges of fire in the early 1950's and mid-1960's. Similarly, India has a long-standing policy of adhering to bilateral negotiations, presumably because it can best address its own needs *vis-a-vis* each of its neighbors separately. Partly as a consequence, neither the Ganges-Brahmaputra nor the Indus River systems have ever been managed to their potential efficiency. All but three multilateral agreements lack definite allotments, although a few establish advisory and governing bodies among states.

[*14] We expect that both the full text of each treaty and the compilation of summaries will be up-loaded to the World Wide Web by the fall of 1998. In the meantime, an electronic version including one-page summaries of each treaty, is available on disk from either author on request.

Of the 21 multilateral treaties / agreements, developing nations account for 13. Only one multilateral treaty, the treaty regarding water withdrawals from Lake Constance signed by Germany, Austria, and Switzerland in 1966, exists between industrialized nations for access to a water source. None of the preindustrial-nation multilateral agreements specified any water allocations - all involved hydropower and/or industrial uses.

The states surrounding the Aral Sea have an agreement, dated 1993, that deals with several joint issues, but the text lacks allocations and provides too little detail for planning water use. Like the Aral Sea, Lake Chad also suffers from intense, poorly managed use and current deficit water withdrawals. The Chad Basin treaty (1964), among Cameroon, Niger, Nigeria, and Chad, deals with economic development inside the basin, the lake's tributaries, and industrial uses of the lake, but lacks allocations. The agreement does create a commission, which, among other things, arbitrates disputes concerning implementation of the treaty. The commission prepares general regulations, coordinates the research activities of the four states, examines their development schemes, makes recommendations, and maintains contact among the four states.

Principal Focus:

Most treaties focus on hydropower and water supplies: 57 (39%) of the treaties discuss hydroelectric generation, and 53 (37%) distribute water supplies. Nine (6%) mention industrial uses, six (4%) navigation, and six (4%) primarily discuss pollution. Thirteen of the 145 (9%) focus on flood control. The Database includes one treaty which primarily discusses fishing (<1%) (included for other treaty elements).

Great Britain is a signatory in 27 (19%) of the treaties. Of that number, 17 (63%) relate to water supply, all but one (in Canada) of an African or South Asian colony.

Monitoring:

Seventy-eight (54%) treaties have provisions for monitoring, while 67 (46%) do not. When monitoring is mentioned, it is addressed in detail, often including provisions for data-sharing, surveying, and schedules for collecting data.

Information-sharing generally engenders good will and can provide confidence-building measures between co-riparians. Unfortunately, some states classify river flows as secrets, and others use lack of mutually agreeable data as a stalling technique in their negotiations (Kaye 1989, 17). Most monitoring clauses contain only the most rudimentary elements, perhaps due to the time and labor costs of gathering data.

However, data collected by signatories of the treaty can provide a solid base for later discussions. India and Bangladesh eventually agreed on Ganges flow data and based a workable agreement on that data in 1977, where previously both parties could not agree to the accuracy of each other's hydrologic records. The cooperation between engineers or among council members can result in the formation of an epistemic community - a community of trans-boundary professionals - another positive outcome of data gathering/sharing. Treaties have not commonly included provisions to monitor compliance, but such additions may bolster trust and increase strength of these epistemic bonds.

Method for Water Division:

Few treaties allocate water: clearly defined allocations account for 54 (37%) of the agreements. Of that number, 15 (28%) specify equal portions, and 39 (72%) provide a specific means of allocations. In other work, Wolf (in review) finds four general trends in those treaties which specify allocations:

1) A shift in positions often occurs during negotiations from "rights-based" criteria, whether hydrography or chronology, in favor of "needs-based"

values, based on irrigable land or population, for example;

2) In the inherent disputes between upstream and downstream riparian and existing and future uses, the needs of the down-stream riparian are more-often delineated - upstream needs are mentioned only in boundary waters accords in humid regions - and that existing uses, when mentioned, are *always* protected;

3) Economic benefits have not been explicitly used in allocating water, although economic principles have helped guide definitions of "beneficial" uses and have suggested "baskets" of benefits, including both water and non-water resources, for positive-sum solutions;

4) The uniqueness of each basin is repeatedly suggested, both implicitly and explicitly, in the treaty texts.

This last point is exemplified in the unique measures which negotiators have devised: the 1959 Nile Waters Treaty divides the average flow based on existing uses, then evenly divides any future supplies (projected from the Aswan High Dam and the Jonglei Canal Project); the Johnston negotiations led to allocations between Jordan riparians based on the irrigable land within the watershed - each party could then do what it wished with its allocations, including divert it out-of-basin; and the Boundary Waters Agreement, negotiated with a hydropower focus between Canada and the US, which allows a greater minimum flow of the Niagara River over the famous falls during summer daylight hours, when tourism is at its peak.

Hydropower:

Fifty-seven of the treaties (39%) focus on hydropower. Power-generating facilities bring development, and hydropower provides a cheap source of electricity to spur developing economies. Postel (1997) and others, however, suggest that the age of building dams will soon end because of lack of funding for large dams, a general lack of suitable new dam sites, and environmental concerns.

Not surprisingly, less-developed mountain-nations at the headwaters of the world's rivers are signatories to the bulk of the hydropower agreements - Nepal alone, with an estimated 2% of the world's hydropower potential (Aryal 1995, 160), has four treaties with India (the Kosi River agreements, 1954, 1966, 1978, and the Gandak Power Project, 1959) to exploit the huge power potential in the region.

Groundwater:

Only three agreements deal with groundwater supply (the 1910 convention between Great Britain and the Sultan of Abdali, and the 1994 Jordan-Israel peace treaty and the Palestinian-Israeli accords (Oslo II)). Treaties that focus on pollution usually mention groundwater, but do not quantitatively address the issue.

The complexities of groundwater law have been described by more than a few authors (see, for example, Hayton 1982 and Utton 1982). Overpumping can destroy cropland through salinity problems, either by seawater intrusion or evaporation-deposition, and therefore allocating too much water (or one party's overpumping) can decimate future freshwater supplies.

The Bellagio Draft Treaty, developed in 1989, attempts to provide a legal framework for groundwater negotiations. The treaty describes principles based on mutual respect, good neighborliness, and reciprocity, which requires joint management of shared aquifers (Hayton and Utton 1989). While the Draft recognizes that obtaining groundwater data can prove difficult and expensive, and its acceptance relies on cooperative and reciprocal negotiations, it does provide a useful framework for future groundwater diplomacy.

Non-Water Linkages:

Negotiators may facilitate success by enlarging the scope of water disputes to include non-water issues.

If pollution causes trouble in a downstream country, an upstream neighbor may opt to pay for a treatment plant in lieu of reduced inputs or reduced withdrawals. In such a case, lesser amounts of high-quality water may improve relations more than a greater quantity of polluted or marginal-quality water. Such tactics "enlarge the pie" of available water and other resources in a basin. Non-Water Linkages include capital, 44/145 (30%); land, 6/145 (4%); political concessions, 2(1%); other linkages, 10/145 (7%); and no linkages, 83/145 (57%).

In the 1929 Nile agreement, the British agreed to give technical support to both Sudan and Egypt. In lieu of payments, the Soviet Union agreed to compensate lost power generation to Finland in perpetuity (the 1972 Vuoksa agreement). Britain even established ferry service across newly-widened parts of a the Hathmatee in India, in compensation for the inaccessibility problems created by their dam project in the late 1800s.

Compensation for land flooded by dam projects is common. British colonies usually agreed to pay for water delivery and reservoir upkeep. However, capital can provide compensation for a greater array of possibilities, flooded homes, and construction of new water facilities (the India-Nepal Kosi River Project Agreements, signed in 1954 and 1966 provide two examples).

Treaties which allocate water also include payments for water - 44 treaties (30%) include monetary transfers or future payments. As early as 1925, Britain moved towards equitable use of the rivers in its colonies - Sudan agreed to pay a portion of the income generated by new irrigation projects to Eritrea, since the Gash river flowed through that state as well. Treaties also recognize the need to compensate for hydropower losses and irrigation losses due to reservoir storage (the 1951 Finland/Norway treaty and the 1952 Egypt/Uganda treaty both include such compensation). Again, this fact emphasizes the monetary aspect of water: it does not describe water as a right or commodity.

Enforcement:

Treaties handle disputes with technical commissions, basin commissions, or government officials. Fifty-two (36%) of the treaties provide for an advisory council or conflict-addressing body within the government. Fourteen (10%) refer disputes to a third-party or the United Nations. Thirty-two (22%) make no provisions for dispute resolution, and 47 (32%) of the texts are either incomplete or uncertain in the creation of dispute resolution mechanisms.

Historically, force or the threat of force can ensure that a water treaty will be followed (e.g., British colonial treaties and the 1947 Allied peace treaty with Italy). Power is an unfortunate guarantor of compliance. Britain could oversee its colonial water treaties because it had one of the most powerful administrative and military organizations in the world. Agreements on the Nile generally favor Egypt, while those on the Jordan River favor Israel for similar reasons.

While the conflict resolution mechanisms in these treaties do not generally show tremendous sophistication, new enforcement possibilities exist with new monitoring technology - it is now possible to manage a watershed in real time, using a combination of remote sensing and radio-operated control structures. In fact, the next major step in treaty development may well be mutually enforceable provisions, based in part on this technology.

INDICATORS OF FUTURE WATER-RELATED TENSIONS[*15]

One can assume that each water treaty represents a dispute which has been resolved - some issue must arise for the parties to enter negotiations to begin with. It would stand to reason, then, that by assessing the variables which immediately preceded the negotiation of a treaty, one might be able to determine what factors act as indicators of impending dispute.

For example, many of the most virulent examples of water conflict came about immediately following the internationalization of a previously national waterway - such was the case on the Jordan, Indus, Nile, and Aral basins. The existence of ethnic minorities or political sub-groups along major waterways, then, may point to regions with the potential for future hydropolitical stresses - Kurdish regions along the Euphrates, or the Punjab between India and Pakistan, for example.

In contrast, and somewhat counter-intuitively, climate seems *not* to be a major variable in water disputes. This may be because water has multiple uses which are all critically important, but which change depending on climate conditions. The hydropower or transportation offered by a river in a humid climate, for example, is no less important to its riparians than is the irrigation water provided by a river in an arid zone. We see, then, hydropolitical disputes across the climatic spectrum, from the Plata and Ganges in the humid zone, to the Nile, Jordan, and Tigris-Euphrates, each of which have humid-zone headwaters, but which flow primarily through arid areas.

To do an extensive analysis of each of the basins represented by the treaties in our Database is beyond the scope of this paper, but the fourteen case studies mentioned above do suggest patterns which may be useful in allowing for anticipation of likely conflict.

In general, a pattern which emerges is as follows. Riparians of an international basin implement water development projects unilaterally first on water within their territory, in attempts to avoid the political intricacies of the shared resource. At some point, as water demand approaches supply, one of the riparians, generally the regional power, [*16] will implement a project which impacts at least one of its neighbors. This might be to continue to meet existing uses in the face of decreasing relative water availability, as for example Egypt's plans for a high dam on the Nile, or Indian diversions of the Ganges to protect the port of Calcutta, or to meet new needs reflecting new agricultural policy, such as Turkey's GAP project on the Euphrates.

[*15] Some of the following section is drawn from Wolf (1997).

[*16] "Power" in regional hydropolitics can include riparian position, with an upstream riparian having more relative strength *vis a vis* the water resources than its downstream riparian, in addition to the more-conventional measures of military, political, and economic strength. Nevertheless, when a project is implemented which impacts one's neighbors, it is generally undertaken by the regional power, as defined by traditional terms, *regardless* of its riparian position.

This project which impacts one's neighbors can, in the absence of relations or institutions conducive to conflict resolution, become a flashpoint, as described above. Each of these projects is preceded by indicators of impending or likely water conflict, which might include:

- *Water quantity issues*. Often, simply extrapolating water supply and demand curves will give an indication of when a conflict may occur, as the two curves approach each other. The mid-1960's, a period of water conflict in the Jordan basin, saw demand approaching supply in both Israel and Jordan. Also, major shifts in supply might indicate likely conflict, due to greater upstream use or, in the longer range, to global change. The former is currently the case both on the Mekong and on the Ganges. Likewise, shifts in demand, due to new agricultural policies or movements of refugees or immigrants can indicate problems. Water systems with a high degree of natural fluctuation can cause greater problems than relatively predictable systems.
- *Water quality issues*. Any new source of pollution, or any new extensive agricultural development resulting in saline return flow to the system, can indicate water conflict. Arizona return flow into the Colorado was the issue over which Mexico sought to sue the US in the 1960s through the International Court of Justice, and is currently a point of contention on the lower Jordan between Israel, Jordanians, and West Bank Palestinians.
- *Management for multiple use*. Water is managed for a particular use, or a combination of uses. A dam might be managed for storage of irrigation water, power generation, recreation, or a combination, for example. When the needs of riparians conflict, disputes are likely.

  Many upstream riparians, for instance, would manage the river within their territory primarily for hydropower where the primary needs of their downstream neighbors might be timely irrigation flows. Chinese plans for hydropower generation and/or Thai plans for irrigation diversions would have an impact on Vietnamese needs for both irrigation and better drainage in the Mekong Delta.
- *Political divisions*. A common indicator of water conflict is shifting political divisions which reflect new riparian relations. Such is currently the case throughout Central Europe as national water bodies such as the Aral Sea, the Amu Dar'ya, and the Syr Dar'ya become international. Many of the conflicts presented here, including those on the Ganges, the Indus, and the Nile, took on international complications as the central authority of a hegemon, in these cases the British empire, dissipated.

Along with clues useful in anticipating whether or not water conflicts might occur, patterns based on past disputes may provide lessons for determining both the type and intensity of impending conflicts. These indicators might include:

- *Geopolitical setting*. As mentioned above, relative power relationships, including riparian position, determine how a conflict unfolds (for a detailed examination of this issue, see Lowi 1993). A regional power which also has an upstream riparian position is in a greater situation to implement projects which may become flashpoints for regional conflict. Turkey and India have been in such positions on the Euphrates and the Ganges, respectively. In contrast, the development plans of an upstream riparian may be held in check by a downstream power as, for example, have Ethiopia's plans for Nile development by Egypt.

The perception of unresolved non-water related issues with one's neighbors, both water-related and otherwise, is also an exacerbating factor in water conflicts. Israel, Syria, and Turkey each, and respectively, have difficult political issues outstanding, which makes discussions on the Jordan and Euphrates more intricate.

- *Level of national development*. Relative development can inform the nature of water disputes in a number of ways. For example, a more-developed region may have better options to alternative sources of water, or to different water management schemes, than less-developed regions, resulting in more options once negotiations begin. In the Middle East multilateral working group on water, for instance, a variety of technical and management options, such as desalination, drip irrigation, and moving water from agriculture to industry, have all been presented, which in turn supplement discussions over allocations of international water resources.

  Different levels of development within a watershed, however, can exacerbate the hydropolitical setting. As a country develops, personal and industrial water demand tends to rise, as does demand for previously marginal agricultural areas. While this can be somewhat balanced by more access to water-saving technology, a developing country often will be the first to develop an international resource to meet its growing needs. Thailand has been making these needs clear with its relatively greater emphasis on Mekong development.
- *The hydropolitical issue at stake*. In a survey of fourteen river basin conflicts, Mandel (1992) offers interesting insight relating the issue at stake with the intensity of a water conflict. He suggests that issues which include a border dispute in conjunction with a water dispute, such as the Shatt al-Arab waterway between Iran and Iraq and the Rio Grande between the US and Mexico, can induce more severe conflicts than issues of water quality, such as the Colorado, Danube, and La Plata rivers. Likewise, conflicts triggered by human-initiated technological disruptions - dams and diversions - such as the Euphrates, Ganges, Indus, and Nile, are more severe than those triggered by natural flooding, such as the Columbia and Senegal rivers.

  One interesting lack of correlation is also found in Mandel's study - that between the number of disputants and intensity of conflict. He suggests that this challenges the common notion that the more limited, in terms of number of parties involved, river disputes are easier to resolve.
- *Institutional control of water resources*. An important aspect of international water conflicts is how water is controlled *within* each of the countries involved. Whether control of the resource is vested at the national level, as in the Middle East, the state level, as in India, or at the sub-state level, as in the United States, informs the complication of international dialog. Also, *where* control is vested institutionally is important. In Israel, for example, the Water Commissioner is under the authority of the Ministry of Agriculture, whereas Jordanian control is at the ministerial level, with the Ministry of Water. Theses respective institutional settings can make internal political dynamics quite different for similar issues.

- *National water ethos*. This term incorporates several somewhat ambiguous parameters together which determine how a nation "feels" about its water resources, which in turn can help determine how much it "cares" about a water conflict. Some factors of a water ethos might include:
  - ◊ "mythology" of water in national history, e.g., Has water been the "lifeblood of the nation?" Was the country built up around the heroic *fellah*? Is "making the desert bloom" a national aspiration? In most countries, in contrast, water plays little role in the national history.
  - ◊ importance of water/food security in political rhetoric.
  - ◊ relative importance of agriculture versus industry in the national economy.

CONCLUSIONS

There is a large and growing literature warning of future "water wars" - they point to water not only as a cause of historic armed conflict, but as *the* resource which will bring combatants to the battlefield in the 21st century.

The historic reality has been quite different. In the modern times, only seven minor skirmishes have been waged over international waters - invariably other inter-related issues also factor in. Conversely, over 3,600 treaties have been signed historically over different aspects of international waters - 145 in this century on water *qua* water - many showing tremendous elegance and creativity for dealing with this critical resource. This is not to say that armed conflict has not taken place over water, only that such disputes generally are between tribe, water-use sector, or state. What we seem to be finding, in fact, is that geographic scale and intensity of conflict are *inversely* related.

War over water is neither strategically rational, hydrographically effective, nor economically viable. Shared interests along a waterway seem to overwhelm water's conflict-inducing characteristics and, once water management institutions are in place, they tend to be tremendously resilient. The patterns described in this paper suggest that the more valuable lesson of international water is as a resource whose characteristics tend to induce cooperation, and incite violence only in the exception.

Nevertheless, 145 treaties which govern the world's international watersheds, and the international law on which they are based, are in their respective infancies. More than half of these treaties include no monitoring provisions whatsoever and, perhaps as a consequence, two-thirds do not delineate specific allocations and four-fifths have no enforcement mechanism. Moreover, those treaties which do allocate specific quantities, allocate a fixed amount to all riparian states but one - that one state must then accept the balance of the river flow, regardless of fluctuations.

While wars do not seem to be fought over water, water-tensions do crop up regularly which, if one considers each treaty the manifestation of a dispute resolved, are exemplified by the very prevalence of such treaties. By examining the conditions in each set of co-riparian states immediately before the resolution of their disputes, one finds patterns which not only may indicate a future water dispute, but may offer clues to the type and intensity of an impending conflict. These indicators might include water quantity issues; water quality issues; multiple uses of the water; political divisions; the geopolitical setting; level of national development; the hydropolitical issue at stake; water institutions; and depth of any national water ethos.

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Jamil Al-Alawi is currently President of the Business Promotion Center in Bahrain. He received his B.Sc. in Mechanical Engineering in 1967 in the United Kingdom. His career has encompassed positions with the Bahrain Ministry of Works, Power, and Water, where he was the Undersecretary for Power and Water from 1990-1995 and Assistant Undersecretary of Power and Water Affairs from 1976-1990; with the Bahrain Ministry of Development and Engineering Services, where he was both a project manager and project engineer; and with the Bahrain State Electricity Department, where he was an assistant project engineer. He is a past chairman of the Gulf Cooperation Council (GCC) Electrical and Water Equipment and Material Standardization Committee; a past chairman of the GCC Gulf States Electrical Interconnection Committee; a past president of the GCC Water Sciences and Technology Association; a past chairman of the Bahrain Water Resources Strategy Study; and a past chairman of the Privatization Committee for Electricity and Water. During 1995 and 1997 he was a member of the Board of Trustees of the World Water Council.

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Tony Allan graduated from Durham University in 1958. He received his doctorate from the University of London in 1971. He specialises in the renewable natural resources of arid regions and especially on water in the Middle East. His publications and edited publications include *Water, Peace, and the Middle East: Negotiating Natural Resources in the Jordan Basin* (1966), *Water in the Middle East: Legal, Political, and Commercial Implications* (1995), and *The Nile: Sharing a Scarce Resource* (1995). He advises governments and international agencies on water issues.

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David Behar is a private consultant focusing on California water issues. One of his current clients is Global Green USA, the U.S. chapter of Green Cross International. Last October, Mr. Behar developed for GGUSA a series of private meetings and a public forum in Los Angeles featuring GCI president Mikhail Gorbachev on the subject of international freshwater conflict resolution, with an emphasis on processes underway in California. From 1991-97, Mr. Behar was executive director of The Bay Institute of San Francisco, one of the most active environmental NGOs working on California water policy and the protection of the San Francisco Bay/Delta estuary. During his tenure, The Bay Institute was instrumental in passing through Congress the Central Valley Project Improvement Act, negotiating the landmark Bay/Delta

Accord, and launching the CalFed Bay/Delta Program, which is currently seeking long-term solutions to longstanding California water policy conflicts. Prior to joining The Bay Institute, Mr. Behar served as an aide to U.S. Senator Alan Cranston (D-CA).

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Barbara Heinzen is a geographer who comes from New York and is now based in London working as a freelance consultant in long range scenario planning and policy analysis. She has specialised in working with organisations who need to understand the driving forces of change in societies experiencing the pressures of development, of post-communist transition or of economic restructuring. Barbara Heinzen has worked with a variety of organisations in the public, private and voluntary sectors. These include the Gorée Institute in Senegal and ActionAid as well as Bankgesellschaft Berlin, Singapore Airlines, Unilever, Volvo, the World Business Council for Sustainable Development, the Open Society Institute and the Dutch Ministry of Home Affairs. In 1992 she co-founded BEAD (Business Exchange on Aids and Development) to help companies respond to the AIDS epidemic in developing countries. She is a Senior Research Associate at the School of Oriental and African Studies (University of London) and a Network Member of Global Business Network.

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Jad Isaac is the director general of the Applied Research Institute-Jerusalem (ARIJ), which is a leading Palestinian institution working in the field of sustainable development and natural resources management. He holds a Ph.D. degree in plant physiology from the University of East Anglia. He has written extensively on the water situation in Palestine. He served as the head of the Palestinian delegation to the environmental working group in the multilateral track of the peace process.

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Cormac McCarthy is a senior manager within Severn Trent and works within that company's international division. He is a civil engineer with a PhD in project management (topic: contractual models for Build-Operate-Transfer and Operations-Maintenance-Training). He is currently resident in Belgium where he is Severn Trent's country manager and is also a director of a joint venture subsidiary company, Aquaplus nv. The Flemish PPP company Aquafin is one of the largest such companies in the world serving up to 5-6 million people with a full sewerage service.

Severn Trent plc is one of the world's largest private water companies serving 8 million people with full water and sewage service in Great Britain and a further 8 million in other countries. It is quoted on the London Stock Exchange where it features in the top 100 companies.

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Prof. Pohoryles is the Director of the Andreas Agricultural Development Trust at the Peres Center for Peace. He is also a special adviser for international agricultural development at the Peres Center For Peace and Chairman of Agrindus International LTD. Among other posts, he has served as a special adviser for international development to the Ministries of Foreign Affairs and Agriculture (1993-97) and as a professor of rural development at Tel-Aviv University (1970-88). He holds doctorates in both agriculture and economics.

Prof. Pohoryles main activities include development of arid and semiarid ecosystems, integrated regional development programs, structural adjustments of the agricultural sector, agricultural and technological forecasting, urban-rural relations, evaluation of World Bank projects, regional pilot demonstration projects, and demand-supply relations.

Prof. Pohoryles has published 24 books, 25 chapters in books and scientific collections, 91 journal articles, and numerous reports and abstracts and has edited in Hebrew, English, Spanish, German, Russian, Chinese, Italian, and Arabic.

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Hillel Shuval was born in Washington D.C. He earned his undergraduate degree in water resources and environmental engineering at Cornell University. He settled in Israel in the early years after the founding of the State and joined the staff of the Ministry of Health, where he served as Chief Environmental Health Engineer until l965. He received his graduate training in Environmental Health and Engineering at the School of Public Health at the University of Michigan.

In l965, he was appointed Professor of Environmental Sciences at the Hebrew University of Jerusalem. He founded the Division of Environmental Sciences at the School of Applied Science. He was visiting Professor at MIT, and University of Michigan, and in 1993/4 Visiting Professor at the Institute for Social and Economic Policy in the Middle East at Harvard University on the Harvard Middle East Water Project. He currently serves as Visiting Professor at the International Academy of the Environment-Geneva.

He has served as consultant on environmental engineering and water resources questions to the WHO, the World Bank, EU, and the United Nations Environment Program. He has served as a consultant to governmental agencies, consulting engineers, and industries in Chile, Peru, India, Australia, Egypt, France, Switzerland, the United States of America, and the People's Republic of China.

In 1988, he was awarded the Israel Environmental Quality Prize for his "outstanding contributions in promoting the quality of the environment in Israel," and for his campaign to safeguard and conserve Israel's aquifers.

As an advisor to the World Bank and World Health Organization he played a critical role in drafting the Engleberg Report and the new WHO health guidelines for recycling and reuse of wastewater in agriculture. He is a Diplomate of the American Academy of Environmental Engineers; a Fellow of the American Public Health Association; past Chair, Israel Ecological Association; past vice-president of the International Water Quality Association; and Chair the Israel Chapter of the International Water Resources Association.

In recent years he initiated joint research projects with Egyptian, Palestinian and Jordanian water scientists on shared environmental and water resources problems and studies on resolving the water conflicts of the Middle East sponsored by USAID and the EU. He is co-author of a joint Israeli-Palestinian "Water for Peace Plan" and the book "Water and Peace in the Middle East." He served as co-Chairman of the First Israeli-Palestinian International Academic Conference on Water held in Zurich in 1992.

Professor Shuval has published over 200 scientific papers and seven books on various aspects of environmental sciences and engineering, particularly on the health, technological, and policy aspects of wastewater recycling and reuse; viruses in water; water quality; water disinfection; marine pollution; low cost wastewater treatment; approaches to resolving Middle East water conflicts; and global water resources planning and management.

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'Sree' N. Sreenath received his Bachelors from Bangalore University, India in 1980, his masters in Engineering from the Indian Institute of Science, Bangalore, India in 1982, and his PhD from the University of Maryland, College Park, in 1987. Currently, he is the Program Director for the Systems and Controls Program of the newly created Department of Electrical, Systems, Computer Engineering, and Science of Case Western Reserve University (CWRU), Cleveland, Ohio, where he has been a faculty member since 1988, first as an Assistant Professor, and from 1994 onwards as an Associate Professor.

For the past seven years he has been interested in the broad topics of global issues, sustainable development, integrated assessment, and computer-based reasoning for policy analysis, negotiation support, and conflict resolution. His area of specialty is in the application of systems science techniques to the problem of understanding the interaction of population, resource constraints, economy, policy making, and the environment. In addition to many research papers, he has published *Systems Representation of Global Climate Change Models*, Springer-Verlag, 1993. His present work has focused on the design of regional and international policies for a realistic, feasible and desirable future, and the understanding of structural properties of integrated global systems.

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Recent work has also focused on the future impact of development in regions where water resources shared between nations could potentially constrain growth and create conflict. In particular, a case study of the Nile River Basin Problematique involving Egypt, Ethiopia, and the Sudan was conducted.

He is a Co-Director of a United Nations Education Scientific and Cultural Organization (UNESCO) and CWRU sponsored *Global-Problematique Education Network Initiative (GENIe)* along with Prof. M. D. Mesarovic at CWRU. The UNESCO GENIe program spans high schools to universities with student groups around the world working cooperatively and jointly over the Internet.

His efforts in the area of education have been recognized by two awards, the CWRU Undergraduate Teaching Excellence Award for 1995-96, and the Center for Professional Ethics Fellowship for 1996. In 1991 he was selected as a Lilly Teaching Fellow. He has been a pioneer in the use of symbolic computation in control education. Software that he has created, the Control SYstems PAcKage (COSY-PAK) has been distributed over the Internet to over 1000 locations around the world, and has been published in two CD-ROMs.

He was selected as one of the first fellows of the Systems Research Center (SRC)-a forerunner of the well known Institute of Systems Research at the University of Maryland, College Park.. Sreenath has held the NASA-OAI Summer Faculty Fellowship and the NASA-USRA Fellowship and was a National Merit Scholarship holder. He is the founding chairman of the IEEE Control Systems Society, Cleveland Chapter, IEEE, and a member of Tau Beta Pi Honor Society.

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Kenneth Strzepek is a Senior Associate at the Stockholm Environment Institute, an Associate Professor of Civil and Environmental Engineering at the University of Colorado, and a Research Affiliate in the Department of Civil and Environmental Engineering at MIT. He received a B.Sc. in Civil Engineering (1975), a M.Sc. in Water Resources and Environmental Engineering (1977), and a Ph.D. in Water Resource Systems (1979), all from the Massachusetts Institute of Technology. He is currently a candidate for an M.A. in Economics from the University of Colorado.

From 1993 to 1994, he was a Water Resource Economist and Deputy Leader, Water Resources Project, at the International Institute for Applied Systems Analysis, Laxenburg, Austria, where he headed the Climate Change, Water Resources and Socio-Economic Impacts Project. From 1986 to 1991, he was the Founding Director of Center for Advanced Decision Support for Water and Environmental Systems (CADSWES), University of Colorado, Boulder, whose mission was the incorporation of models and data analysis in water and environmental policy and operational decision making.

He received the Department of Interiors Citizen's Award for the contributions of CADSWES to US water management. He was leader of the Climate, Environment, and Sustainability Project in the Environment and Behavior Program of the Institute of Behavioral Science at the University of Colorado. He was on the faculty of the Dept. of Civil Engineering, Texas A&M University, 1984-1986, and was Adjunct Professor of Quantitative Analysis, Dept. of Economics and Finance, Webster University, Vienna, Austria, 1982-83. From 1980 to 1982 he was a research scholar in the Water Resources and Food and Agriculture Programs at the at the International Institute for Applied Systems Analysis, Laxenburg, Austria.

Dr. Strzepek has over 20 years of professional experience specializing in the application of operations research, systems and policy analysis, computer applications and economics related to the management of water and environmental systems. He is a noted expert on planning tools for integrated river basin management, the application of advanced computer techniques for water and environmental management, the use of computer-based quantitative methods in public policy and decision making. He is a consultant and advisor to industry, water management organizations, consulting firms, UN agencies, and US and foreign governments.

2.3.11. I.H. Olcay Ünver

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Since 1991, Olcay Ünver has been President of the Republic of Turkey's Southeastern Anatolia Project (GAP) Regional Development Administration. GAP is the largest development project ever undertaken by Turkey and one of the largest in the world. GAP is an integrated, multi-sectoral project based on water resources development in a 75,000 square kilometer area with a population of over 6 million people. The GAP Regional Development Administration is charged with the planning, coordination, and monitoring of all activities in agriculture, energy, transportation, telecommunications, industry, health, education, and urban-rural infrastructure. In his capacity as President, Dr. Ünver actively interacts with international organizations, finance institutions, and foreign governments.

His GAP accomplishments have included development of the sustainable development definition for GAP and management of its implementation; initiation of special programs to improve the status of women and other less advantaged groups; modification of projects to involve stakeholders and NGOs in planning and management; initiation of projects for sustainable use of natural resources; and development of support and partnership programs for local initiative, including entrepreneurship development. Between 1989 and 1991, Dr. Ünver was Regional Director of the GAP Regional Development Administration, based in Sanliurfa, Turkey. Dr. Ünver holds a B.S. (with honors) and an M.S. in Civil Engineering from the Middle East Technical University. He received his Ph.D. in Civil Engineering from the University of Texas at Austin in 1987.

Among other affiliations, he is currently a member of the Board of Governors of the World Water Council based in Marseilles, France; a Council Member of the International Hydropower Association, London, UK; a member of the Steering Committee of the Middle East and Mediterranean Desert Development Programme; a member of the Agribusiness Council of the Black Sea Economic Cooperation Foundation of the United States; a member of the National Olympic Committee of Turkey; and Honorory Governor of the Agricultural Energy and Mechanization Foundation of Turkey.

Between 1989 and 1991 Dr. Ünver was a part-time lecturer at Dicle University in Sanliurfa, Turkey. Among his publications are included "An Integrated, Regional Socioeconomic Development Project: GAP," in the *International Journal of Water Resources Development*. He is currently preparing "The Southeastern Anatolia Integrated Development Project (GAP) from a Sustainability Perspective."

2.3.12. Aaron T. Wolf

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Aaron Wolf is an assistant professor of geography whose research and teaching focuses on the interaction between water science and water policy, particularly as related to conflict and conflict resolution. He has an M.S. in water resources management (emphasizing hydrogeology) and a Ph.D. in environmental policy analysis (emphasizing dispute resolution) from the University of Wisconsin, Madison.

His recent research focuses on issues relating international water resources to political conflict and cooperation, where his training combining environmental science with dispute resolution theory and practice have been particularly appropriate. He has acted as consultant to the US Department of State, the US Agency for International Development, and the World Bank on various aspects of international water resources and dispute resolution. He has been involved in developing the strategies for resolving water aspects of the Arab-Israeli conflict, including co-authoring a State Department reference text, and participating in both official and "track II" meetings between co-riparians. He is author of Hydropolitics Along the Jordan River: The Impact of Scarce Water Resources on the Arab-Israeli Conflict, (United Nations University Press, 1995), and a co-author of Core and Periphery: A Comprehensive Approach to Middle Eastern Water, (Oxford University Press, 1997).

Wolf coordinates the Transboundary Freshwater Dispute Database, which includes a computer database of 150 water-related treaties, negotiating notes and background material on fourteen case-studies of conflict resolution, news files on cases of acute water-related conflict, and assessments of indigenous/traditional methods of water conflict resolution.

Wolf is a member of the Association of American Geographers, the American Water Resources Association, the International Water Resources Association, and the International Association for Impact Assessment. He is an associate editor of the Journal of the American Water Resources Association, Water International, and World Water Policy.

3. APPENDICES

3.1. AGENDA

Time Period	Activities and Issues	
09.30 - 12.00	**Intro & Idea Exchange**	
Session 1	- Events that Led to the Workshop	Dr Bertrand Charrier, Director
	- Objectives and Process of the Workshop	Mike Hiniker, Green Cross
	- Socio-economic Scenarios and Water	Dr Ken Strzepek, SEI & UCol
	- The Desalination Option	Jamil Al-Alawi & S. McCarthy
	- Computer Modeling Demonstration	Dr Sree Sreenath, Case Western
	- Identify Opportunities (Work Session)	Dr Jerry Delli Priscoli, IWR
13.00 - 16.00	**Formal Presentations**	
Session 2	**Chaired by Dr. Mahmoud Abu Zeid**[*1]	Dr Janos Bogardi, Secretary[*2]
	- The Mikhail Gorbachev GC Initiative	Prof A. Likhotal, Vice President[*3]
	- UNESCO as Full Partner in the Initiative	Prof A. Badran, Deputy D-G[*2]
13.00 - 13.30	- *Summary of Session 1*	Dr A. Szöllösi-Nagy, Director[*2]
13.30 - 14.15	- Regional Socio-economic Dev. - Water Security, Food Security And - Global Soil Water Solution - *Questions and Responses*	Dr Olcay Unver, Pres GAP, TK Prof Hillel Shuval, Hebrew UOJ Prof Tony Allan, SOAS, ULdn
14.30 - 15.15	- Alleviating Fears About Water - Conflict and Cooperation - South West USA Arid Area Experience - *Questions and Responses*	Dr Jad Isaac, ARIJ, Palestine Prof Aaron Wolf, Univ. Alabama Mr David Behar, California
15.15 - 16.00	- Water Saving Opportunities in Agriculture - Private/Public Partnership Arrangements - Scenarios as a Management Tool - *Questions and Responses*	Prof Samuel Pohoryles, Peres PC Mr Cormac McCarthy, Severn T Ms Barbara Heinzen, WBCSD
16.30 - 18.30	**Workshop to Shape the Next Steps ... the Middle East Water Forum**	
Session 3	Facilitated by Dr Jerry Delli Priscoli, Institute for Water Ressources, USA - WHAT is the most valuable contribution we can make now ? - HOW will we accomplish this ? - WHO accepts responsability to implement ?	

[*1] *Chairman WWC, Minister, Public Works and Water Resources, Egypt*

[*2] *Adnan Badran, UNESCO; A. Szöllösi-Nagy & J.Bogardi,UNESCO IHP*

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3.4. PROFILE OF GREEN CROSS

Green Cross International was founded by **Mikhail Gorbachev** in 1993, building on the 1992 Earth Summit in Rio de Janeiro and Agenda 21. Our mission is to help create the conditions for a sustainable future by cultivating a more harmonious relationship between humans and the environment. Green Cross concentrates its efforts on 5 programs whose common theme is to promote a significant change in human values.

3.4.1. INTERNATIONAL PROGRAMS

Earth Charter - Green Cross strives to broaden the scope and effectiveness of laws and governance systems affecting the environment. The Earth Charter initiative is a brief set of fundamental values and principles intended to serve as a universal code of conduct to guide people and nations towards a sustainable future. In partnership with the Earth Council and other like-minded organizations throughout the world, and via a global participatory process, we are contributing to the drafting of the Earth Charter. We are working to have these mutually agreed principles approved by the United Nations (e.g., through national hearings and regional seminars and an interactive drafting effort).

Environmental Legacy of Wars - Green Cross works to mitigate the social, environmental, and economic consequences of man-made damage attributable to wars (especially the Cold War). We help people and communities afflicted by chemical and nuclear environmental contamination. We promote clean-up and conversion of military bases. We seek the environmentally-responsible destruction of chemical weapons stockpiles, and we contribute to the determination of clean-up priorities for nuclear contamination. We endeavor to convince competing sectors of society and institutions to work together in a democratic fashion to elaborate sustainable solutions (e.g., through the Kids-for-Kids health improvement camps in Russia and Belorussia, the Third Russian Public Hearings on Chemical Weapons Destruction, and studies of such issues as the impact of the Gulf War on the Kuwait environment).

Water and Desertification - Since more than 1.2 billion people live without access to adequate drinking water, Green Cross seeks to mitigate conflicts linked to the growing pollution and scarcity of freshwater. We also strive to stop land degradation in dry areas, i.e. desertification. We contribute to the solution of water problems in specific communities, where we convene people representing all interest groups to shape viable mutual solutions. Current projects are focused on promoting cooperation leading to mutual benefits among competing stakeholders and on information dissemination and training (e.g., organization of workshops on water scarcity/conflict in the Middle East, and tree planting and training in Burkina Faso).

Energy and Resource Efficiency - Green Cross advocates reduced consumption of energy and natural resources by promoting new consumption patterns. We place emphasis on dissemination of information about energy efficiency and renewable energy and on technology transfer by means of technology cooperation partnerships. Currently we are working on the design of efficient and affordable housing for low-income neighborhoods (e.g., through the "greening affordable housing" project in the USA).

Environmental Education and Communication - Green Cross works to have environmental principles integrated into traditional classroom education programs (e.g., via the Earth Charter International Youth Contest). We organize conferences for educators on environmental topics (e.g., the Fourth International Conference on Environmental Education in Russia). Environmental education and information dissemination is a cross-cutting element of everything we do. Thus, we regularly organize workshops, roundtables, seminars, hearings and fora and publish information on the Internet that focuses on the programs described above.

Other Cross-Cutting Projects - Green Cross national organizations are also independently but actively working on cross-cutting projects that relate to the general thrust of the above International Programs and include:

- Environmental Response Network for Emergencies by GC UK with support of Kingston University
- Neuquen 2020 Project in Patagonia region by GC Argentina
- Youth for Environment Movement by GC Switzerland's special team of students.

3.4.2. NATIONAL ORGANIZATIONS

Green Cross organizations are active in 21 countries. The organizations in Germany and the USA have adopted the name "Global Green."

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Additional information is available on the Internet at URL ***http://www.gci.ch***

3.5. PROFILE OF UNESCO IHP

UNESCO's International Hydrological Programme

Water - the source of life and human civilisation - is set to become one of the major issues of the 21st century. During the coming years problems associated with water shortage will affect the lives of virtually everyone on the planet. Regions of the world facing water shortages are growing. Issues concerning the world's fresh waters highlight the dilemma facing humankind. Can competition between the environment and development be transformed into a partnership between the two, so that the goal of sustainable development is met?

The rational and equitable management of water use is ultimately the responsibility of us all.

UNESCO's International Hydrological Programme is the only science and education programme of the United Nations in the field of hydrology and water resources. It is a vehicle through which Member States can upgrade their knowledge of the water cycle and thereby increase their capacity to better manage and develop their water resources. IHP is a truly international programme reflecting the needs of and participating in the execution of the activities of its Member States. IHP is governed by the Intergovernmental Council and its Secretariat, housed at the Division of Water Sciences of UNESCO, Paris, plays a catalytic role in the execution of the Programme. The UNESCO regional offices, five of which have Regional Hydrologists, play an increasingly important role in supporting the implementation of the Programme.

Regional co-operation is an important aspect of IHP's global programme and Headquarters and the Regional Offices work closely with some 160 national committees and focal points in implementing its activities.

The International Hydrological Programme (IHP) was originally launched as the International Hydrological Decade (IHD) in 1965, and afterwards, as an international programme, has had a number of successive multi-year phases; the theme of the present fifth phase which extends from 1996-2001 is: Hydrology and Water Resources Development in a Vulnerable Environment.

IHP's objectives are to stimulate a stronger interrelation between scientific research, application and education. Emphasis is on environmentally sound integrated water resources planning and management supported by a scientifically proven methodology.

Access to knowledge and education is a human right. IHP sponsors post-graduate hydrology courses with emphasis on a multidisciplinary approach. It is also engaged in preparing computer-based learning materials and, in co-operation with other UN agencies, a thesaurus of water resources terms. The UNESCO/WMO International Glossary of Hydrology is regularly updated on CD-ROM. IHP publications include the International Hydrology Series, Studies and Reports in Hydrology, Technical Papers in Hydrology, Technical Documents in Hydrology, IHP Humid Tropics Programme Series, WATERWAY (IHP Newsletter).

Further information on the International Hydrological Programme (IHP) can be obtained from:

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The IHP Homepage may be consulted on the World Wide Web at the following locations:
http://www.unesco.org and http://www.pangea.org/orgs/unesco/

3.6. ACKNOWLEDGEMENTS

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