17 Protecting Source Water: Jordan

General Information

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- **Implementation Period:** Phase 1: March 2002 to January 2003. Phase 2: June 2003 to June 2005.

- **Costs:**
  United States Agency for International Development (USAID): US$3 million for technical assistance and procurement (includes programme components not discussed below).
  Water Authority of Jordan (WAJ): an estimated US$1 million for related infrastructure and programme supervision.

SUMMARY

This case study describes the Jordan Water Quality Management Project (JWQMP), the overarching aim of which is to protect and improve the water quality of drinking water sources in Jordan, thereby helping to protect public health and safeguard investments in infrastructure.

Key elements include the development of clear, appropriate and enforceable drinking water regulations; the strengthening of monitoring activities (planning, sampling, analysis and data management) by using the internationally recognized ISO 17025 standard as the basis and motivation for improving practices; the implementation of a source water protection programme to slow down any deterioration of groundwater quality; and the improvement of operations and maintenance practices at drinking water facilities. (This final part of the programme is not covered in detail in the present report, which will focus on more innovative aspects.)

JWQMP is a USAID-funded project for which the implementing institution, CDM International, Inc., is providing technical assistance to the Water Authority of Jordan and the Ministry of Health.

BACKGROUND AND JUSTIFICATION

By 1997, the Water Authority of Jordan (WAJ) had realized that the water quality at several of its wells and springs had deteriorated to the point where simple disinfection was no longer adequate for protecting public health. A two-pronged approach to the problem would have been to first protect these sources to prevent further water quality deterioration, followed by further treatment to bring the water to appropriate standards. WAJ focused most of its efforts on the treatment facilities and commissioned CDM International, Inc., via USAID, to design and construct treatment facilities at six sites at a cost of over US$23 million.

In 2001, after the investments had been made and the treatment plants completed, their smooth operation and delivery of safe water to the public were hampered by changes in regulatory guidelines that meant that some plants were shut down more than 30 per cent of the time. USAID sought to take stock of past achievements and obstacles and set a progressive, rational plan of action for future assistance.

Jordan's water supply problem is one that affects the whole eastern Mediterranean region. The unregulated activities of a growing population result in increasing groundwater pollution. These people also demand increasing quantities of high-quality drinking water. The problem is made more acute in Jordan, where water scarcity forces the abstraction of drinking water from potentially risky sources. In addition, deteriorating source water quality demands increasingly sophisticated treatment technology. However, the importation of such technology into an inadequate, uncoordinated and overly conservative regulatory framework can provide a false sense of security rather than safeguard public health. Further problems arise because the process to develop Jordanian Drinking Water Regulations continues to be under-resourced. No agency has the clear mandate, time or resources to study and legislate over the increasingly complex, multidisciplinary problems inherent in integrated water resources management.

CDM International, Inc., therefore, undertook to review the entire drinking water supply system in Jordan. This review revealed weaknesses in several areas, including:

- groundwater under the influence of surface water represented a large proportion of the drinking water supply;
- the quality of source water was deteriorating, with increasing levels of microbiological and nitrate contamination; and
- there was a general lack of data on many water-quality parameters.

It was therefore decided that a source protection programme was needed and the Jordan Water Quality Management Programme (JWQMP) was launched.

Monitoring of the total water cycle came under the jurisdiction of the WAJ Central Laboratory and the Environmental Health Directorate (EHD) Laboratory of the Ministry of Health (MOH). However, there was often no consensus between data generated by WAJ, EHD and the MOH Jerash Directorate water-quality laboratories, owing to the lack of a systematic approach to laboratory practices and quality control. These practices could be improved by implementing an ISO 17025 plan. The desire to work in, and have as an asset, an ISO-accredited laboratory gave both the laboratory staff and management a strong motivation to improve laboratory practices. Also, because ISO accreditation needs to be maintained on an annual basis by demonstrable indicators, ISO accreditation provides a long-term, sustainable mechanism for ensuring good laboratory practices.

Description

Phase I (2002): An Extensive Strategic Response

Triggered by deteriorating source water quality, plant shutdowns and regulatory obstacles, this initiative was launched as a short-term, holistic analysis of the water

resources picture. Key results included:

- preliminary watershed management plans for catchments supplying five key treatment facilities in northern Jordan;
- improved monitoring of water quality;
- laboratory training and procurement; and
- expert guidance to regulators and stakeholders in the development of drinking water regulations via a consensus-building approach.

Phase II (2003-2005): Implementing Intensive Solutions

Based on the lessons learned during Phase I, a set of priority projects was selected for intensive implementation during Phase II. These included:

- institutionalization of watershed management at WAJ;
- implementation of a pilot watershed management programme at WAJ; and
- implementation of ISO-based quality management programmes at WAJ and MOH laboratories.

The Qairawan watershed (fig. 1) was selected as the site for the pilot project that would run parallel with the institutionalization of watershed protection in WAJ. The Qairawan watershed covers an area of 36 square kilometres that is home to 39,000 people, concentrated mostly in three urban areas: the historic Roman town of Jerash, Suf town and the Suf (Palestinian) Refugee Camp. The Qairawan spring, which produces 25 cubic metres of water an hour, was the source of some of the poorest water in the area and additional treatment was necessary to bring it up to required standards.

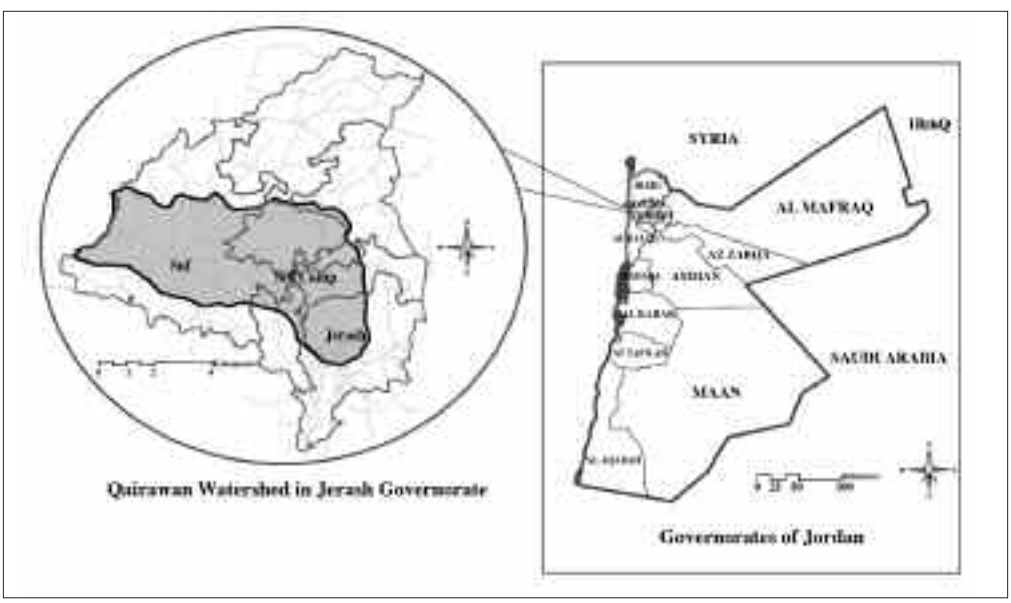

Figure 1. Location of the Qairawan watershed management pilot scheme.

The overall project approach to tackling the problem combined both technical work and community participation and has included:

- developing a comprehensive understanding of the quality of the Qairawan spring and other springs in the watershed;
- understanding the practices and activities in the watershed that contribute to water-quality problems, and their spatial distribution through both physical surveys and targeted community meetings;
- working with community groups to develop solutions that can foster the sustainable coexistence of the many human and economic activities within the Qairawan watershed; and
- soliciting funding and agreeing on cost-sharing mechanisms for the implementation of best management practices (BMPs). The next phase of work will be to implement these BMPs.

Concerning monitoring and laboratory practices, the focus has been on developing and implementing a quality management system that is recognized both within and beyond Jordan. The international standard ISO/IEC 17025:1999 (General requirements for the competence of testing and calibration laboratories) contains requirements that address both the management and technical aspects of a testing-laboratory operation.

Quality management principles were introduced through a series of workshops and training sessions to some 70 people in administrative, technical and managerial roles within WAJ and EHD. Staff from both organizations attended these sessions together to promote the sharing of ideas and experiences and to foster the cooperation and trust necessary between the departments.

Assessment of Water-quality Data

Analysis of springs in the Qairawan watershed revealed a series of water-quality problems:

- *microbiological contamination*: faecal coliform bacteria and *E. coli* were detected at varying levels throughout the year;
- *turbidity*: levels of suspended particles increase shortly after rainfall in winter and cause periodic problems in summer;
- *salinity and nitrate concentrations*: these are rising above the permissible level for drinking water in several springs; and
- *pesticides*: some organochlorine compounds were detected at low concentrations; total organic carbon, oil and grease have been detected at low and erratic concentrations.

Assessment of Wastewater Data

A survey of more than 5,000 residences and businesses in the Qairawan watershed revealed that more than 4,600 properties used cesspits to dispose of domestic

and commercial wastewater. The survey also identified 244 residences where the cesspit was originally a natural cave. These cesspits have a direct connection to the groundwater and pose a high risk. However, most of the densely populated areas of the Qairawan watershed are served by sewers although the percentage of the population connected to the sewers varies from community to community. The survey also indicated that 2,605 of the properties with cesspits were connected to a sewer but that 23 per cent of properties had not properly decommissioned their cesspits. Of the remaining cesspits, 1,854 were confirmed to be active, while the status of 163 was indeterminable. Over two thirds of the active cesspits had not been pumped in over 20 years.

Establishment of Groundwater Protection Zones

With no guidelines in place for the implementation of groundwater protection zones in Jordan, the Qairawan Watershed Pilot Project developed a method for delineating areas to be protected. Recommendations of the Watershed Protection High Committee of the Ministry of Water and Irrigation (MWI) were accepted for Zone 1, the area immediately around the source. Essentially, Zone 1 is a 30-metre-wide buffer centred on the wadis (valleys) in which all activities except farming are prohibited. To determine Zones 2 and 3, the JWQMP team adapted a ground water vulnerability map developed in Switzerland for use in limestone areas (the EPIK method).

Assessment of Potential Pollution Sources

The conclusion was reached that the main causes of water contamination were wastewater, specifically from households connected to sewers with improperly commissioned cesspits, and agricultural practices, including the use of chemical fertilizers; continued use of the soil fumigant, methyl bromide; and the practice of spreading organic manure in winter. More specifically, among the major sources of this contamination were cesspits; sewer overflows; the illegal dumping of liquid wastes, including by the drivers of septage trucks; and intensive cultivation practices in wadis. The main sources of nitrogen pollution in groundwater were similar but might also include run-off from manure stockpiles, particularly from chicken farms, which are plentiful, the waste from olive-pressing operations and blood from slaughterhouses (fig. 2).

Identification of Priority Best Management Practices

Taking into account these and other potential pollution sources, the technical programme team developed a series of watershed mitigation measures, or best management practices (BMPs). These BMPs comprise structural measures, such as building a new sewer, as well as non-structural control measures, such as recommending changes in behaviour or the development and enforcement of new regulations. Consideration was given to BMPs that met the following general criteria:

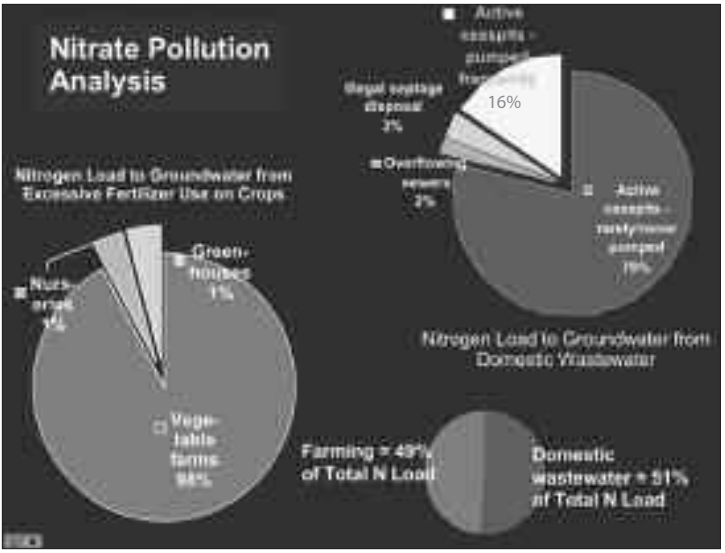

Figure 2. Sources of agricultural and domestic nitrate pollution in groundwater.

- they were based on common and proven measures;
- they would be acceptable to and achievable by the local communities;
- they would be likely to achieve rapid, tangible results;
- they required little technological input; and
- they were low-cost solutions.

Watershed Management Pilot Programme

Over many years, the concept of stakeholder participation has evolved. No government can, by itself, solve problems that depend on human interaction and human behaviour. If problems are to be solved, the government needs the support of the people as much as the people rely on the government to act as a regulatory body. The community participation approach for the Qairawan watershed management project consisted of the following elements:

- frequent interactions with the residents of the watershed through focus groups targeted at particular pollution sources, including septage truck drivers and chicken farmers;
- meetings with local and national government officials to discuss problems and identify solutions; and
- creation of a formal Joint Stakeholders Group that brought together both government and community representatives on a bi-monthly basis to discuss the technical findings of the project, to allow community members the opportunity to express their expectations and concerns directly to the government representatives, and to work together to prioritize problems and solutions based on specific BMPs.

Public awareness of the findings and recommendations of the programme was also raised through a five-week campaign consisting of:

- 35 imams each conducting eight Friday sermons *(khutbas)* that reached some 4,000 citizens;
- 17 women lay preachers *(waethat)* conducting 12 religious lessons reaching some 360 women;
- workshops at 12 schools involving 36 teachers and 768 students;
- the distribution of outreach materials; and
- an ongoing media campaign.

The specific aims of the public awareness campaign were to:

- introduce the concept of watershed protection;
- provide information on the watershed area; and
- highlight harmful practices.

A campaign logo (fig. 3) was also developed and it proved to be widely popular with both government and community members.

Figure 3. Logo of the Watershed Campaign.

REPLICABILITY

The deterioration of water quality as a result of increasing human population pressure is of concern around the world. In many developing countries in particular, increasing urbanization usually precedes the enactment of drinking water regulations, leading to the deterioration of both ground and surface water quality. In such cases, the early implementation of an integrated water resources approach, such as that outlined above, is crucial to safeguarding public health and protecting expensive investments in treatment. Particular areas where the replicability of the project is immediately apparent include the following:

- the policy guidelines being developed by the Jordanian agencies and WAJ can be used as a template for establishing source water protection programmes elsewhere;
- the specific processes used in the Qairawan Pilot Programme for community/stakeholder engagement and raising public awareness have proved successful and are simple enough to be applicable anywhere. Stakeholder engagement is the cornerstone of watershed management and source protection;
- as the geomorphology of much of the Mediterranean region is similar to that in northern Jordan (i.e., limestone rock), the modified EPIK method for assessing groundwater vulnerability could be used in similar regions; and

- the prestige associated with attaining an internationally recognized standard such as an ISO provides a powerful motivator for improved laboratory and monitoring practices.

Policy Implications

Implementation of the JWQMP required several changes in policy and legislation.

The establishment of a pilot programme provided a reality check for regulators drafting guidelines for allowable activities in watershed zones. When faced with real-life scenarios such as the need for land acquisition and both political and public pressure, regulators favoured negotiated solutions rather than the top-down implementation of unrealistic directives. New regulations have been drafted and are currently awaiting parliamentary ratification:

- a memorandum of understanding between WAJ and MOH on the framework for new water-quality monitoring systems has been agreed to in principle and awaits signing.
- turbidity, faecal coliform, *Cryptosporidium* and *E. coli* standards have been revised (until now, *Cryptosporidium*, a small internal parasite, has not been analysed consistently by the laboratories concerned);
- the new Watershed Protection Department has been created within WAJ; and
- an internal agreement delineating departmental roles in watershed management between MWI and WAJ was negotiated and signed.

Lessons Learned

A key lesson learned was that it is crucial to build partnerships with all stakeholders and, perhaps most importantly, find a strong champion within the government and donor sectors with whom a joint vision can be built and who will be committed to sustaining the programme after the implementation project has been completed. Successful partnerships are those built by helping partners to learn new information together although specific relationship-building workshops do not work as well as working interaction on a daily basis. A key strength that donors bring to such programmes is the ability to create a neutral forum where all stakeholders can communicate. Often this is all that is needed and, once the forum is created, facilitating interaction is not difficult.

In preparing the public to accept changes, it is critical that information be shared and that stakeholders be contacted at the inception of the programme or even before it begins. The community must be involved in defining the problems and a methodical process for meetings and workshops should be presented to ensure the engagement of local people throughout the process. Even when stakeholders do not agree with one another or the programme's

objectives, they must be included in the process.

The participation of the local people ensured the success of the project. It helped to create awareness and then a demand for improved water supplies. This was most apparent once the BMPs had been defined. Community motivation was instrumental in getting the Government and donors to commit funds for future phases of the programme. In addition, the sharing of technical scientific and engineering concepts was vital to enabling the community members to feel that they were a real part of the team. Investing in a lengthy educational process and ensuring that technical information was never "dumbed down" were much appreciated by the community.

Even so, any endeavour aimed at changing the way people conduct their business will encounter obstacles that need to be managed. Among the obstacles faced and the steps taken to overcome them in this project were the following:

- there was a lack of trust and familiarity between community and local government officials. By enabling the partners to talk to one another, mutual respect was built;
- many high-level technocrats and regulators had little or no understanding of critical scientific concepts. A lengthy education process, including scientific debate, was necessary;
- it was difficult to convey the benefits of the watershed programme to people with low incomes. Institutionalization of the WAJ financing mechanism for sewer connections went a long way towards building goodwill;
- an adequate water-quality database was lacking. An independent sampling programme was initiated to develop this information; and
- documentation relating to the ISO standard was not available in Arabic. Additional time and training were required to overcome the language barrier.

Impact

The programme has successfully strengthened ties between MWI and MOH. Counterparts at various levels of government who previously interacted primarily on contentious enforcement issues now share a commitment to the protection of public health.

The project propelled watershed management from a concept into a practice at WAJ and other agencies of the Government of Jordan and local stakeholders.

Revised regulations to safeguard public health have been instituted. Thanks to the combination of these revised regulations and improved spring water quality, shutdowns of the water treatment plant have been reduced to almost zero.

Evaluation surveys of awareness campaigns carried out in schools indicate that knowledge has been successfully transferred to families and there is anecdotal evidence of improved household practices.

There is an increased understanding of the need to decommission cesspits as part of the process of connecting houses to the sewer system. To aid this process, WAJ has instituted a finance mechanism for sewer connections for low-income community members. In addition, Suf municipality has begun to collect solid waste from chicken slaughterhouses. Both these measures have helped to improve groundwater quality.

Farmers have articulated a strong desire for advice on how they can reduce pesticide and fertilizer inputs and run-off.

Work towards ISO accreditation has improved laboratory practices. The various laboratories have now completed a series of Quality Systems Manuals, the most difficult step towards ISO accreditation, and Quality Assurance Officers have been hired at both WAJ and MOH/EHD laboratories. It is expected that ISO accreditation for these laboratories will be achieved by mid-2005.

Future Plans

A memorandum of understanding between WAJ and MOH to modify monitoring protocols for laboratories and to harmonize water monitoring protocols will soon be signed. The quality of spring and well water, including flow rate (for springs), *E. coli* and nitrate levels, will be assessed quarterly and, at least once a year, an analysis of hazardous chemicals (pesticides, volatile organics and petroleum products) will be conducted at the public water supplies. Such data will help towards assessing the long-term impact of the BMPs.

Concerning the Qairawan watershed pilot programme, a by-law defining groundwater protection zones, including prohibitions and restrictions on human activities, will be finalized and formally adopted.

Recommendations to protect water supplies will be incorporated into decisions on land use made by local municipal boards and the Ministry of Municipalities and Rural Affairs.

Another major future plan is to replicate the methods for protecting critical water supplies in another watershed and, eventually, throughout the whole country. WAJ has already identified a new watershed project site and has started planning procedures with the collaboration of local stakeholders.

Publications

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