Identification of Joint Management Structures for Shared Aquifers

A Cooperative Palestinian-Israeli Effort

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Marwan Haddad
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The World Bank
Washington, D.C.
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Foreword

In recent years there has been an increasing reliance on groundwater for water supply worldwide. Groundwater, however, is highly susceptible to pollution and to salinization, and it is very difficult to rehabilitate once the water quality has deteriorated. Consequently, it has become increasingly important to ensure that aquifers are managed judiciously and in a sustainable manner.

Groundwater, like surface water, does not conform to either administrative or international boundaries. While there is extensive experience in the management and adjudication of cross-boundary surface water, less information exists on the management of transboundary groundwater. Consequently, the need to establish a mechanism for identifying and establishing cross-boundary management institutions for groundwater has become more pressing.

This paper presents a mechanism for identifying possible transboundary groundwater management regimes on the basis of a five-year project undertaken cooperatively by Palestinian and Israeli researchers. The study was conducted by the Truman Institute for Advancement of Peace at the Hebrew University of Jerusalem and the Palestine Consultancy Group, an umbrella group of Palestinian research institutions. The paper advances an open-ended approach for identifying cross-boundary management institutions for groundwater basins. In addition, the authors discuss the work they conducted, focusing on the elements that allowed for such a cooperative effort.

While the need for joint management of shared aquifers may be more apparent in the Middle East in general, and in the Israeli-Palestinian case in particular, this political setting is only a backdrop for the main issue addressed in the paper - the identification of ways to advance joint management structures where none existed before. The paper also discusses the implications of changes in the geopolitical setting on the efforts to establish joint management structures. However, this discussion does not imply that its conclusions are limited to the Israeli-Palestinian case. On the contrary, the points raised in this case are likely to be relevant in a wide array of settings.

As the authors maintain throughout the paper, the establishment of joint management structures for transboundary aquifers should be viewed as a process. It is hoped that this paper will represent an important step toward better management of shared aquifers in all parts of the world.

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Director
Rural Development Department
Chair, Rural Board
Abstract

In this study, the authors provide an approach for building joint management institutions over time for groundwater, and present some of the lessons that may be gleaned from their collaborative experience. Although the paper's focus is limited to the Israeli-Palestinian situation, the conclusions reached in this study can be applicable to other settings.

The paper begins by describing the process by which the joint management institutions were identified. This process is described at two levels: one, the course that the team went through; and two, the analytical approach by which these structures were identified. The authors then describe the outcome of the first phase of the team's work, namely, a flexible-sequential capacity building structure. In the second phase of the team's work this structure was further scrutinized, given the geopolitical changes in the region, and its accumulated experience. In addition, issues that did not receive sufficient or any attention in the first phase were discussed in the second phase. As a result, a number of issues and problems that may adversely affect the implementation of joint management structures were identified. These are described in the fourth section. A brief discussion of the process and outcomes is presented in the fifth section of the paper. Particular attention is given to the possible role and limitations of international organizations in this process, as seen from the local (i.e. Israeli and Palestinian) perspective. While the discussion focuses on the Israeli-Palestinian case, the process and results are likely to be applicable in a much wider array of cases, including at the sub-national level.
Acknowledgments

An Israeli-Palestinian team conducted the work on which this paper is based over a four-year period. Shaul Arlosoroff and Taher Nasseredin participated in all the stages of this work. Ali Wihaidi participated in the first phase of the study. In addition, many experts participated in their private capacities in the four workshops conducted as part of this effort. Many of the ideas presented in these pages originate from the important contributions of these team members. We thank them all for their support.

The work was a cooperative enterprise of the Palestine Consultancy Group and the Truman Institute for the Advancement of Peace of the Hebrew University of Jerusalem. The International Development Research Center (IDRC), Canada, and the CRB Foundation generously funded it. David Brooks, Dan Bitan, Issa Kahter and Edy Kaufman did everything possible to facilitate this study within this complex institutional setup.

This paper was submitted to Israel's Commissioner of Water, Meir Ben-Meir and to the Chairman of the Palestinian Water Authority, Mr. Nabil El-Sharif for their comments. We are grateful for their time and consideration in reviewing it.

The publication of this paper was made possible through the sponsorship of the Water Resources Thematic Group of the Rural Development Family at the World Bank. We are grateful to the thematic group team for its support and encouragement, and particularly to Ariel Dinar for suggesting the publication of this paper in this venue.

We also would like to recognize the many specialists within and outside the World Bank who read the paper and provided insightful comments, including Franklin Cardy, Stephen D. Mink, and Miguel Solanes of UN/ECLAC. We also are indebted to Joseph Saba of the West Bank/Gaza Program, Jamal Saghir and Andrew Macoun of the Middle East and North Africa (MENA) region for their invaluable assistance in facilitating the publication of this paper.

Finally, we would like to thank Lili Monk for her endless efforts in reviewing, editing and publishing the paper. Still, the views and positions expressed in this paper are solely those of the authors and do not represent those of any other institution or body.


Introduction

Water can be both a source of conflict and a basis for cooperation. The discrepancy between water sources, water users, spheres of control (either at the national or sub-national level) and ownership patterns, and the extensive externalities involved can all be a basis for conflicts. In essence, the effects water withdrawals or wastewater disposal upstream may have on users downstream have often been a basis for contention. Yet, overcoming the scarcity and temporal variance of water availability in semi-arid regions, or the excess of water in temperate regions, often requires cooperation. Thus, water works and institutions have long been central elements of societal organization (Wittfogel, 1957).

All these factors have been well recognized in riverine systems. However, they are just as pertinent to groundwater. Groundwater basins do not conform any better to administrative and international boundaries than surface water, or involve lesser externalities. While most of the attention has focused on cross-boundary surface flows, the growing dependence on groundwater in many parts of the world requires that cross-boundary groundwater should not be overlooked if conflicts are to be contained and cooperation enhanced.

There is widespread recognition that groundwater is best managed in a comprehensive manner (Das Gupta, 1993; Hayton, 1982). This is especially true in light of the susceptibility of aquifers to pollution, their liability to salinization if they are over pumped, the high levels of uncertainty regarding their structure, the often not fully understood inter-relationship between groundwater and surface water, and the potential of aquifers to serve as multi-year storage within comprehensive management schemes. In cross-boundary circumstances this implies a need for joint management, as in most situations it is unlikely that any party will be able to manage its share of an aquifer (assuming such a share can be clearly defined and identified) in a sustainable manner independent of other parties.

These issues are of particular importance in the Palestinian-Israeli context, since the area has been the scene of a protracted and still unresolved conflict, which is still subject to negotiations. Currently, the mountain aquifers underlying the West Bank and Israel (Map 1) provide approximately 35 percent of Israel’s total annual consumption. Moreover, the western-shared aquifer is Israel’s major multi-year storage of high-quality water, and thus is arguably the most important element in its water supply system. The same aquifers provide virtually the total consumption of the Palestinians on the West Bank. Moreover, there are no other readily available groundwater sources for the Palestinians and there are no other cross-seasonal and multi-year storage options available to them. The Israeli-Palestinian case is further complicated by the forecasts for a rapid increase in domestic demand, due to the high levels of population growth in both parties and the likelihood of increasing per-capita use in the Palestinian sector, the fact that

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1 The Palestinian share in the Jordan River basin is also unresolved at present. Since this issue is largely independent of the mountain aquifers it is not addressed here.
all the feasible freshwater sources have been utilized\textsuperscript{2} and the rapid rate of development over aquifer recharge areas.

There is scant practical experience in joint management of shared aquifers, much of which cannot be seen as successful. While there is extensive experience in the management of cross-boundary surface water, that experience is not directly transferable due to the inherent differences between ground and surface water, making the management of groundwater more difficult and risky than that of surface water\textsuperscript{3}. Overall, only limited attention has been given to cooperation mechanisms, as the focus of international law has been on allocation of (surface) freshwater (Benvenisti, 1996). The few attempts to identify cooperative mechanisms for groundwater tried to define ‘ideal’ management regimes for groundwater. Foremost among these attempts is the Bellagio draft treaty, modeled after the U.S.-Mexico case (Hayton and Utton, 1989). Yet, these attempts focused on an ‘end state’ providing only limited guidance as to how that ‘end state’ may be achieved. One of the few applicable lessons that can be gained from the extensive experience with international surface water management, and the more limited sub-national experience in groundwater management, is that management institutions develop over time. Usually institutions initially focus on a single issue, and where they prove successful the scope of their responsibilities may eventually expand.\textsuperscript{4} Thus there is a need to identify an approach for building joint management institutions over time for groundwater.

This paper describes the approach taken by an Israeli-Palestinian team to identify joint management structures for the aquifers shared by these two parties and some of the lessons that may be gleaned from their experience. It begins by describing the process by which these institutions were identified. The process is described at two levels: one, the process the team went through; and two, the analytical approach by which the structures were identified. Then, the outcome of the first phase of the team’s work, a flexible-sequential capacity building structure is described. In the second phase of the team’s work this structure was further scrutinized, given the geopolitical changes in the region, and the accumulating experience. In addition, issues that did not receive sufficient or any attention in the first phase were discussed in the second phase. As a result, a number of issues and problems that may adversely affect the implementation of joint management structures were identified. These are described in the fourth section. In the fifth section a brief discussion of the process and outcomes is presented. Particular attention is given to the possible role and limitations of international organizations in this process, as seen from the local (i.e. Israeli and Palestinian) perspective. While the discussion focuses on the Israeli-

\textsuperscript{2} Actually, several sources have been overutilized, and there are grave concerns over the long-term viability of several aquifers, in particular the Gaza aquifer (Macoun, 1995).

\textsuperscript{3} The most important differences are (a) the inability to control groundwater flows, thus precluding solutions based on diversions (such as implemented in the Indus River case), (b) the inability to clean up aquifers once polluted or salinity levels rise, and (c) the much higher levels of uncertainty regarding aquifer flows and boundaries.

\textsuperscript{4} Examples include the Rhine River, the Danube basin, the Nile, the Murray-Darling basin, and the experience with cross-jurisdiction groundwater management in Southern California and the Edwards Aquifer.
Palestinian case, the process and results are likely to be applicable in a much wider array of cases, including at the sub-national level.

The Process

In early 1993 the Palestine Consultancy Group, an umbrella group of Palestinian research institutions, and the Truman Institute for the Advancement of Peace of the Hebrew University of Jerusalem searched for appropriate research efforts to follow up on the first Palestinian-Israeli water conference held in Zurich in December of 1992 (Isaac and Shuval, 1994). The study described hence was formulated in response to this search. Two outside (Canadian) sources, the International Development Research Center (IDRC) and the CRB Foundation, funded the study. The two principal researchers were affiliated with universities a fact, which allowed them to pursue this study as part of an academic research effort, regardless of the positions, held by Israel and the Palestinian authorities at the time. This was important since it allowed the researchers to propose options without committing anybody to these propositions (including the participants themselves when appearing under formal hats). The two principal researchers were joined in the research team by leading experts with current or past experience at the top level of water administration in Israel and the occupied territories.5

The first phase of the study took two years. It was greatly facilitated by the environment of rapid and sometime dramatic developments in the overall peace process, in particular the declaration or principles agreed upon in Oslo and signed in Washington in September 1993, followed by the Gaza-Jericho accords of 1994 and Oslo B accords of September 1995. Still, closures following terrorist attacks (such as the Hebron massacre in February 1994, or suicide bombings later on) created technical difficulties, as Palestinians involved in the study were prevented from reaching Jerusalem, where most meetings were held.

The structure of the first phase of the study shown in Figure 1 included two closed international workshops. Participation in each workshop was limited to approximately thirty invited experts. About one third of the experts were Israelis one-third were Palestinians and one-third were of other nationalities. A specific agenda was set for each workshop. The first workshop focused on the international experience with regard to cross-border water resources and the issues that need to be addressed when managing an aquifer in general, and the mountain aquifers in particular. The second workshop focused on more specific issues, such as the requisites for the management of aquifers, the potential of water trading, and the legal and institutional facets of joint management.

Each workshop was comprised of papers prepared in advance (and included in the workshop proceedings) and of a series of roundtable discussions. The main points raised in these dis-

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5 The experts are Mr. Shaul Arlosoroff, formerly deputy Water Commissioner of Israel and head of a national committee for examining the national water policies, and Mr. Taher Nasseredin, director of the West Bank water department. In the first phase Mr. Ali Wahiadi, director of the Gaza water department was also part of the team.
cussions were summarized in the proceedings. However, the discussions were not recorded, and statements were not attributed to the speakers in order to assure them that they could speak freely regardless of their official affiliations.

Figure 1: Identification of Appropriate Structure for Joint Aquifer Management

STAGE ACTION

I

Lit. Surveys Previous

Identification of Issues Joint

International Expertise

Workshop I

Local Expertise

II

Identification of Structural

Identification of Criteria

Delineation of Structures

III

Workshop II

Evaluation Possible

Identification Appropriate

Revisions Final

The research team held several meetings before and after each workshop. In these meetings the tasks that needed to be addressed by joint management institutions were discussed among the participants. On this basis, nineteen initial structures were identified. A basic governance structure was proposed for each one, and its main attributes outlined (Table 1). These were then evaluated according to criteria elicited in the discussions during the second workshop. On this basis the team met for an intensive two-day working sessions, following which a final report of this phase was drafted (Feitelson and Haddad, 1995). In this report a flexible-sequential approach for building up joint management structures over time was advanced. These structures are described later in this paper.

All the structures identified at this stage had several elements in common. In particular, all emphasized the need to begin with confidence-building measures, in particular joint monitoring and data sharing, and the establishment of conflict resolution mechanisms. The first step of the second phase was therefore a more careful scrutiny of these issues. In the first phase, water rights and allocations were not discussed, as they were seen as sensitive issues, which would need to be resolved by decisionmakers. However, many of the structures proposed have direct bearing on the definition of water rights and the determination of water allocations. Moreover, it is unlikely that any structure could be implemented before these issues are resolved. Thus, in the second phase these issues were addressed. In this phase two additional workshops were held. One focused on the technical issues, and one on the question of water rights.

Important geopolitical shifts were taking place during the course of this study. First, the Oslo B accords were signed in September 1995. The accords called for the establishment of a Joint Water Commission (JWC) and Joint Supervision and Enforcement Teams (JSETs). So far, these institutions have failed to establish confidence among the two parties. As a result of this situation and the conclusions reached after two additional workshops, several problems will need to be addressed before a joint management structure is implemented. These problems are detailed in the section entitled Implementation Issues and Requisites.

An important element in this process has been the continual dissemination of information regarding the workshops and the reports generated by the team to professionals and decisionmakers on both sides. As the study was an academic one, regardless of positions held by several team members at different points of time, all the information generated through it was made public. This is not the general attitude in both communities, as reports dealing with water issues have generally tended to have a highly restricted circulation. Thus, negotiators from both parties were well aware of the ideas and views generated by this study throughout the course of the overall negotiations.
| Structure                              | Function                                      | Staffing                  | Coopera-
|                                      |                                              |                          | tive Level | Financing | External  |
|                                      |                                              |                          |            |           | Support   |
| 1 Apportionment monitoring body       | Monitor extractions & compliance              | Separate professional    | Moderate   | By parties| Perhaps by funding |
|                                      |                                               | staff (hydrologists)     |            |           |           |
| 2 Investigative advisory body         | Investigation of technical disputes          | Administrative staff only | Moderate   | By parties| Perhaps professional oversight |
| 3 Technical research body             | Coordinate & initiate research                | Small Administrative staff | Limited    | Research by grants & by parties | Funding & peer reviews |
| 4 Aquifer monitoring body             | Monitor water quality & quantity              | Joint or separate hydro-
|                                      |                                               | logical staff             | Minimal    | By parties| None       |
| 5 Economic development body           | Plan & coordinate economic development over   | Technical, economic &    | Very high  | By parties| Finance and technical |
|                                      | aquifer                                      | engineering staffs        |            |           |            |
| 6 Project management body             | Manage & coordinate water projects           | Economic & engineering   | Very high  | By parties and foreign aid | Mainly funding |
| 7 Joint regulatory body               | Protect aquifer                              | Planning, legal & techni-
|                                      |                                               | cal                      | High       | By parties| None       |
| 8 Integrated aquifer management body  | Manage aquifer                               | Moderate size, comprehen-
|                                      |                                               | sive                    | Extremely high | By parties & charges | None |
| 9 Centralized aquifer management body | Manage aquifer                               | Large staff, comprehen-
|                                      |                                               | sive                    | Extremely high | Self-financing | Financing & arbitration |
| 10 Water transfer & market            | Administer water markets                     | Moderate size, economic, | Very high  | Mostly self-financing | None |
| administering body                   |                                               | legal & engineering      |            |           |            |
| 11 Risk management body               | Prepare for & manage emergencies             | Separate technical Staffs | Moderate   | By parties | None       |
| 12 Pollution control body             | Aquifer protection                           | Separate legal, planning | High       | By parties | None       |
|                                      |                                               | & hydrological            |            |           |            |
| 13 Resource conservation body         | Promote water conservation                   | Small separate technical | Low        | By parties | Funding    |
| 14 Resource apportionment body        | Discuss apportionment issues                 | Minimal joint administr-
|                                      |                                               | ative staff              | Low        | By parties & foreign aid | Funding & teaching |
| 15 Training establishment             | Train professionals                          | Minimal joints administra-
|                                      |                                               | tive & professionals     | Low        | By parties & foreign aid | Funding & teaching |
| 16 Arbitration body                   | Dispute resolution                           | Small administrative     | Moderate   | None      | None       |
| 17 Water utility                      | Water supply                                 | Large professional*      | Very high  | Self-financing | None |
| 18 Waste-water utility                | Waste-water treatment                        | Comprehensive staffs*     | Moderate   | Self-financing | Funding |
| 19 Aquifer management corporation     | Pump & sell water                            | Large professional staff* | High       | Self-financing | None |


* In the case of utilities in addition to the utility's staff, a supervisory staff is needed to oversee and regulate the utility's operations. This staff can be joint or separate.
The Analytic Approach

The management of an aquifer requires that decisions be made on a wide set of issues, including pumpage regimes, drought policies, protection measures, monitoring, enforcement of restrictions, recharge enhancement policies, wastewater treatment standards and reuse policies and crisis management measures. In addition, coordination of research, sharing of data bases, models and expertise facilitates a more effective and efficient management regime. Joint management implies that institutional structures allowing coordination of such activities would be established. All these features can thus serve as bases for joint management efforts, though not all of them would necessarily be included in any specific joint management structure.

As there is limited viable prior experience with the management of shared aquifers; the research team took an exploratory open-ended approach, whereby no option was discarded a-priori. The first step in this approach was the identification of the full range of options for joint management activities, regardless of whether they exist in practice or not. To this end, a possible structure was devised for each activity and issue identified above. For every structure staffing requirements, necessary level of cooperation, financing options, possibilities for third party involvement, and basic governance structure were then specified (Feitelson and Sylvan, 1995). These initial structures, summarized in Table 1, include both single-task bodies (such as a joint monitoring body) and more comprehensive multi-task structures. The structures differ not only in their actual goals, but also in the scope of goals, ambitiousness, tasks needed to carry out the mandate of the structure, level of cooperation, needed capacities, role of markets and private capital, and the possibilities for third party involvement. They provide thus indeed a wide array of options to consider. Moreover, many of these structures have not been tried yet in any real cross-boundary groundwater basin.

The elementary structures identified in Table 1 are only the initial building blocks toward a joint management structure. The next step is to recognize the advantages and disadvantages of each of them. To this end the nineteen structures were evaluated according to a set of criteria. These were:

- **Sustainability** - the degree to which the structure contributes toward resource protection, facilitates proper responses to emergencies and promotes efficient use of the resource;
- **Flexibility** - the ability of the structure to adapt to changes;
- **The ability to monitor and verify the agreements**, and thus reduce the potential for future disagreements;
- **Minimal infringement on sovereignty.**

This last criterion was introduced as it was recognized that infringement on sovereignty is a major impediment to cross-boundary environmental action (Piddington, 1989).

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6 This criteria assumes that water rights and allocations can be defined, identified and agreed-upon at the political level, regardless of the institutional joint management structures.
An additional criterion that is often referred to is equity. However, this criteria was found to be inoperable, regardless of how equity was defined, since in most cases equity effects vary widely as a function of the specific provisions of any agreement reached, rather than because of the basic character of the institutional structure agreed upon. It was found that for almost any one of the institutional structures discussed several equity results could conceivably materialize (Feitelson and Sylvan, 1995). Therefore this criterion was dropped. The ensuing analysis is summarized in Table 2.

As the sustainability criterion has several facets, among which there may be contradictions, it was subdivided into three criteria: contribution to resource protection, efficiency, and contribution to facilitation of emergency responses. Each of the possible nineteen structures identified in Table 1 was evaluated on a seven-level scale, according to its perceived effect on each criterion. While this evaluation is clearly subjective, it does clarify the considerations for recommending or rejecting a certain function or structure, and thus is helpful in focusing the discussions among policy analysts and with decisionmakers.

The wide array of options delineated in Tables 1 and 2 may seem bewildering, even when their advantages and disadvantages are well understood. The degrees of freedom these options leave to decisionmakers and policy analysts are such that a major effort is needed in order to narrow down the field to those structures that may actually be of interest. Moreover, the structures presented in Table 1 are not mutually exclusive. There are many possibilities to combine different structures. The actual number of permutations that can conceptually be considered is therefore much higher than seen in Tables 1 and 2. Thus, it is pertinent that the initial structures be aligned in a way that would help decisionmakers focus on the main issues that need to be discussed and agreed upon.

Conceivably, there are many ways in which the initial structures can be combined and aligned. One option would be to sort them by level of cooperation. In this situation, decisionmakers would define the level of cooperation desired, and thus focus only on the institutions that are within that level. A second option would be to align the structures according to level of comprehensiveness. Decisionmakers would agree on the level of comprehensiveness, and hence on structures that are within the agreed-upon range. However, decision makers may find it difficult to think and discuss relatively obtuse terms such as "desired level of comprehensiveness" or "level of cooperation." Therefore, in this study the structures were aligned according to their ultimate goals. Essentially, four main goals, or rationales were identified, and the structures were combined according to their contribution toward achieving these goals. These four goals are thus seen as the optional directions that an institution building initiative may take.
Table 2: Evaluation of Possible Aquifer Management Institutions

<table>
<thead>
<tr>
<th>Structure's Goals</th>
<th>Contribution to Resource Protection</th>
<th>Contribution to Flexibility</th>
<th>Contribution to Efficiency</th>
<th>Contribution to Emergency Response</th>
<th>Disagreement Potential</th>
<th>Infringement on Sovereignty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Apportionment monitoring</td>
<td>Limited</td>
<td>Very limited</td>
<td>None</td>
<td>Very limited</td>
<td>Moderate-significant</td>
<td>Limited</td>
</tr>
<tr>
<td>2. Investigative advisory body</td>
<td>Moderate</td>
<td>Significant</td>
<td>Moderate</td>
<td>Very limited</td>
<td>Moderate-significant</td>
<td>Limited</td>
</tr>
<tr>
<td>3. Technical research</td>
<td>Moderate-substantial</td>
<td>Moderate</td>
<td>Significant</td>
<td>Very limited</td>
<td>Limited</td>
<td>None-limited</td>
</tr>
<tr>
<td>4. Aquifer monitoring</td>
<td>Substantial</td>
<td>Limited</td>
<td>Moderate-significant</td>
<td>Significant</td>
<td>Limited</td>
<td>None-limited</td>
</tr>
<tr>
<td>5. Economic development</td>
<td>Limited</td>
<td>Very limited</td>
<td>Significant</td>
<td>Moderate</td>
<td>Significant</td>
<td>Potentially significant*</td>
</tr>
<tr>
<td>6. Project management</td>
<td>Moderate-substantial</td>
<td>Moderate</td>
<td>Limited</td>
<td>Moderate</td>
<td>Significant</td>
<td>Limited</td>
</tr>
<tr>
<td>7. Joint regulatory</td>
<td>Major</td>
<td>Very limited</td>
<td>Limited</td>
<td>Limited</td>
<td>Significant major*</td>
<td>Significant major*</td>
</tr>
<tr>
<td>8. Integrated aquifer management</td>
<td>Substantial</td>
<td>Significant</td>
<td>Substantial</td>
<td>Major</td>
<td>Substantial</td>
<td>Major</td>
</tr>
<tr>
<td>9. Central integrated aquifer</td>
<td>Substantial</td>
<td>Significant</td>
<td>Substantial</td>
<td>Major</td>
<td>Substantial</td>
<td>Major</td>
</tr>
<tr>
<td>10. Administer water transfers/markets</td>
<td>Limited</td>
<td>Significant</td>
<td>Major</td>
<td>Substantial</td>
<td>Significant</td>
<td>None-limited</td>
</tr>
<tr>
<td>11. Risk management</td>
<td>Limited</td>
<td>Significant</td>
<td>Limited</td>
<td>Major</td>
<td>Significant**</td>
<td>None*-significant</td>
</tr>
<tr>
<td>12. Pollution control</td>
<td>Major</td>
<td>Moderate</td>
<td>Significant</td>
<td>Very limited</td>
<td>Significant-substantial</td>
<td>Moderate-substantial</td>
</tr>
<tr>
<td>13. Resource conservation</td>
<td>Moderate-substantial</td>
<td>Moderate</td>
<td>Significant</td>
<td>Very limited</td>
<td>Limited</td>
<td>None</td>
</tr>
<tr>
<td>15. Training</td>
<td>Limited</td>
<td>Very limited</td>
<td>Limited</td>
<td>Very limited</td>
<td>Very limited</td>
<td>None</td>
</tr>
<tr>
<td>16. Arbitration forum</td>
<td>Very limited</td>
<td>Moderate</td>
<td>Very limited</td>
<td>Limited</td>
<td>Not applicable</td>
<td>None</td>
</tr>
<tr>
<td>17. Water utility</td>
<td>Limited</td>
<td>Substantial</td>
<td>Substantial</td>
<td>Limited</td>
<td>Limited</td>
<td>Limited</td>
</tr>
<tr>
<td>18. Waste-water utility</td>
<td>Substantial</td>
<td>Moderate</td>
<td>Substantial</td>
<td>Limited</td>
<td>Limited-moderate</td>
<td>None-Limited</td>
</tr>
<tr>
<td>19. Aquifer management corporation</td>
<td>Substantial-major*</td>
<td>Substantial</td>
<td>Moderate—substantial***</td>
<td>Significant</td>
<td>Moderate</td>
<td>Limited-moderate*</td>
</tr>
</tbody>
</table>


* Effect would be a function of the exact authority given to the new structure.

** Disagreement in emergency situations can be acute without this structure.

*** Effect would be a function of oversight of potential monopoly power.

Note: (Major>substantial>significant>moderate>limited>very limited>none)
The four directions identified were:

- **Aquifer protection** - whereby the institutional focus is on the long-term protection of the water quality in the aquifers;

- **Crisis management** - whereby the focal point is on structures that are needed to formulate responses to both rapidly developing crises (such as accidental spills of contaminants), and evolving crises, most notably droughts.

- **Efficiency** - whereby the main goal would be to supply and use water from the aquifer in the most efficient manner. Actually, this goal can be sub-divided into two distinct sub-goals. The first is to promote efficient water use. To this end, structures whose primary purpose was to reduce transaction costs, that would otherwise impede water trading, would need to be identified. The second sub goal is to promote efficient water supply. This would focus primarily on privatization options, broadly defined.

- **Integrative-comprehensive structures** - the fourth possible goal is to address all the facets of aquifer management. This would require that an integrative-comprehensive structure be formed, and thus the formation of such a structure can be viewed as a goal onto itself.

Each of these four basic options can be the primary goal of a joint management structure. However, none of these possible joint water management (JWM) structures is a singular structure. Rather, each group includes multiple possibilities for structures, to which different tasks can be added or detracted. In all four cases it is likely that the structure will evolve over time. Moreover, the four groups are not mutually exclusive. Thus it is possible that a JWM structure would begin as one group and eventually be expanded to include elements from other groups. The question that has to be faced now is which tasks should be included in each step.

### The Proposed Flexible-Sequential Approach

The approach advanced by the research team at the end of the first phase is a sequential process during which a decision would need to be made at certain time intervals within a pre-agreed framework (Feitelson and Haddad, 1995). There are four possible initial routes, leading to the four basic options. However, it is possible to move from one route to another, and expand the scope of any management structure. The only caveat to this statement is the integrated comprehensive option, which already includes all other facets, and thus to shift from such a structure to one of the other options would not be feasible.

This approach allows decisionmakers to embark on a cooperative route without committing themselves in advance to a fully integrative structure. Thus they may choose a less demanding level of cooperation (and lesser restrictions on sovereignty) and still obtain important benefits from an aquifer management perspective. Moreover, as it is not clear which course will be attractive or acceptable to decisionmakers at any given moment, this approach provides the flexibility to include elements from other courses as circumstances change, without compromising previous achievements.
Figure 2: The Evolution of JWM

Integrated Comprehensive JWM

- Crises Management Orientation
- Resource Protection Orientation
- Economic Orientation

- Monitoring
- Short term supply Augmentation
- Conflict regulation
- Trading/Pricing/Fund Regulations
- Planning
- Research
- Project coordination
- Long term supply Augmentation

The approach is depicted conceptually in Figure 2 (preceding page). At the beginning, a limited set of activities are undertaken jointly. These serve as a basis for the JWM structures. Additional activities are added to the purview of the JWM over time. The activities added can lead up to one of the four basic options. Alternatively, from the second stage onward, activities can be added horizontally, to widen the scope of the JWM structure. It is thus possible to begin with elements leading up to a crises management structure, but at a certain stage include also pollution prevention elements (such as coordination of wastewater standards and re-use), thus widening the scope of the evolving JWM structure.

The direction shown in Figure 2 is fundamentally different from that presented by the Bellagio Draft Treaty, which essentially proposes a concurrent agreement on all the elements of an integrated structure. However, the approach shown in Figure 2 does not contradict the option detailed in the Bellagio Draft Treaty, as eventually it can also lead to a fully integrated JWM structure.

One advantage of the proposed approach is that it allows confidence to be built over time in the new institutions. This may be of particular importance in cases where the parties were previously belligerent, as in the Israeli-Palestinian case.

Table 3 details the proposed sequence of activities that would be included in each of the processes leading to the four basic types of JWM structures. Each column represents one of the four basic types of JWM structures: a resource protection structure, a crisis management structure, an economic management structure and an integrative structure. The numbers in each column represent the priority of each activity for the structure, as analyzed by the project team, and the stage in which it needs to be incorporated in the structure. Therefore, an activity with a number one in a certain column means that this activity should be included in the first stage of the structure discussed in that column. For example, joint monitoring of water use would be a first step toward any economic management structure, but could be incorporated in the second stage in a process geared toward an integrative structure.

In the following sub-sections the rationale for the sequencing of each process is explained. However, before turning to this discussion several additional points have to be clarified.

• Many activities can seem pertinent to all JWM structures. Therefore, in compiling Table 3 an effort was made to identify the minimal number and scope of activities that need to be incorporated in each stage to make the process rational and operational.

• Description of a JWM structure requires that its governance, decision making, staffing, financing and conflict resolution mechanisms should be outlined, as well as the degree to which external involvement may be involved (Feitelson and Sylvan, 1995).

• In formulating the structures it was assumed that an agreement on water rights and allocations would be reached separately. Therefore, each structure is designed so that it can be implemented regardless of the specifics of such an agreement.
In formulating the structures it was assumed that all JWM structures should not supplant the existing water institutions of the different parties (the Israeli Water Commissioner and Palestinian Water Authority in this case).

To improve the operational capabilities of the JWM institutions, a two-level structure is advanced. In addition to a governing body, a number of specific units would be set up at a lower technical level to carry out professional tasks. Examples of such bodies are a joint monitoring unit to carry out monitoring or data collection activities or a planning and policy unit to draft contingency plans for drought situations.

Table 3: Sequencing of Activities’ Incorporation by Type of JWM Structure

<table>
<thead>
<tr>
<th>Structure Type Activities</th>
<th>Resource Protection Structure</th>
<th>Crisis Management Structure</th>
<th>Economic-based Structures</th>
<th>Comprehensive Integrated Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor water resources</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Monitor water extraction</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Crisis management</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Preparation for droughts</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Licensing of drilling and pumping</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Wastewater management</td>
<td>2</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Landfill siting</td>
<td>3</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Hazardous waste disposal</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Enforcement</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Funding of joint projects</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Impose &amp; collect taxes/levies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning of supply and resource</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference/conflict management</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Structure modification</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Pass by laws</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Coordinate standards and regulations</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Research and development</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Operation (pumpage)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price setting</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Database compilation</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Facilitate water trading</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>


**Resource Protection Structures**

Perhaps the most important inducement for joint management is that all parties have a joint interest in maintaining the water quality of the aquifer and its storage capacity. This factor
makes joint management a potential win-win solution, and the lack of it a likely lose-lose situation.

In the first column of Table 3 the activities that should be included in structures whose primary goals is to assure that the resource base (i.e. the aquifer) be protected are identified, and a sequencing of their introduction is proposed.

Four or five stages can be identified in the sequence leading up to most resource protection structures. Since the monitoring of the quality and quantity of water in the aquifer and the compilation of resulting data in a joint data base are a prerequisite to any joint management effort (Haddad and Mizyed, 1995), they are placed in the first stage. At the second stage, emphasis shifts to addressing the main threats to the aquifers. These often pertain to wastewater treatment and reuse (or lack of these), as is the case in the Palestinian-Israeli scene. Therefore wastewater issues and preparation of plans for containing pollution incidents and resolving disagreements are placed in the second stage. The latter element is placed early so as to preclude the possibility of disagreements leading to a loss of confidence in the joint institutions, something that may be detrimental to the whole process.

After laying the foundations for addressing the most immediate concerns, more comprehensive long-term issues can be addressed. These include the capacity to set standards, the control of solid and hazardous waste, the coordination of research on long term threats to the aquifers, and the advancement of possible solutions to these threats.

In subsequent stages, joint planning and funding of projects that may help protect the aquifer (most notably wastewater treatment plants) can be introduced, as well as drought planning (to preclude over-pumping), and the assumption of drilling licensing power.

A possible structure for carrying out the tasks outlined above is composed of four levels. At the top are decisionmakers and mediators. Below them is the Aquifer Protection Commission (APC), to be composed of high-ranking representatives of the main interests (water, health, environment, agriculture and industry) from the different parties. The APC would have the ultimate responsibility for protecting the aquifer, and would need to make the main policy decisions necessary to do so. It would also be the first stage for resolving any differences regarding the aquifer.

To help the APC in its work several joint technical units need to be set up. The first is an aquifer monitoring and data compilation unit, responsible for monitoring and data storage and dissemination tasks. A second body is a project review unit. This unit would initially review the various economic initiatives, as well as the wastewater treatment and re-use schemes, to assure that they do not damage the aquifer. However, its terms of reference may be expanded as the structure evolves, to include planning of joint schemes, promulgation of land use controls necessary to protect the aquifer (including review of landfills and hazardous waste schemes) and review of water projects. In addition, the role of this unit may be extended to include the financing of joint projects and drought planning.
Another task that would require institutionalization is standard setting. The unit or committee charged with this task would suggest qualitative and quantitative water standards (or modifications of existing standards), and guidelines for wastewater re-use. However, these standards would need to be ratified by the APC. In addition, joint inspection teams may be desirable, to assure compliance with the agreed upon standards, guidelines, principles, land use policies, waste management requirements, and similar agreed upon actions.

As there is much uncertainty regarding most shared aquifers, there would always be a need for a long-term continuous research program to improve and guide the protection efforts. One of the goals of this program would be to update the best available information on the safe yield of the aquifers. Based on this information, the pumping rates of both sides should be adjusted. To this end a research coordination unit may be established. This unit may help set the research agenda, and prevent duplications of effort. Finally, a drilling licensing element is needed to prevent over-pumping and consequent salinization.

The fourth level of the JWM structure includes field teams of both sides, and the different local and regional authorities and water utilities or units. These may include local water or wastewater utilities, or municipal or regional water units. This level, where local units operate separately according to the guidelines set by the JWM structure, will be responsible for implementing many of the provisions needed to protect the aquifer.

If a need for modifications in the JWM structure emerges, a special forum would be established to address these issues. This forum could even include high level decisionmakers of both parties, or at least receive authorization from these individuals.

Crisis Management Structures

The management of any aquifer faces its most severe test during crisis situations. Three types of crisis are possible: 1) sudden crisis, such as the spilling of toxic material in highly porous areas, the discovery of hazardous materials in drinking water coming from certain wells, or the breaking of levies built as part of aquifer recharge efforts; 2) cumulative crisis, which could stem from the cumulative effects of certain trends or natural events, such as droughts, or 3) the overpumping of water by one side, above the quantities previously agreed upon by both parties.

Crisis management involves three basic actions: first, the recognition of the crisis (the realization that a crisis has occurred); second, agreements on the steps that need to be taken to address the crisis (contingency planning); and third, implementation of the crisis management scheme, which requires the availability of appropriate facilities, personnel and means. The second column in Table 3 advances a possible sequencing of the activities that should be included in a joint crisis management structure.

The first stage is the establishment of a joint monitoring and data sharing system, including water extractions and use monitoring. In addition, to identify a crisis, it is necessary that both background information be available (to serve as a basis for monitoring and inspections,) and the basic knowledge (necessary for both contingency and drought planning) be available.
In the second stage clear guidelines and a decision-making mechanism that can declare a crisis situation need to be set. Such mechanisms are especially needed to cope with sudden emergency-type crisis. In the second stage enforcement and conflict-resolution mechanisms are also needed, as the requisite steps in such situations often impinge on practices of various water users, generating sometimes-vehement opposition.

Drought management, including contingency plans and agreement on tentative measures for responding to such situations should be incorporated into the structure in the third stage. Feedback mechanisms should be introduced in the fourth stage to learn from each crisis and allow for adjustments.

Over pumping needs to be recognized and managed at the earliest stage because of its potential long-term impacts on the aquifer, and in order to preclude the creation of vested rights in the over-pumped water. The terms for resolution of such a crisis have to be spelled out clearly at the outset, in the political agreement, and may include a process with several steps, beginning with fact-finding and discussions within the joint management structure.

The central body in a JWM crisis management structure would be a Water Crisis Management Board. This is the body that would be authorized to declare a crisis and that would need to ratify all contingency plans and see that they are implemented. It may also serve as the first level in a conflict resolution mechanism, by differentiating between facts that are agreed upon to those under dispute, and by advancing potential solutions for the disagreements. This body would include top water, environment and health officials. It would be assisted in its duties by several joint technical units, including the contingency planning and response coordination team, and investigation and inspection unit, research and monitoring teams, and a drought-planning unit. As in other cases, local authorities would implement the measures proposed by the joint technical units and ratified by the Water Crisis Management Board. However, in this case joint inspection is warranted.

Economic Structures

The focus of the two previously discussed structures is ultimately on the long-term sustainability of the aquifers. Yet, the term "sustainable development" as promoted by the Brundtland Commission also implies that the resources will be managed efficiently or at least in a cost-effective manner. In addition, the development of a resource in a sustainable way requires investments, and this implies the need for sustainable funding. The economic structures address these two issues, although their objectives may not be as clearly spelled out as in the previous structures.

The economic structures envisioned in this section can be divided into two groups. The first contains structures intended to facilitate trading of water allocations, to allow greater flexibility in accommodating changes in circumstances and coping with situations of rapid shifts in demand. By using a market mechanism these structures allow for such accommodations without requiring a readjustment in the more sensitive issues of water rights or basic allocations.
second type of structures is utilities. These open the way for private sector involvement in the management of the aquifer, and in funding the necessary water supply and protection programs.

The common denominator of both groups of economic structures is their reliance on market mechanisms, thus allowing them to circumvent some of the most problematic issues that face water negotiators on both sides, and their promise of greater efficiency in the production and use of water. The third column in Table 3 notes the main activities that would need to be included in such structures, and proposes an approximate sequence for their incorporation.

The first step towards any kind of economic structure is the establishment of a joint monitoring system and a center for compiling and assessing this information. This priority is due the fact that all economic structures require that water be priced, or bought and sold, and unless consumption is monitored no market transaction is possible (Lonergan, 1995).

The second stage requires that trading and/or pricing mechanisms be set up. However, such mechanisms are meaningless unless enforcement capacities are established concurrently. In addition, any trading or other transaction mechanism also requires the establishment of a system for adjudicating disagreements.

After these primary functions have been institutionalized, several additional, more complex, issues need to be addressed. First among them is the variance in water availability. To address the adjustments needed in such situations a priority system of water allocations should be considered (Berk and Lipow, 1994), and trading rules across priorities be set and enforced. A second topic that should be incorporated in the third stage is a mechanism for adjusting trading rules after there is sufficient experience in this area, and in response to unforeseen situations. In the case that utilities are established, the two parties should agree upon the financing mechanisms or the power to collect levies.

In the fourth stage, the constraints for trading should be further scrutinized, to assure that the aquifer is not damaged. As part of this effort the joint commissions should require drilling and pumpage licenses (also of the utility), and the water quality in the aquifer also should be monitored. In addition, the financing mechanisms can be elaborated, by allowing the utilities to issue bonds, or by setting a special development bank as was done under the North America Free Trade Agreement (NAFTA) in the U.S.-Mexico case (Killgore and Eaton, 1995).

The institutional structure of an economically based JWM system would include three basic elements. At the top there would need to be a board of directors (in the case of a utility) or an aquifer management commission, which would set the trading rules and govern the structure. This body would be composed of top officials of both sides, representing water, environment, health and economic development interests, as well as some consumer or local authorities' representatives. In determining its policies this body could be assisted by a staff unit that would relay to it the aquifer's condition, and suggest what constraints need to be placed to prevent a deterioration of its water quality. In the case of a privatized utility this body would need to set the terms for a tender, and choose the operator.
The second basic element is the aquifer utility, or the water trading authority. In the case of a utility, this body would be a private or publicly owned company, and managed as a business enterprise. It would pump the water and sell it to local water authorities for both domestic and agricultural use. This utility could also initiate schemes to replenish the aquifer. In this capacity it may buy or sell water to other regional water utilities. For example, a utility managing the western mountain aquifer in the Israeli-Palestinian case could, conceivably, buy water from the Israeli national water carrier during winter for replenishment purposes if rains were plentiful in the north, but less so over the West Bank.

If a water trading authority were established, it would need to manage and enforce the transactions among local water authorities. If a certain authority would want to increase its water supply it would contact some other authority with a water allocation and offer to purchase some of its water. This transaction would need to be ratified by the joint authority, to assure that the basic needs of all the population are maintained.

The third element in these systems is the local authorities that supply the water to end-users. These authorities would be funded by user fees or government subsidies, and use these revenues to purchase water from the utility, or buy additional water from other jurisdictions (in the trading scheme case).

To operate these systems several issues would need to be addressed. Paramount among them would be the financing of water transfers, and of the infrastructure necessary to facilitate these transfers. It is possible that these issues would be part of the mandate of a jointly managed development bank, such as proposed in the U.S.-Mexico case.

Such a bank, jointly managed by the two sides, may also help address a second issue, the treatment and use of wastewater, not included in the third column in Table 2. However, this issue can be easily incorporated within the general framework by establishing wastewater utilities, and allowing treated wastewater to be sold to low priority (i.e. irrigation) uses, subject to environmental constraints imposed by the aquifer governing board.

Comprehensive Integrative Structures

The goal of an integrative structure is to cover all the aspects of aquifer management comprehensively, so as to ensure the best results from an aquifer management perspective and to assure its long-range sustainability. To accomplish this, such a structure would need to be more than a combination of the previous three types of structures, as it would need to address issues not addressed so far. A sequencing of the activities that could be included in such a structure is presented in the fourth column of Table 3.

7 It is important to note that utilities can be created at different spatial scales, and allowed to operate different elements of the water system, and can take various forms (Lee and Jouravlev, 1997). These options have not been fully scoped yet in the Israeli-Palestinian context.
In the first stage a joint monitoring and data storage and compilation unit would be established. At this stage, this unit, whose fieldwork would be conducted by teams from both sides (but with compatible guidelines), would focus on monitoring the aquifer parameters (rather than water use). The establishment of an agreed-upon database and monitoring system is a prerequisite for any successful aquifer management (Haddad and Mizyed, 1995).

In the second stage, mechanisms for resolving disagreements would be set up, as well as a crisis management unit. These are intended to anticipate the dangers of an early crisis in the accommodation process. At this stage it would also be necessary to establish a coordinated drilling permit system so that aquifer yield and quality would be sustained. Joint water supply planning, to address current supply problems, including water allocations to users would follow this system. Joint research could then be initiated to address fundamental issues that are likely to be faced in the future by the aquifer managers.

In the next stage, policies for drought situations would be drafted and agreed upon, since drought periods are those likely to cause the greatest stress in the system and thus put the JWM structure to its severest test. In order to help address future strains re-allocation mechanisms should also be established in this (third) stage, to accommodate future structural changes. It would also possible to add financing instruments and a joint water project management capacity to the structure at this point.

At a later stage a comprehensive regulatory capacity and enforcement unit should be set up. This unit would be able to propose standards or by-laws and, following their approval, enforce them. This stage is perhaps the most problematic in the transition from a comprehensive structure, covering many facets, to an integrative one, whereby a single aquifer management authority is established.

In the next stage the regulatory capacity can be expanded to other issues, such as land use controls. Other issues might include water-trading mechanisms. At this stage a self-financing capacity may be necessary. This could be achieved by levying an aquifer use levy, whereby the authority would collect a fee for any water pumped from the aquifer, and/or a water use tax.

The Bellagio Draft Treaty, which proposed an integrative JWM structure, suggested that a single commission be charged with all the duties (Hayton and Utton, 1989). This commission is to have the ability to regulate, establish conservation areas, draft and implement drought policies and investigate complaints. It would also propose budgets for water projects, monitor the aquifer and withdrawals from it and direct aquifer-related research. Finally it would also prepare comprehensive management plans. However, enforcement is left to the parties, as is conflict resolution, followed by a mediation procedure.

In contrast to the Bellagio Draft Treaty, this study takes the approach that any JWM structure needs to be built up over time, and that any such structure should include a governing board and several joint technical units.

In tandem with the stages outlined above, a monitoring and data compilation unit should be set first, followed by an aquifer oversight commission. Under this commission several joint
professional units need to be established to implement the tasks assigned. These should include a drilling licensing committee, a planning unit that would coordinate water supply plans of the populations, a crisis management team, and a research coordination unit.

Over time, as the structure evolves, some units may assume additional tasks, while other tasks added would require that new professional units be set up. Thus, the planning unit could also prepare drought contingency plans, while the drilling licenses committee can be incorporated in a wider regulatory structure that would issue permits to all activities that have to meet standards set by the JWM institutions. This body could also propose such standards, based on the monitoring and research conducted by the joint monitoring and research units. If a self-financing capacity is indeed created, a new financial unit that would manage these finances might be set up.

Eventually, the aquifer oversight commission may assume the role of a governing board for the JWM structure, and take on the responsibility to re-apportion water if circumstances require it.

From an institutional perspective this framework can accommodate additional activities that are added in the later stages. The only possible additional unit that may need to be established is a water-trading unit, if water trading is indeed allowed. Such a unit would have to record, enforce, and authorize water trades.

**Implementation Issues and Requisites**

The flexible-sequential approach and structures outlined so far are essentially directions that negotiators may choose to take. However, before any road is taken, several implementation issues have to be addressed. The experience accumulated with the JWC and JSETs established pursuant to the Oslo B accords, as well as the discussions at the third and fourth workshops have revealed several issues that may preclude or delay the establishment of any JWM structure in the Israeli-Palestinian case.

After two years of operation, the JWC and JSETs have not met the expectations of both parties. Palestinians feel that the JWC's purpose has been to further Israeli control, and that it has not addressed Palestinian needs (Nasseredin, 1998). Several Israeli projects proceeded without the JWC's authorization. Information and data on water resources and use requested by the Palestinians have not been provided to them. At the same time the water supply to Palestinian cities and towns continues to be precarious. In most cities and towns running water is not available to all households throughout the year. As a result there has been a loss of confidence in the coordination of structures that were established. Consequently, the starting point for any future building of JWM institutions is more difficult now that in the past.

The first step that was identified in all structures, as can be seen in Table 3, is the establishment of joint monitoring structures and databases. This was viewed also as a confidence-building measure. Yet, as van der Gun (1997) warned, such efforts may backfire, if these efforts lead to the creation of "data graveyards". That is, if monitoring and data collection and man-
agement become an end to themselves, and do not facilitate the work of the joint management and decision making efforts of both parties. Thus, it is imperative that monitoring, modeling and data handling efforts be well integrated in a wider decision and management oriented framework, and not become an end to themselves.

The implication of these two points, the loss of confidence in existing coordination institutions and the danger that the first step proposed in the flexible-sequential approach may become another source for disillusionment, is that much greater attention needs to be accorded to the initial steps. Concrete measures are needed to assure that the first step would not be the last.

In addition to the need to give greater attention to the initial steps, several issues have not received sufficient attention in the general framework, yet may be important. The first is the level of cooperation. In the framework outlined above the implicit assumption is that most coordination and cooperation mechanisms would be established at the national level. Yet, that need not be so. Recently, an Israeli regional council (Emek Hefer) has reached an agreement with a nearby upstream Palestinian city on the West Bank (Tul-Karem) for the treatment and re-use of the city’s wastewater. It is possible that similar local agreements be reached, and that positive experience at the local level would help build up confidence.

The structures of which the general approach is composed include both innovative suggestions and more mundane, straightforward structures. The structures lumped under the ‘economic orientation’, in particular, may require greater adjustment than other orientations. However, this orientation may hold some of the most promising options for overcoming several of the most difficult issues faced by the two parties. In a study of the options for addressing Jerusalem’s sewage problems it was noted that utilities, established through an international tender, may help overcome political problems posed by cross-border sewage flows better than any other management structure (Feitelson and Abdul-Jaber, 1997). On a more general level, the privatization of water supply and treatment elements forces the two parties to cooperate in structuring the tender and to establish mechanisms that will monitor the actions of the utility. Privatization may thus create common goals for the parties vis-a-vis the (foreign) utility operator. Yet, as Beecher (1997) has noted, the introduction of large international firms is also fraught with risk. Therefore, more work is needed to analyze the potential and limitations of this option.

The second option lumped under the ‘economic orientation’ heading is that of water trading. This option has been shunned in Israel to date. Also, there is only very limited prior experiences with international water transfers. Two recent developments may help overcome the obstacles to trading. Within Israel there is growing recognition of the need for allocative efficiency in water use. This may make trading more acceptable. At the same an international team has developed a model that allows for analysis of trading options in Israel-Palestine. This model may help reduce the transaction cost of such trading, and thus reduce the difficulties inherent in the introduction of trading. Still, unless the problems associated with definitions of property rights in water are overcome, such trading may be unfeasible (Dellapenna, 1995; Benvenisti, 1996).
The determination of water rights and their initial allocation is not only a requisite for trading, but it is also a pre-requisite for any settlement of water conflicts. In the fourth workshop participants reached several important conclusions with regard to this topic:  

1) Water rights need to account for variances in quality and over time. Thus there is a need to establish priority rights and define water allocations as a function of water quality. The allocation of water, when defined as a function of quality and time has to take into account the use of water, as the priority should be given to the domestic sector.

2) The domestic sector should have priority rights regardless of nationality. This is in essence a change toward a human right perspective on water allocations. From this perspective all people should have an equal right to water on a per-capita basis for domestic use.

3) The combination of these understandings, the dire situation of water supply to the Palestinian domestic sector, and the need to establish confidence, leads to recognition of the need to enhance Palestinian water supply as an early confidence-building step, prior to the establishment of a comprehensive JWM structure.

While these understandings reflect merely the views of a limited number of experts from both parties, they are indicative of the range of issues that need to be addressed before a JWM structure is established.

The implementation of any joint management scheme requires widespread support within the two communities. No community is homogeneous. Rather, there are various interest groups within each community, often with conflicting perspectives on appropriate water use. It is therefore necessary to assure that a wide coalition will support, or at least not oppose, the creation of a joint management system. To this end it may be helpful to assure that all interest groups are represented in the joint management institutions. While the possibility that the joint management institutions (and particularly governing boards) would be composed of representatives of different sectors from each party, the need for such representation has not been emphasized. As the difficulties in the peace process become more apparent, the need for such broad-based representation increases. Moreover, it can be visualized that in certain circumstances, when the general atmosphere improves, there may be cases when similar interests from the two parties may form coalitions regarding various management issues.

A major impediment to the establishment of joint management structures at present is the lack of public awareness of the potential for cooperation. The dominant public perception of water issues is still that of a zero-sum game for a limited strategic resource. This view is not shared by many, if not most, of the professional community. The dissemination of the idea of joint management, its promise and implications, to decisionmakers and the public at large should

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thus be an important element in any strategy geared toward the implementation of a JWM sys-

tem.

Discussion

The study described in this paper has been instrumental in introducing the notion of joint
management of shared aquifers to the Israeli-Palestinian discourse. It demonstrates thus the use-
fulness of parallel-track discussions in academic settings for introducing new positive-sum solu-
tions to negotiations regarding cross-boundary water resources.

There are several factors that enabled the work to proceed and reach meaningful results:

⇒ The availability of a large number of professionals on both sides, and the availability of
an appropriate academic setting. This enabled the researchers and participants in the
workshops to express ideas openly, even when they did not conform to the official posi-
tions held by the negotiating team of their side at the time.

⇒ The enabling environment created by the peace process at the time the study was initi-
ated. This enabled the widening of the circle of both Palestinian and Israeli experts that
were willing to be involved in such a joint endeavor. Once the study was well underway,
and personal rapport was established between the team members and among other profes-
sionals, it was possible to continue the meetings and work also when the overall situation
deteriorated and the organization of meetings became difficult.9

⇒ The partners were equals, and all activities were conducted jointly. The workshop or-
ganization was undertaken jointly, and the workshops were structured so that both parties
would be equal, in terms of both the number and level of participants. There was no ele-
ment of training or data transfer from one party to another as part of this project.

⇒ The early definition of a win-win framework. Both sides accepted the premise that nei-
ther can manage the aquifers alone, and that mismanagement of the aquifer will be deleter-
ious to both. Both viewed joint management as a feasible option that may allow both
parties to have more water of better quality in the future.

⇒ The participation of foreign experts. These helped elevate the discussions above the local
agenda by showing that similar problems exist elsewhere. This perspective emphasized
the fact that all experts need to search for ways to better manage cross-boundary aquifers,
and that none have a ready-made solution. By showing the problems inherent in different
solutions the foreign experts help diffuse local anxieties regarding the motives of either
party to accept or oppose particular options.

9 The third workshop was delayed by three months, and later moved from Jerusalem to Bethlehem due to
consecutive closures limiting Palestinian access to Jerusalem, and the fourth workshop was held in Istanbul due to
the increasing difficulties in finding appropriate venues in Israel and Palestine.

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The provision of adequate funding. The fact that both parties were fully supported by hands-off outside sources allowed them to proceed without undue regard to the position of local officials at different points in time. It also allowed them to be in a position where the local parties invite the foreign participants. Thus, the foreign participants did not facilitate or run the workshops. Rather, the local teams were fully responsible for all facets of the work, and was free to do as they saw fit.

After its initial success in introducing the concept of joint management, and identifying a number of possible directions and institutional forms such a JWM structure may take, several limitations to the implementation of these ideas were identified. This critical review of the first phase in the second phase of the study has led to the realization that much more concrete work needs to be done. In addition three directions for action were identified.

The first direction is the identification of a wide array of topics that need to be addressed in the water negotiations between the two parties. These negotiations tend to focus on water quantities, with only limited regard to other issues and to institutional structures. This study showed that many other issues need to be addressed, and that these issues are not less (and sometimes more) important than the allocation of water quantities. The issues identified include the need to define decisionmaking structures, and agree on how changes to such structures may be made, and how disagreements or disappointments regarding the functioning of the decisionmaking structures are to be dealt with. In addition there is a need to fully specify water allocations not only in quantities, but also in terms of time and quality, and to define the liabilities of the parties with regard to the protection of the aquifers. In addition, financing of water transfers and wastewater treatment, wastewater reuse, the role of third parties and private capital and the regulation of such capital should be an integral part of the negotiation agenda. The ensuing agreements should also include provisions that would allow for continuous capacity building and reduce the risk that institutional development will 'freeze' before its benefits are felt. It is possible that third parties may play a role to this end.

The second direction is the need to take immediate steps to facilitate the discussions of joint management options. First among these is the need to establish confidence in the ability of such institutions to address the concerns of the two parties. This would require changes in the way the current JWC operates (for example rotation of chairmanship and meeting places has been suggested as one way to address the imbalance felt by Palestinians). At the same time there is a need to address the acute problems faced by many Palestinians, especially during the summer months. This would require some supply augmentation. Finally, the notion of joint management has to be sold to the public at large. Thus, the dissemination of this idea is part of any comprehensive strategy for the implementation of joint management.

The third direction is to better understand, and clearly demonstrate, the advantages and disadvantages of the different options. At present many of the concepts advanced here may still be too obtuse for many decisionmakers. To this end a simulation game whereby different scenarios would be played out given different institutional settings is planned. This may serve as a third phase to this study.
Conclusions

The management of an aquifer in a sustainable manner is a challenge everywhere. It requires a diverse and complex series of ongoing decisions to be made often without sufficient understanding of groundwater flows and aquifer structure, using models that do not capture the full complexity, and with full knowledge that mistakes may be irreversible. As the utilization of aquifers shared by more than one country grows so does the need to find ways to accommodate the different users without compromising the aquifers’ long-term storage capacity, and the quality of the water withdrawn from it. The necessity to manage aquifers in such circumstances is thus a doubly difficult challenge. Moreover, solutions that may be feasible in cross-boundary surface water cases are often inapplicable to groundwater. It is not surprising, therefore, that there are no readily available models for the successful management of shared aquifers. Yet, in many semi-arid regions, such as in Israel-Palestine, there is a need for immediate action.

This study has suggested a step-by-step open-ended approach for the identification and structuring of joint management systems for shared aquifers, with special reference to the Israeli-Palestinian case. In the first phase of this study four directions and routes for building joint management structures have been outlined. However, further scrutiny in the second phase of the study has shown that there are many elements that need to be addressed in negotiations by the two parties before such structures can, or are likely to, be implemented.

A Palestinian-Israeli team, with international funding and support conducted this study. The conduct of this effort has demonstrated the potential of parallel-track academic endeavors in introducing new concepts, such as joint management, into the water discourse. This study has been able to continue even when the geopolitical climate became less conducive for cooperative efforts. However, it is also clear that the likelihood of a joint management agreement being reached is small or negligible when the relations between the parties deteriorate and confidence in the current coordination institutions erodes.

This study suggests that international agencies can have a role in advancing new ideas such as joint management by providing the funds for independent local research, where local capacities exist. In such cases a no-strings attached hands-off approach, such as was taken by the funders of this effort, may be the most constructive.

International bodies may have also an important role in the joint management schemes. One idea found to be of interest is the possible role privatization efforts may play in reducing the conflict between the parties, by changing the rules of the game and the interest structure of the parties. This option, however, needs more theoretical and empirical research. International bodies may also play a role in conflict management functions, though it is also not clear at this stage whether the availability of outside elements helps or detracts the sides reach an accommodation by themselves.

This study has shown that there are several real options for joint management of shared aquifers. However, much work still needs to be done before joint management can be successfully implemented. This work should commence immediately, as it is unclear where and when
would the policy windows open that would allow such structures to be implemented. However, once the options have been presented and accepted, it is likely that when the local conditions are favorable, and the different parties recognize the need to reach a sustainable accommodation for managing their shared groundwater resources joint management structures, one would be established. Once set up, they would need to evolve in response to changes in understanding of the aquifer's structure and problems, and of changes in human demand patterns and attitudes. The structures outlined in this study may provide the initial map necessary to facilitate such adaptations without losing the course.
References


Berck P. and Lipow J., 1994, Real and ideal water rights: the prospects for water-right reform in Israel, Gaza and the West Bank, Department of Agricultural and Resource Economics, The university of California at Berkeley, working paper 698.


Kahane Y., 1994, The Turonian-Cenomanian aquifer: the need for a joint monitoring and management program, in: E. Feitelson and M. Haddad (eds.) *Joint Management of Shared...*
Aquifers: The First Workshop, The Truman Institute for Advancement of Peace and the Palestine Consultancy Group, Jerusalem.

Kilgore M.W. and Eaton D.J., 1995, NAFTA Handbook for Water Resource Managers and Engineers, American Society of Civil Engineers and The University of Texas at Austin, Austin.


IDENTIFICATION OF JOINT MANAGEMENT STRUCTURES FOR SHARED AQUIFERS
A COOPERATIVE PALESTINIAN-ISRAELI EFFORT

AQUIFER BOUNDARIES
FEEDING/STORAGE AREA
TRANSITION ZONES
FLOW DIRECTION AT FEEDING ZONE
FLOW DIRECTION AT STORAGE ZONE
ARMISTICE DEMARCATION LINES, 1949
INTERNATIONAL BOUNDARIES

Tel Aviv - Yafa
Petah Tiqwa
Ashkelon
GAZA
Qiryat Gat
Be'er Sheva

NABLUS-GILBOA
AQUIFER, 140 MCM

YARQON-TANNINIM
AQUIFER, 360 MCM

WEST BANK

JERUSALEM

EASTERN-BASIN
AQUIFER, 100 MCM

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