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Final Narrative Report to IDRC

Canada Syria Lebanon Akkar Watershed Project

Alternative Institutional Arrangements for Boundary Waters Management in the Middle East

IDRC Project No: 804566

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Synthesis

The report should begin with a half-page to one-page synthesis of the project that can be easily disseminated to a wide audience. It should contain the rationale for the project, the research problem that was addressed, the objectives, methodological approach, principal findings, results, and expected impact of the project. The abstract of the project written when the grant was initially approved by IDRC and the objectives listed in the grant agreement should be useful inputs when preparing this part of the report.

Alternative Institutional Arrangements for Boundary Waters Management in the Middle East

Two years of IDRC funded research on the El Kabir River along the northern boundary of Lebanon with Syria has been completed by the National Council for Scientific Research (NCSR) in Lebanon, the General Organization of Remote Sensing (GORS) in Syria, and CadhamHayes Systems Inc. (now Canadian Environmental Assistance) of Ottawa, Canada.

The broad objective for the project was to set the framework for a comprehensive program to:

Design a Co-operative Ecosystem Management Protocol for the Sustainable Development of the Akkar Watershed of Syria and Lebanon.

The Akkar watershed encompasses the basin of the El-Kabir El-Janoubi River - a shared water course defining the northern boundary of Lebanon with Syria and draining into the Mediterranean. This watershed is under severe stress.

Both parties work well on this boundary and an opportunity exists to create a bi-national, multi-institutional protocol for the management of this basin. It was hoped that a watershed specific political agreement instituting the protocol might be developed so as to be sufficiently robust to endure and possibly provide a model for other shared and transboundary waters in the Middle East.

The research program looked at relevant legislation, conducted inhabitant surveys and public workshops and, together with the Fares Foundation in Lebanon, instituted a public awareness program in the watershed. Water quality surveys were carried out for water sediment and bacteria revealing extremely high levels of bacterial and organic pollution throughout the watershed. Remote sensing agencies have provided 1:50,000 maps of the watershed including drainage, geology, land use, soil erosion, utilities, settlements, roads and railways for use as the basis for future land use management.

One of the most surprising findings of our research is that, arguably, there is an ample supply of water in the Akkar region to meet all perceived needs for the foreseeable future. It is the inability and failure of the current institutional arrangements to control the runaway pollution of the watershed and to take any measures to manage demand that are stressing the resource beyond sustainable limits.

Through evaluation of the data derived from field sampling and analysis of sediment and water for nutrients and bacterial, we were able to provide a coherent picture of the degree and extent of environmental degradation in the waters of the El Kabir. The findings provide a level of understanding and insight that allows for establishing priorities in any watershed management plan. When considered with the findings of the public surveys, there is a remarkable convergence of scientific evidence with public knowledge and opinion. This convergence could

be used as a powerful tool to influence decision makers to begin the development and implementation of an Akkar Watershed Management Plan.

This is especially timely for two reasons. First, because there are plans underway to build a major dam in the middle reaches of the river – a project that faces potentially disastrous environmental and public health challenges if it does not first address the water quality issues in the watershed. Secondly, both Syria and Lebanon are undertaking extensive reforms of their environmental and water resources management agencies and this state of flux represents a unique opportunity for concerned stakeholders to seek immediate action as well as to influence future policy.

A series of priorities for the watershed have been suggested based upon a three phase implementation. The first phase calls for immediate action on solid waste and sewage clean up plus the elimination of the use of DDT and other banned agro-chemicals. The intermediate phase is the initiation of social change in the watershed population, including attitudes to waste disposal and agricultural practice in pesticide and fertilizer use, animal access to the river and implementation of small-scale community sewage treatment plants to eliminate bacterial infection of the system. The third stage is the overall approach to bi-national management of the basin including institutional arrangements, sharing agreements and development of strategic plans for groundwater and surface water conservation and protection.

The final reporting for the project presented in a symposium in Damascus in December 2002, to a largely technical and professional audience held as a special session within the GORS Annual Symposium. This event attracted a large, domestic and international audience, particularly from the Middle East, Europe and Russia. Summaries of the presentations and briefing notes have been provided to environmental and water agencies and to the Fares Foundation to be disseminated more broadly to government agencies and the public. In addition, a conference presentation was made with published contribution (reference Khawlie, M., Thomas, R., Kawass, I., Cadham, J., Shaban, A., and Adballah, C., 2002. *Role of remotely-sensed observations of a shared border watershed in environmental management, Lebanon-Syria* in Proceedings of 24th Canadian Symposium on Remote Sensing: Integrating our view of the Planet. Toronto, Canada, June 2002).

During the project, presentations of results were made at well-attended public workshops in both Lebanon and Syria. These marked the beginning of a public participation processes being continued in Lebanon with the support of the Fares foundation. Conclusions have been summarized in short brochures and on high quality posters which were distributed throughout the watershed. The Fares Foundation will continue the dissemination of results in their community work in the watershed and has already initiated a number of English and Arabic newspaper articles which have given recognition to the project with a high profile for the partners.

Finally, a set of papers is now in preparation which will be submitted as a block to *Lakes and Reservoirs, Research and Management*, an international journal of peer reviewed papers while about five hours of digital video has been taken which will subsequently be edited to a 30 minute presentation in Arabic and English for use by the partners and for local television.

Research Problem

The reader should be reminded of the basic rationale of the project and the research problem or problems that were addressed. Often, the researchers' understanding of the problems will have evolved since the project was approved. The report should describe this evolution and the reasons behind it.

The original proposal for this project was to conduct research into *Alternative Institutional Arrangements for Boundary Waters Management in the Middle East* for the Akkar watershed of Syria and Lebanon. The goal of the research was to establish a framework for the subsequent development of a mutually acceptable basin management plan, to specify the scientific and information needs for optimum management, and to propose institutional roles and responsibilities for the full-scale implementation of the arrangement.

The broad objective for the proposal was to set the framework for a comprehensive program to:

Design a Co-operative Ecosystem Management Protocol for the Sustainable Development of the Akkar Watershed of Syria and Lebanon.

The Akkar watershed encompasses the basin of the El-Kabir El-Janoubi River which is a shared water course defining the northern boundary of Lebanon with Syria and draining into the Mediterranean. It is commonly recognized that this watershed is under severe stress.

Both parties work well on this boundary and an opportunity exists to create a bi-national, multi-institutional protocol for the management of this basin. It was thought that a watershed specific political agreement instituting the protocol might be developed sufficiently robust to endure and possibly provide a model for other shared and transboundary waters in the Middle East.

The broad objectives of the research project are summarized as follows:

- To evaluate alternatives and develop protocols and appropriate institutional arrangements for the multi-jurisdictional management of transboundary waters and associated basins;
- To design and initialize selected activities of a major research evaluation program on the impact of land use on water quality under a variety of climatic conditions in the Akkar River basin and to consider the resilience of any proposed institutional arrangements to the stresses and demands occasioned by extended periods of drought;
- To understand and define the information needs for the effective management of the watershed and how these needs might be met;
- To evaluate the linkages amongst research, scientific knowledge, data, management and politics and to see how science can be used to transcend political boundaries and harmonize negotiations in a transboundary watershed;
- To work with the appropriate agencies in the participant states to build confidence and the capacity to facilitate the subsequent implementation of the overall program.
- To identify those parts of the management plans which are unique to the Akkar watershed as distinct from those which are generic in nature.

We never expected that this research project would fully meet all of these objectives. However, activities were specifically chosen to provide some basic elements providing a preliminary, working protocol sufficient to launch a broader program.

This project, as originally conceived, was based on a model evaluating the institutional arrangements using an interactive triad of a management framework, institutional capacity and scientific understanding.

However, in implementation, fundamental gaps in knowledge and an evident lack of scientific and public understanding caused a shift in the focus of the study towards scientific understanding and basic public awareness initiatives with a lesser emphasis on framework protocol and institutional capacity. The rationale for this shift was underscored as it quickly became apparent that the relevant legislative and ministerial responsibilities in both countries were and are being re-assessed and re-aligned.

The beneficial result of this shift was a much earlier than anticipated program of public workshops highlighting the extent of the degradation in the watershed and laying the basis for the mobilization of local actors to take a role in future management and remediation activities.

Research Findings

The main research results should be described and interpreted by highlighting the contribution to knowledge that this project represents from a scientific and policy perspective.

One of the most surprising findings of our research is that, arguably, there is an ample supply of water in the Akkar region to meet perceived needs for the foreseeable future. It is the inability and failure of the current institutional arrangements to control the runaway pollution of the watershed and to take any measures to manage demand that is stressing the resource beyond sustainable limits.

We were able to provide a coherent picture of the degree and extent of environmental degradation in the waters of the El Kabir by evaluating the field sampling data and analyzing sediment and water for nutrients and bacteria. These findings provide a level of understanding and insight that allows for establishing priorities in any watershed management plan. Major research findings from the scientific program can be summarized as follows:

- The river is a ground water controlled river system indicating a priority need to protect recharge areas. The springs that were analyzed are polluted by direct animal access and by bacteria nutrients from surface land use upflow of the springs. Aquifers are open and highly sensitive to land use of potentially polluting substances. The regional geology results in rapid infiltration rates. A groundwater protection strategy is an imperative in the Akkar region.
- Concentrations of sodium in sediment and an increase in specific conductivity in the waters of the river in the coastal plain indicate the onset of irrigation-induced salinization. Current spray and flood-type irrigation practices are wasteful and are producing high return flows laden with agrochemicals and sediment. Uncontrolled withdrawals, diversions and groundwater extractions are creating excessive demands during summer months.
- Phosphorus levels are extremely high along the course of the river and together with high ammonium nitrogen indicate sewage from human waste and to a lesser extent from direct

- animal access to the waters. Nitrate is high and mainly derived from fertilizer use while the high nitrite is a result of the flagrant disposal of solid domestic waste directly into the river, on riverbanks and on roadsides throughout the watershed.
- Bacterial infection with total coliform and faecal coliform is extremely high and results from sewage waste. Untreated human sewage is piped directly to the river from numerous settlements throughout the watershed resulting in water unfit during both summer and winter for any human use including direct contact, irrigation and the washing of fruit and vegetables.
 - Despite winter dilution, levels stay high year round and are relatively consistent throughout the watershed. Water is unusable and a major program of sewage treatment is an absolute necessity to protect water quality and human health. Bacteria, phosphorus and ammonia all show winter high-flow dilution supporting the concept of a large number of point source sewage loading points to the river. This is not so for nitrate and nitrite which show similar concentrations in both summer and winter flow. This implies a diffuse source with loadings increasing as a function of flow, probably due to leaching of excessive nitrogen fertilizer applied during the growing season, and to the huge amounts of domestic, sanitary and other wastes randomly disposed of in river courses, on riverbanks, over bridges and along roadsides. Leaching from these wastes will increase proportionately to rainfall, run-off and near-surface groundwater flows. Findings here again directly affect policies and management for 1) fertilizer application management and guidelines and 2) an effective solid waste disposal program.
 - Sediment analysis for pesticide residues identified the ubiquitous occurrence of low levels of DDT. DDT parent compound was found in the river sediment at higher levels than its metabolite indicating current use of this banned substance.
 - Trace metals in sediment other than nickel and chromium were low. Nickel and chromium averaged 486 and 732 ppm respectively indicating leather tanning and metal plating activities in the watershed. There is a need for further research and evaluation.

The major research findings from the social and institutional program can be summarized as follows:

- There is a profound supply-side bias in the current and traditional approach to the management of the watershed. Such public investment as there is in the region is targeted at supply-side projects, specifically dam construction, diversions and channel canalization of the riverbed. This, together with the almost complete lack of consideration for ecosystem and water quality impacts is leading to a completely unsustainable situation and a public health nightmare.
- Attempts to answer the question of whether there is a sufficient legal framework in place in each of the countries to allow them to take appropriate action to control these activities yielded inconclusive results. Though there are basic legal frameworks, there seems to be little coherence in the laws and only the most rudimentary regulatory controls. There is an entrenched legal bias towards issues of supply (though the promulgation of a new environmental protection act in Syria shows signs of shifting this trend). We could see neither evidence of any structures for enforcement nor any effective land-use controls, livestock management regulations, solid and liquid waste management controls, restrictions, limits or planning/approvals protocols for irrigation withdrawals.
- Efforts to identify which ministries or agencies are charged with responsibility for administering and enforcing these laws and to assess their capacity to carry out their responsibilities effectively were frustrated by changes happening in both Syria and

Lebanon. Significant administrative reforms are underway in both countries, including attempts to strengthen Environmental agencies, but it remains unclear the extent to which these will result in meaningful change. Encouragingly, though, both countries are publicly stating their intent to improve environmental performance with special attention being paid to water resources.

- Public awareness of human impacts on the water resource is woefully lacking. Throughout the Akkar region, the dangerous combination of ignorance and poverty has resulted in patterns of behaviour that are having severe negative impacts on the environment. As noted above, dumping of garbage dead animals and offal into streams and ravines, discharge of raw sewage directly into rivers, grazing of animals on the shoreline and in the rivers themselves, harvesting of fish using poisons, common use of banned agrochemicals such as DDT, flood type irrigation with significant return runoff, smuggling activities which involve driving vehicles or riding horses across the river and the common accidental discharge of smuggled goods such as diesel oil into the watercourse, informal irrigation diversions and dams – these and other activities are putting the watershed under severe stress and must be controlled if there is to be any serious attempt at recovery.

Overall the research findings have profound implications for the development of a management plan. Taken in combination, the scientific and social research show clearly how community and individual practices are causing serious degradation of the Akkar watershed and significant health, social and economic consequences. More importantly, they underscore the urgent need for a comprehensive watershed management plan combining the strong leadership of national agencies with local level initiatives to make the needed investments and to change behaviour. The key elements of such a plan can be summarized as follows:

Immediate priorities

- Solid waste management plan
- Recharge area protection plan for springs and aquifers
- Sewage treatment plan
- Agricultural runoff abatement plan
- Shoreline protection strategy
- Elimination of DDT use

Medium-term priorities

- Water demand management plan
- Agricultural reforms
 - Irrigation improvements
 - Fertilizer & pesticide abatement strategies
 - Review of greenhouse practices
 - Measures to reduce soil loss
- Institutional cooperation for on-going monitoring program
 - In-situ monitoring for management information and to measure improvement
 - Parallel information systems & information sharing
 - GIS & Remote Sensing as a decision making tool
- Continuing Research
 - Geomorphic zones of protection

Longer-term considerations

- An Akkar-specific watershed protection Treaty

- Strengthened legal framework
 - Setting standards
 - Provide basis for self-regulation
 - Providing basis for enforcement
- A bi-national Commission charged with management of the watershed on a sustainable ecosystem basis
 - Community involvement
 - Adaptive capacity – to manage variability & continuously assess risk
 - Continuous improvements to “environmental competence”

Underlying principles

- Management on a watershed basis
- Collaboration and cooperation
- Sustainability
- Balancing Quantity with Quality and Equity
- Public involvement
- Solutions that demand a combination of both public investment AND individual initiative

Fulfillment of Objectives

The report should address each objective specified in the grant agreement, including the general objective, and assess the extent to which it was fulfilled. If any objectives were modified, added, or removed during the life of the project, this should be explained. The degree of fulfillment of any new objectives should also be assessed.

The original objectives, as set out in the MGC, are set out in bold below. Following each is our assessment of the extent to which the objective was met during the course of the project.

To evaluate alternatives and develop protocols and appropriate institutional arrangements for the multi-jurisdictional management of transboundary waters and associated basins

Efforts to achieve this objective have been largely overtaken by events. Both Syria and Lebanon are in a state of transition carrying out extensive evaluation and changes in institutional arrangements, legislative authorities and ministerial responsibilities with respect to their environmental portfolios and water resources in particular. Plans for a dam and the preliminary bi-national negotiations and agreements for construction and water apportionment have also dominated the agenda in this regard. To the extent that the analyses conducted and the recommendations made during this project have been directed towards individuals and groups engaged in the current institutional processes we can be hopeful that our work may find some relevance.

Perhaps even more significant is the unique opportunity for follow-up that is presented by these organizational changes and by the possibility of leveraging the investments that will be made on the dam project towards parallel efforts to effect meaningful remediation of the watershed and the implementation of policies and procedures to introduce and support more sustainable use.

To design and initialize selected activities of a major research evaluation program on the impact of land use on water quality under a variety of climatic conditions in the Akkar River

basin and to consider the resilience of any proposed institutional arrangements to the stresses and demands occasioned by extended periods of drought

This objective was completed with respect to the determination of the interaction of land use and water quality. Some changes in the program were made as a result of the delays in the delivery of strip chart recorders for the installation of hydrographic stations. Consequently the direct relationships between water flow and water quality parameters could not be evaluated. The direct linkage of water quality to land use, in a spatial sense, could not be made for nutrients and bacteria since the whole water system is overwhelmed by human sewage and solid waste disposal. However, trace metals and organic pollutants can be clearly connected to specific land uses. Overall the water system is a groundwater system with adequate water quantity in the main stem at all periods of the year. Clearly extended summer drought conditions can be accommodated even though under extreme conditions however, to achieve this, demand management will be essential. Based on flow characteristics, groundwater reserves appear to be adequate to meet current and anticipated demands but only if these demands are brought under some degree of careful management.

To understand and define the information needs for the effective management of the watershed and how these needs might be met

The scientific research information provides a compelling case for urgent and effective watershed management. It defines the kinds of information needed for such management and provides much of the base information needed to institute management programs in the watershed, including base maps of major natural and anthropomorphic characteristics. The results further provided clear evidence of the kinds of activities and behaviours resulting in the widespread water quality degradation enabling management priorities to be established and clearly defining the type of data required in ongoing management activities.

To evaluate the linkages amongst research, scientific knowledge, data, management and politics and to see how science can be used to transcend political boundaries and harmonize negotiations in a transboundary watershed

The project was able to bring together the science, knowledge and data to engage the citizens of both countries in a harmonious dialog. The vital roles played by the National Council for Scientific Research (Lebanon) and the General Organization for Remote Sensing (Syria) cannot be over-emphasized. The public/science/knowledge meetings in Rhabe in Lebanon and Tartous in Syria, together with a concluding symposium in Damascus, were remarkably successful. With the cooperation and support of the Fares Foundation, a fundamental structure for public participation has been created in Lebanon.

The public workshops far exceeded expectations both from the perspective of the size and composition of the audiences as well as the scope and range of the public discussion. Local, municipal and regional politicians and officials actively participated in an open discussion within a framework of science, knowledge, data, and management interaction and co-operation. National levels of government and politicians were less well engaged and it is somewhat disappointing that the Ministries outside of GORS in Syria and the National Council for Scientific Research in Lebanon became disassociated from the project at an early stage.

Nonetheless, the results of the project have been and are being made available to the Ministry of Irrigation in Syria and the Ministry of Hydraulic and Electric Resources in Lebanon as well as to the environmental agencies in both countries.

To work with the appropriate agencies in the participant states to build confidence and the capacity to facilitate the subsequent implementation of the overall program

Efforts to make any substantive progress on this objective were somewhat hampered by the administrative and agency reforms that were underway during the course of the project. They were further complicated by inter-departmental rivalries and perceptions of individual managers.

However, excellent relations between the two major country participants and the Canadian participants were achieved attracting considerable favourable attention in the region, raising awareness and setting the basis for future cooperation. Similarly the emergence of re-organized agencies and new personnel presents a significant opportunity to build on the project's strengths to develop stronger multi-agency support for the adoption and implementation of a management plan or its derivative.

Moreover, the remarkable convergence observed in the interpretation of the scientific results and in the emergent public opinion in the watershed has highlighted the important role for the public in a participatory process in establishing the needs, priorities and local involvement in watershed management. The convergence also strengthens the potential for public pressure to bring about implementation of a management plan. The community meetings and workshops held during the course of the project and now being continued after the project by a regional NGO have laid the foundation for ongoing local involvement as a key element in the implementation of any subsequent program.

To identify those parts of the management plans which are unique to the Akkar watershed as distinct from those which are generic in nature

Most unfortunately, the environmental issues observed in the Akkar, despite their severity, cannot be regarded as unique or unusual. The management challenges in this watershed are somewhat complicated by its bi-national character, but this too is not unusual. Indeed, the historic cooperation of the two countries is clearly an asset to the prospects for change.

However, the Akkar is and remains a clearly under-serviced and marginalized region of both countries. Uncovering the reasons for this is beyond the scope of this project, but this fact does add an element of differentiation. It fosters a certain sense of alienation from the national governments in the local communities and a perceptible element of resentment.

Here again, though, the proposed dam construction project, if coupled with a comprehensive resource management plan opens the possibility that this basin could be used as a watershed management development and demonstration project. This would necessarily involve all components of such a plan, from international agreement to monitoring protocols, based upon the specific conditions in the Akkar watershed but more broadly relevant to other regional watersheds as well. To do this successfully would provide an excellent opportunity for the development of expertise, capacity and model systems which, with appropriate adjustments, could be exported to many parts of the region and similar environments. We feel it is an opportunity that should not be missed.

Project Design and Implementation

Briefly describe the activities supported under the project and the period of time covered by these activities. Describe and discuss the research methods and analytical techniques used and any problems that arose. Indicate and explain any changes in orientation that may have occurred since the project was designed.

If relevant, please comment on specific aspects of project design such as:

- *any partnerships with Canadians or with other researchers, and the usefulness of these in achieving the project's objectives;*

- *the disciplinary orientation of the project;*
 - *the involvement of research users or ultimate beneficiaries, or their representatives, in identifying the project idea, project design and implementation, review of results, and*
 - *utilization; and features addressing gender issues.*
-

As discussed above, this project, as originally conceived, was based on a model evaluating the institutional arrangements using an interactive triad of a management framework, institutional capacity and scientific understanding. The research program was to be assembled as a set of three activities designed to address the objectives discussed above. The first activity was to research appropriate institutional arrangements and management protocols. The second was directed towards the improvement of scientific understanding and the enhancement of existing institutional capacity and cooperation. This second activity was further broken down into a set of four projects dealing with specific subject-areas. These first two activities were to be carried out concurrently. The third activity was a workshop to review the findings of the first two activities and to develop a proposal for a formal watershed management agreement.

However, in implementation, fundamental gaps in knowledge and lack of scientific understanding coupled with the institutional and organizational changes in the two countries led to a shift in the focus of the study towards scientific and social understanding and basic public awareness initiatives with a lesser emphasis on framework protocol and institutional capacity.

The scientific program proceeded much as outlined in the project proposal. The most notable deviation was due to the failure to install two hydrograph stations on the main stem of the river. This was due to the late release of the strip chart recorder equipment generously donated by Environment Canada. The delays were encountered due to difficulties securing necessary Customs clearances. The lack of temporal data was partially compensated by carrying out four spatial synoptic sampling campaigns which provided some information on the seasonal variability of a number of important parameters.

Some difficulty was encountered in obtaining analyses for nutrients and bacteria. This was due to lack of laboratory personnel and to a change in original commitments necessitating recourse to a consulting laboratory. This resulted in some gaps in the data, however sufficient results were achieved to enable a sound interpretation to be achieved of water quality degradation and causes.

As indicated above, the social and institutional research component underwent the most major shift. The evaluation of legislation and institutional arrangements was started but changed as it could be seen that legislative and ministerial responsibilities were being re-assessed and re-aligned in both countries. Instead, the focus moved more towards local conditions and public awareness. Most notably, this resulted in a series of local public workshops and the exciting involvement of the Fares Foundation which is continuing with this program in Lebanon. Significant long-term benefits are likely to accrue as a result of this shift.

Canadian co-operation was seen as extremely beneficial as demonstrated by the first-rate analytical support for organic micropollutants in sediments received from the University of Windsor (Great Lakes Institute for Environmental Research).

A wide range of disciplines was involved in the project such as microbiology, public health, geology, geochemistry, water chemistry, social and political sciences, and law.

There was a clear understanding throughout the project for the necessity of strong public participation and involvement of regional decision makers. These latter groups, together with higher levels of government, represented the major user groups and early engagement was carried

out in the project. The higher national political levels are currently being advised of the project results so that they can be major users in any remediation and watershed management that may be implemented.

Though there was no specific mention of gender equity within the project objectives and design, gender issues generally cross-cut the project. At the most fundamental level, the human health impacts of the deplorable water quality place a disproportionate load on women as the traditional primary care-givers in the local family units. This was underscored by anecdotal evidence in the social research. It is also significant that the local workshops were notable for their lack of female participants. Importantly though, young professional women played major roles in the field research teams on both sides and, interestingly and encouragingly, the final symposium – attended by academics and professionals - attracted an audience with a much greater proportion of women.

Project Outputs and Dissemination

Provide a listing and self-assessment of project outputs. Identify any outputs that are planned, but which have yet to materialize. Please specify what dissemination efforts were made wherever relevant. Three general categories of outputs can be identified:

- *information sharing and dissemination (reports, publications, conferences, websites, CD-ROMs etc.);*
- *knowledge creation (new knowledge embodied in forms other than publications or reports: new technologies, new methodologies, new curricula, new policies etc.); and*
- *training (short-term training, internships or fellowships, training seminars and workshops, thesis supervision etc.).*

The major outputs of the project were as follows:

- We were able to identify and quantify the levels of pollution in the watershed in significant detail and resolution.
- Related to major causative factors to a point where the management intervention priorities could be determined
- Provided a base set of land use and physical data needed for land use management and control in the basin
- Brought about the implementation of a successful public participation program in Lebanon and engaged the public in open debate in Syria

The final reporting for the project was in a symposium in Damascus in December 2002, to a largely technical and professional audience. This symposium was a session within the GORS Annual Symposium attracting a large, international audience, particularly from the Middle East, Europe and Russia. The National Council for Scientific Research of Lebanon has expressed an interest in hosting a similar presentation in Beirut (subject to funding being made available outside the project).

Summaries of the presentations and briefing notes have been provided to environmental and water agencies and to the Fares Foundation to be disseminated to government agencies and the public.

To-date, one conference presentation has been made with published contribution (reference Khawlie, M., Thomas, R., Kawass, I., Cadham, J., Shaban, A., and Adballah, C., 2002. *Role of remotely-sensed observations of a shared border watershed in environmental management, Lebanon-Syria* in Proceedings of 24th Canadian Symposium on Remote Sensing: Integrating our view of the Planet. Toronto, Canada, June 2002).

Presentations of results were made at well-attended public workshops in two locations, Rhabe in Lebanon in January 2002 and Tartous in Syria in July 2002. These marked the beginning of a public participation processes being continued in Lebanon with the support of the Fares foundation. Conclusions have been summarized in short brochures and on high quality posters for distribution throughout the watershed.

The Fares Foundation will continue the dissemination of results in their community work in the watershed. This Foundation has already initiated a number of English and Arabic newspaper articles which have given recognition to the project with a high profile for the partners, namely NCSR, GORS, CadhamHayes and IDRC.

A set of papers is now in preparation which will be submitted as a block to *Lakes and Reservoirs, Research and Management*, an international journal of peer reviewed papers.

Finally, about five hours of digital video has been taken which will subsequently be edited to a 30 minute presentation in Arabic and English for use by the partners and for local television.

Capacity Building

Indicate what capacity-building impact the project may have had on the following:

- *institutional reinforcement and sustainability of the research organization (new equipment),*
 - *training, improved administrative skills, lessons learned etc.);*
 - *increased research or administrative skills of the researchers involved; and*
 - *any particular contribution to capacity-building of women or marginalized social groups*
-

The project Working Group provided a useful model for the management of a complex research undertaking. The project enhanced both the profile and the capacity of GORS and NCSR in conducting environmental research and developing a greater environmental awareness and capacity in linking remote sensing to land use and water quality. It allowed both agencies to develop a sampling and analysis capacity in water-related research and developed their capacity to understand water quality data interpretations and the analytical procedures for assessing the relative impacts of point-source vs. diffuse sources of pollution.

The agencies acquired hydrological measuring equipment which, while not available in time to support this project, will enable them to conduct quantity and quality temporal research within their jurisdictions.

Efforts to build cooperative research networks both within and between Syria and Lebanon was a major feature, particularly between scientists, the public and local political leaders. Long-standing ties have been enhanced providing a sound base for continuing with future studies and generally strengthening environmental awareness.

The interaction with the Fares Foundation taking on a prominent public participatory role provided immediate results and opened opportunities to influence policy formulation and implementation of environmental remediation projects well beyond the scope of this project.

While women were involved throughout the project, it is clear that greater involvement leading to confidence building and enhanced professional training is necessary. Environmental projects of this type are an ideal mechanism both for lowering traditional barriers as well as for developing expertise in the application of specialized skills for women needed to build leadership in scientific and social endeavours.

Project Management

Briefly assess and comment on the quality of project management with reference to the following through all stages of the project cycle:

- *administration by the research organization;*
 - *scientific management of the project; and*
 - *technical and other support and administration by IDRC.*
-

Administration of the project was carried out efficiently and effectively. The principal local-partner organizations lived up to their commitments and generally met or exceeded expectations with regard to field logistics and support. These were of a consistently high order, allowing for work to be undertaken within the specified time frame. The allocation of funding as needed in the project delivery was timely and met all requirements.

The scientific management of the project was conducted through a Working Group which met frequently. Meetings were orderly and conducted to a fixed agenda covering all components of the study. Minutes were kept and served as the operating instructions to all parties. Progress was measured by review and reporting of the parties under the action items of the minutes. Copies of these minutes are available and serve as a complete record of the scientific management of the project.

The administrative, technical and advisory support given by IDRC was exemplary and sincerely appreciated by the participating organizations. The enthusiasm and interest in the project from all IDRC staff in Cairo and Ottawa was quite exceptional and praiseworthy. All participants have acquired a high level of respect for IDRC and the manner in which it conducts its business.

Impact

Describe and assess any development impact that the project may have had or might be expected to have. A useful distinction can be made here between the concepts of reach and impact. Reach refers to the reception and use of the knowledge produced. Impact refers to the influence of this new knowledge on decisions or on development more generally. Special attention should be paid to the expected impact on marginalized social groups.

Various project impacts have been discussed throughout this document. However, the greatest impact that the Akkar project has already had would undoubtedly be to have started the difficult process of changing public attitudes and behaviour in the watershed. The reaction to the public

workshops and to the NGO participation marked a clear turning point where we could start to see attitudes shifting from a general expectation that “national government must act” to the realization that local action is essential.

If this momentum continues, the prospects for positive local actions and for the formation of a local watershed committee are very good.

We are also cautiously optimistic that the work done in this project, its conclusions and the experience of the agencies involved will have some impact on the future shape of the re-organized water and environment agencies in both countries. The project clearly laid out a case for increased local participation in watershed management and certainly the representatives of the national-level agencies who participated at various stages of the project came to recognize the potential benefits. The seed has been planted, but it remains to be seen whether these benefits can be harvested.

Proposed Dam Construction on the Nahr El Kabir

The greatest potential impact that we can hope the findings of the project may have will be on the proposed construction of the dam on the mid-section of the river.

An examination of volumetric discharge of waters from 1999 to 2002 for the Nahr El Kabir shows that water extraction and use is rapidly approaching or already exceeding its maximum potential during the summer period. Large surpluses of water are available during the winter period. Clearly supply side management with no consideration of demand management indicates the need for a dam for supplementing the irrigation needs of the coastal region during the summer period.

A dam producing a deep, long reservoir as would be the case for the Nahr El Kabir could also be perceived as a tourist asset in providing recreation and tourist opportunities with associated development in commercial properties and dwellings. However, such development is predicated on a reservoir of high water quality allowing for body contact recreation, fisheries and scenic appeal.

Under the present conditions of the El Kabir River, the water entering the gorge from the Sahlet el Bqaiiaa is of dreadful quality, extremely high in nutrients (N and P) and bacteria of faecal (animal and human) origin. Under these conditions the following environmental conditions will exist in the reservoir following stabilization after filling.

1. Bacterial infection will continue and the waters will not meet international guidelines for irrigation. It will further fail guidelines for body contact, the washing of fruits and vegetables and will not be usable for potable water without filtration and disinfection.
2. Nutrient levels will create hyper-eutrophy with large blooms of phytoplankton including blue-greens. Water transparency will be reduced to less than 50 cms and there will be patchy discolouration of the water and loss of aesthetic appeal.
3. Algae, when washed ashore, will be unsightly and create odour as well as clogging water intakes.
4. Death of algae followed by bacterial oxidation during settling through the water column will result in oxygen depletion and anoxia. This will result in the loss of high quality fish species and only coarse fish such as carp, bream and roach will survive. A recreational fishery will never be instituted.
5. Due to slope instability and soil exposure by agriculture, erosion is a problem in the watershed particularly upstream of the dam in the Sahlet el Bqaiiaa, the Chadra valley and along the Nahr Nasrive. Water at the outlet to the gorge from the Sahlet el Bqaiiaa is highly turbid and suggests that high levels of siltation maybe a factor limiting the

effective life of the reservoir. Quantification of sediment load is necessary as well as studies to determine optimum methods to control soil loss to the river are urgently required.

Under these conditions, it is predicted that frequent advisories, as are already commonplace on the Quaroun reservoir on the Litani River in Lebanon, to stop human access to the reservoir will be necessary to protect human health.

A clean-up of all sources of nutrients and bacteria above the dam is essential to achieve the optimum benefit and commercial opportunity from this large capital investment. A small proportion of the capital involved should be used to implement collect clean-up (small scale) procedures and to develop land use protocols to provide instant alleviation of the negative aspects of the dam. It would also provide much improved water quality for irrigation thereby expanding the market opportunities for the agriculture of the coastal plain.

Overall Assessment

Briefly provide your own views on the value and importance of the project relative to the investment of time, effort, and funding involved.

With the cooperation of the government agencies of Syria and Lebanon, together with the local NGO involvement, the Akkar Watershed project was able to achieve considerably more far-reaching results than the investment of time, effort and funding involved. The study itself is a very good model of how water quality analysis can be used to determine how human activities in a watershed result in environmental degradation and of how these results can be used to demonstrate the need to change policy and behaviour. But beyond the provision of numerical values and a clear statement of facts, the project was able to energize both the agencies involved and the local communities in a way which, hopefully, will have a direct impact on national and local public policy and will aid in starting the process to protect and enhance the long-term well being of the citizens in the watershed.

In this respect we exceeded our expectations considerably.

Recommendations

Include any recommendations that you would like to make to IDRC.

Given the state of flux in regional institutional arrangements for water and environmental management in Syria and Lebanon, there exists a very real opportunity to effect material change in attitudes in a most fundamental way and to influence policy in the near term as the relevant institutions work to re-organize their mandates.

We recommend that IDRC continue to fund activities in this regard within both Syria and Lebanon – most especially in the areas of social adaptive capacity, local water management and demand management.

Considerable goodwill has been fostered by this activity amongst the agencies involved in both countries. We recommend that any opportunity to leverage this goodwill be seriously considered.

NGO participation was highly beneficial to this project. Some of the most far-reaching successes in this project were due to the support of the Fares and Hbous foundations. We recommend both of these organizations to the IDRC as potential partners in future activities.

Finally, the proposed dam on the Nahr el Kabir represents an excellent opportunity to start working towards a comprehensive watershed management plan to ensure good quality water in the reservoir and in the watershed itself and to contribute towards a sustainable future for the residents of this region.

