The Al-Bireh demonstration project on agricultural reuse of wastewater in the West Bank

David Meerbach

High crop yields and relatively uncontaminated eggplants were some of the results when treated wastewater was used to irrigate tree and vegetable crops. The Al-Bireh demonstration project in Palestine was also important for bringing together institutions that will continue to drive water reuse in agriculture in future.

In the semi-arid climate of the West Bank the use of treated wastewater (also known as reclaimed water) to meet increasing agricultural water demands has been identified as one of the main objectives of the Palestinian water sector.[1] The total volume of treated urban wastewater suitable for reuse is projected to be 12.1M m^3/year (million cubic metres per year) for the main Palestinian cities by the year 2010. In comparison, total agricultural water demand is projected to increase by 50M m^3 over the years 2005–2010.[2]

In the current political climate this increased demand is unlikely to be met by an increase in freshwater supply and therefore water reuse is key to the development of the agricultural sector. Various studies have been conducted to assess the feasibility of reuse at several locations in the West Bank, but implementation of a comprehensive water reuse project is still pending the approval and construction of wastewater treatment plants (WWTPs).

As a result, the discussion regarding reuse among Palestinian institutions is mainly theoretical and not yet based on hands-on experience. As a first step to generate Palestinian expertise, therefore, a demonstration project for the agricultural use of reclaimed water was established at the WWTP in Al-Bireh.

The Al-Bireh demonstration project

The Al-Bireh demonstration project for reclaimed water use in irrigation was implemented in partnership with the Palestinian Water Authority (PWA), the Ministry of Agriculture (MoA) and the Al-Bireh Municipality (ABM) and funded by USAID. The objectives were to demonstrate:

- the important role of water reuse for agriculture
- a range of crops and irrigation equipment suitable for reused water
- and appropriate management procedures for Palestinian institutions involved in future water reclamation and reuse projects.

All activities at the demonstration project were co-ordinated by a steering committee that was chaired by the PWA and consisted of representatives of the Ministries of Agriculture and Health, the Environmental Quality Authority and the ABM. Members of the steering committee received training in basic water reuse principles and the installation and operation and maintenance of the systems.

The demonstration project showed that high yields for crops such as these roses can be obtained and that sound agricultural practices and water treatment systems can minimize the risk of crop contamination

Project design

The Al-Bireh WWTP is located east of Ramallah and treats approximately 1.25M m^3/year of raw municipal wastewater. The treatment at the WWTP consists of oxidation ditches, secondary clarifiers and a UV-disinfection system for pathogen removal. The reclaimed water has a tested quality of 10/10 mg/l BOD/TSS (Biochemical Oxygen Demand < 10 mg/l and Total Suspended Solids < 10 mg/l), Total Nitrogen 30–40 mg/l and a faecal coliform level lower than 100 CFU/100 ml. Since there are no adjacent agricultural lands, the effluent is not normally reused and is discharged to the wadi.

The main activity of the demonstration project was the construction and management of a 1 ha reclaimed-water drip-irrigation system. The project operated according to Palestinian and Israeli reuse standards and demonstrated several options for reuse that are allowed according to these standards, including the irrigation of freshly eaten vegetables with disinfected effluent. Within the WWTP site an area of 0.84 ha was demarcated and planted with ornamentals (flowers and

The disinfection system rendered the reclaimed water suitable for unrestricted irrigation

hedgerows), young orchard trees (olive, date palms and various fruit trees) and indigenous Palestinian trees (nut trees and acacia). All trees and ornamentals were irrigated by drip irrigation and no fertilizer was applied to supplement the nutrient application with the reclaimed water. A parcel of 0.1 ha was planted with sweet corn. Pre-sowing irrigation of corn was by sprinklers, and after emergence by alternate row drip irrigation. Nitrogen application through the reclaimed water was 70 kg/ha for the growing season and cob yield was measured.

For unrestricted irrigation purposes, a disinfection system to treat 0.8 m^3 of effluent per hour was installed. The disinfection consisted of gravel media filtration for turbidity reduction, a chlorine-dosing unit calibrated to inject chlorine at a concentration of 2 mg/l and a 400 litre vessel that retained the chlorinated water for 30 minutes. The disinfected water was tested for turbidity, residual chlorine and faecal coliforms. After disinfection, the water was conveyed to a 600 m^2 greenhouse for the drip irrigation of eggplants (aubergines) and a nursery producing 25 000 seedlings of indigenous Palestinian rangeland trees per year. The eggplants were trellised to ensure a safe distance of 50 cm from the emitters, as required by Israeli standards. Eggplants irrigated with disinfected water and a control sample of eggplants from the Ramallah market were analysed for faecal coliforms, enterococci and enteroviruses.

Results

Despite the fact that no mineral fertilizers were used throughout the season, the ornamental trees and flowers, and the young orchard trees showed high vegetative growth but only results from future years will indicate the effect of reclaimed water on yield quality and quantity. Sweet corn showed high vegetative growth and obtained a high cob yield of 5 t/ha. Corn residuals were used as fodder for animals.

Water quality tests on the disinfected effluent showed that the system delivered water of quality suitable for unrestricted irrigation. Turbidity levels were lower than 2 NTU, residual chlorine levels were between 0.5 and 1.0 mg/l and no faecal coliforms were detected in the water. In the nursery, seedling germination rates were high (> 90 per cent) and seedlings irrigated with the reclaimed water showed high vegetative growth. Eggplant yield obtained without the addition of mineral fertilizers was 8 t/ha. Crop quality tests showed that eggplants irrigated with reclaimed water were not contaminated with faecal coliforms and enteroviruses, whereas eggplants from the Ramallah market were contaminated at the low level of 3 faecal coliforms CFU/eggplant and 100 enterococci CFU/eggplant, indicating both human and animal faecal contamination. These results showed Palestinian counterparts that post-harvest contamination is likely to occur and that water reuse can be safe, as long as appropriate management procedures are followed.

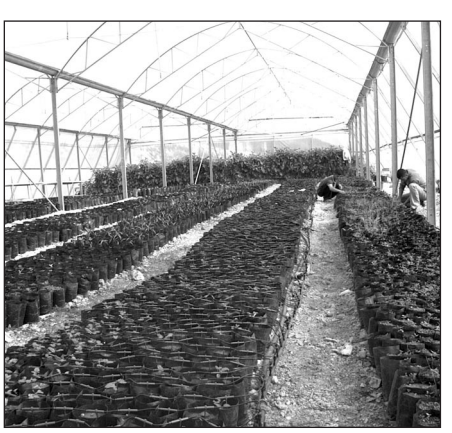
Institutional aspects

The formation of an inter-agency steering committee highlighted the multi-disciplinary aspects of water reuse and showed that successful implementation of water reuse projects requires the co-operation of water, agricultural, environmental and health professionals. During the course of the project the committee identified institutional roles and responsibilities and as a result the MoA became the primary project-implementing partner, with professional input from the committee members. The MoA continued to manage operations and maintenance after the handover of the project.

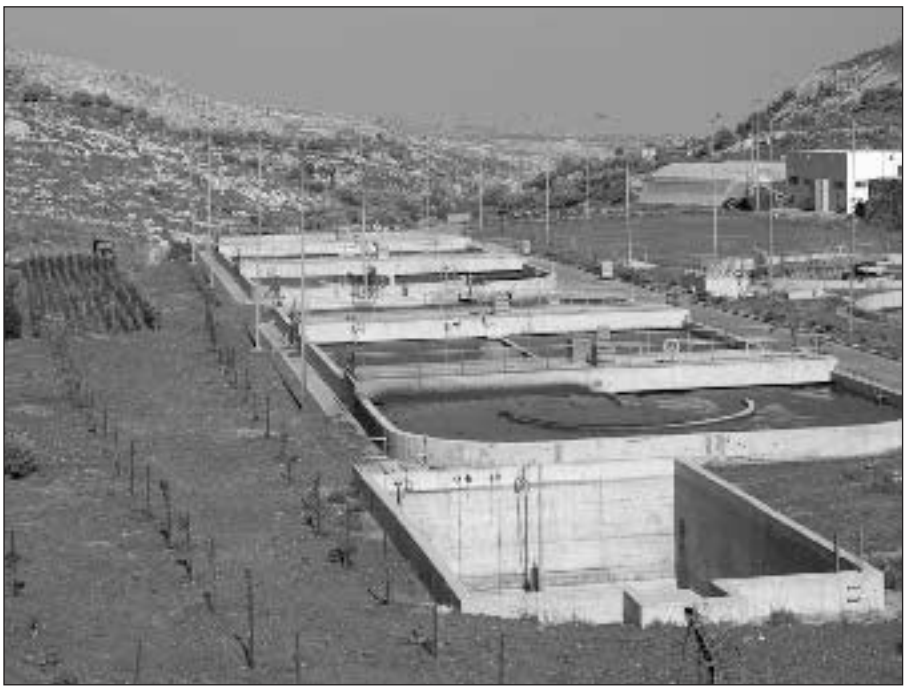
Since most literature emphasizes the potential hazards of reuse, the project partners initially were rather reluctant to consider water reuse as a safe source of irrigation water for a variety of crops. At the end of the project, the demonstration project showed that high crop yields can be obtained without the addition of mineral fertilizers and that sound agricultural practices and water treatment systems can minimize the risk of crop contamination. As a result, the technical capacity of the institutional counterparts increased and their attitude towards reuse changed from reluctance to enthusiasm.

Conclusions and recommendations

Reuse of reclaimed water is essential to meet the expanding water demands of the agricultural sector in the West Bank and therefore should be part of the integrated management of the available and future water resources. The demonstration project showed that reclaimed water of a high quality can be used beneficially for a range of crops, including freshly eaten vegetables and that significant reductions in mineral fertilizer use can be applied. One of the main successes of the Al-Bireh demonstration project was the establishment of a steering committee consisting of government institutions involved in water reclamation and reuse. Through this steering committee institutional roles and responsibilities became clear.



Germination rates and seedling growth using reclaimed water for irrigation were all high



The demonstration plot was located next to the wastewater treatment plant

A strong institutional capacity is the basis for the capacity building of Palestinian farmers and the future of sustainable water reuse. The main institutional challenge is to expand and strengthen the partnership of Palestinian institutions in the water reuse sector, to define and implement roles and responsibilities and to develop procedures for sound water reuse regulation, licensing and monitoring. Increased technical and institutional capacity is required to address the technical issues of the planned reuse projects in Palestine.

As there is a vast global knowledge base in the field of reclamation and reuse, consisting of standards and guidelines, examples of 'best-practice' projects and numerous centres of reuse expertise, Palestinian institutions can use this as a basis for increased institutional capacity. Through practical research at experimental and pilot projects, institutions can establish a local knowledge and database that contains data on agronomic, environmental and public health aspects of reclaimed water use.

References

1 CH2M HILL, Inc. (2002) 'Identifying goals, objectives, standards, policies and priorities (GOSPPs) for the Palestinian Water Sector', paper for the USAID mission, Tel Aviv.
2 CH2M HILL, Inc. (2003) 'West Bank Integrated Water Resources Management Plan', paper for the USAID mission, Tel Aviv.

About the author

David Meerbach is a water management specialist. He has worked on irrigation and water and sanitation in Palestine, Jordan, Pakistan, Ecuador and Israel. He can be contacted at: email: dmeerbach@meg.palnet.com / d_meerbach@hotmail.com