19th WEDC Conference ACCRA, Ghana 1993

WATER, SANITATION, ENVIRONMENT and DEVELOPMENT

Treated wastewater reuse in the Gaza strip

Lana Abu-Hijleh

The Gaza Strip, occupied by Israel since 1967, is located along the Mediterranean Sea between Israel and Egypt. Its total area amounts to 365 km^2 and the present population is approximately 800,000 inhabitants, of which 50% are refugees.

The climate, which is typically Mediterranean, is characterized by daily average temperatures ranging from 13C° in January to 27C° in August.

The western part of the Strip is composed of sand dunes extending along the seashore, and the eastern part is composed of heavy soil of clay and sometimes of loose soil. The average annual rainfall increases from 200mm/yr in the south to about 400mm/yr in the north.

The total amount of rainfall is around 100 million cubic meters per year (mcm/yr), part of which is consumed by agricultural vegetation (45 mcm/yr) or is lost through surface run-off and evaporation (20 mcm/yr). The remainder infiltrates into the soil and recharges the groundwater (25 mcm/yr).

The major part of the water utilized in the Gaza Strip for domestic (25 mcm/yr), agricultural (100 mcm/yr) and industrial (5 mcm/yr) purposes is supplied from underground water. The deficit between the groundwater consumption (130 mcm/yr) and the groundwater recharge (estimated at 35 mcm/yr) has led to over-exploitation of the aquifer, and has resulted in declining water levels and increased salinity reaching 1500 ppm of chloride in large parts of the area.

Short and long term solutions for the Gaza Strip water problem are being debated. They include:

- promotion of more effective water use in agriculture;
- protection of the groundwater quality by improving the sanitary situation and treating the wastewater;
- introduction of irrigation schemes with treated wastewater;
- collection of run-off rainwater for use in agriculture.

Other solutions which involve importing water from neighboring countries or desalination of sea water, in spite of being expensive, are being considered as possible long term approaches.

Within the framework of the short term action, from 1985 onwards, the United Nations Development Programme/ Programme of Assistance to the Palestinian People has been implementing two major sewage collection, treatment and re-use for irrigation projects. The projects' objectives are to:

- reduce the use of fresh groundwater for agriculture;
- protect the groundwater from contamination by the infiltrating sewage;
- improve the environmental health conditions of the population;
- recharge the aquifer when possible with the treated sewage.

The first project was concerned with the upgrading of the existing sewage treatment facilities of Gaza City (with a population of 400,000 people) and the construction of an effluent distribution system to the citrus orchards south of the city. The main components were:

- Primary and secondary treatment lagoons (aerated);
- Gaseous chlorination station;
- Booster stations and storage reservoirs;
- Percolating ponds;
- Distribution pipelines to the citrus orchards and overflow line to the Gaza City Wadi.

The second project's intent was the implementation of the Sewage Master Plan for the Northern Region of the Gaza Strip (120,000 inhabitants). The region is composed of three towns and a large refugee camp, all closely located. When designed, the Master Plan intended to serve only the towns, ignoring the presence of the refugee camp despite its miserable environmental situation. However, following UNDP involvement in the project and by exerting pressure on the authorities, it was permitted to include the refugee camp in the master plan. The project components were:

- A complete sewage collection scheme for the refugee camp (70,000 people), considered to be one of the most highly condensed areas of the world;
- Lifting stations and a main pumping station;
- A central treatment plant (presently oxidation ponds designed to receive aerators);
- Distribution pipelines to citrus orchards and an overflow line to the Northern Region Wadi.

The completion of the two projects was delayed beyond the planned dates due to the political situation which prevailed in the Occupied Palestinian Territories (OPT) from 1987 onwards namely, the Uprising. The construction of the Gaza City project was completed in 1991 but it is not yet fully operational. The following describes the project's present status:

- Firstly, the effluent characteristics are not yet at the designed level, due to serious sludge problems in the ponds and the continuous breaking down of the aerators.
- Secondly, the chlorination station is not operational, because for security reasons the Israeli authorities do not permit using gaseous chlorine in the Gaza Strip.
- Thirdly, the farmers are still reluctant to irrigate with effluent and refuse to adapt their irrigation systems at their own expense.
- Finally, the overall management structure of the project is not yet identified, therefore; the municipality is trying to avoid the responsibility for operating and maintaining the project.

As for the Northern Region Master Plan, presently, around 80 percent of it has been accomplished. The following describes its status:

- The sewage collection component operates satisfactorily in the dry season; however, it floods and clogs in the rainy season because the population use it as storm drainage.
- The treatment segment also suffers from the flooding in the rainy season, which disturbs the whole treatment process.
- The irrigation part has had to be suspended until the farmers agree to irrigate with the effluent. The overflow line has met the same fate. Its construction was opposed by the land owners and the residents living adjacent to the Wadi, who fear the effluent will cause health hazards and odor problems in their area.

Due to the lack of relevant experience in this area and the fact that the UNDP was pioneering in undertaking projects of this sort and scale, most of the problems which have lead to the abovementioned situations were not anticipated and dealt with at the formulation or early implementation stages.

Only at the final implementation stages were the obstacles which hindered the full realization of the projects' objectives revealed.

The following is a personal contemplation of the multifaceted technical, institutional, cultural and political problems and circumstances which contributed in an integrated manner to the obstruction of the two projects. It is based on my experience as the projects engineer from 1986 to 1991 and the officer in charge from 1991 to date:

Technical

Most of the sewage schemes designs for the Gaza Strip municipalities are prepared by Israeli consultants. This is usually a condition set by the Israeli authorities in order for the municipalities to receive construction permits.

The designs of these two projects were also prepared by Israeli consultants and sponsored by the municipalities. UNDP, as the body responsible for the implementation of the projects encountered the following problems due to certain shortcomings in the designs:

a. The physical conditions of the Gaza Strip, such as the sandy unpaved roads and the lack of storm water collection schemes, were not taken into consideration. Consequently, the primary and secondary screening designed were inefficient, causing serious grit and sludge problems in the collection networks, at the pumping stations and at the treatment lagoons.

b. The second problem was related to the treatment system and to the equipment utilized. The designs were based on inappropriate technologies for the area: aerated lagoons, electro-mechanical grit removal devices,.etc. Such sophistication and imported equipment require regular maintenance and highly skilled operators. In addition is the fact that some of the equipment was unfit for the Gaza climate.

c. Another shortcoming was related to the pre-design preparation and the construction implementation plans. It became apparent that the designers of the distribution and overflow lines did not investigate the ownership status of the land where the pipes were planned to be laid, i.e. public or private. Naturally, once the construction commenced, the private land owners objected and forbade the contractors to work in their territories. Therefore, the project was delayed tremendously; obliging the alteration of the designs. The delay, logically, has had an impact on the status of the whole construction plan. For example, the treatment plant for the northern region was constructed and operated prior to laying the overflow or distribution pipelines. Thus, the sewage was flowing in the ponds and had no way out except by flowing over the dikes into the adjacent inhabited areas, creating terrible health hazards.

d. Finally, the Sewage Master Plan of the northern region was limited in scope, covering only the population which resides in the three towns and excluding the refugees living in the camp (who comprise more than 50% of the overall population). This decision, I believe, was for political reasons, since the refugee camps are not recognized as permanent communities. However, once the refugee camp sewage collection network was installed and connected to the central treatment plant, the negative technical implications of such a decision appeared. The inflow to the plant was much higher than allowed for in the design criteria, disturbing the whole treatment process and necessitating significant changes in it.

Institutional

The capability of the counterpart institutions, namely the Gaza municipality and the Local Councils of the Northern Region, to take over and manage comprehensively the whole sewage schemes were not considered at the formulation or early implementation stages. It was only when the counterparts refused to take over the installations, that their incapability to assume the projects' responsibility was revealed.

At that time, and due to the fact that the newly constructed installations were deteriorating, the UNDP decided to launch another technical assistance project with the objective of enhancing the technical capabilities of the counterpart municipalities to maintain and operate the constructed sewage installations. For two years, and under the supervision of an expatriate and an experienced local engineer, a team of engineers and technicians employed by the counterpart institutions received the necessary theoretical and on-the-job training.

The project activities have been completed, and the team recently re-joined the municipalities to assume their responsibilities as the technical personnel in charge of the sewage installations.

This project dealt successfully with the technical shortcomings of the counterpart institutions. However, the lack of management capacity, combined with their financial problems, remains as a serious obstacle hindering the proper operation of the projects.

Another side of the institutional problems is related to the lack of a management structure to coordinate and organize the efforts of all the parties involved, i.e. the municipalities, the agricultural departments, the water departments and the farmers' representatives. For there were a number of complex, integrated issues related to the collection, treatment, or irrigation parts, which remained at another level difficult to be addressed by each institution individually.

Cultural

People's culture in all its aspects (religion, customs, traditions, ideals, perceptions..etc.) could act as a promoter or an inhibitor of a new idea. In the case of the sewage projects in OPT, specifically the treatment and re-use for irrigation part, cultural obstacles stood in the way of the people's acceptance of these projects as solutions to their water and environmental problems. I believe the following two points have led to such a negative attitude:

- To mix sewage with clean water, to work, or to irrigate edible crops with it, was perceived as an unholy practice by many of the farmers and sometimes workers due to the religious believes and customs. Such a view led them to reject any dealing with the projects, especially the treatment and irrigation parts.
- For the Palestinians to trust the good intention behind any project which concerns their community, it is extremely important for them to be totally involved in all its activities, including planning. Regrettably, this was not the case in these two projects. Consequently, once the projects were completed, the community members refused to assume any responsibility in operating and sustaining any part of the scheme, even the sewage collection one.

Political

In order to understand the connection between the political situation and the success or failure of the concerned projects, it is important to point out the following:

- In an attempt to keep an iron grip on the water resources in the OPT, the Israeli authorities do not release any significant data on the underground water quality or quantity. Moreover, they restrict the discharge of water from the wells owned by the Palestinians, by imposing certain quotas. These quotas are subject to reduction if the owners are proved to have alternative sources.
- As a result of the above, the Palestinians receive with suspicion any action which concerns water, even if it is claimed to be for their benefit. This was one of the reasons for the farmers' refusal to utilize the treated sewage for irrigation. For they feared it would allow the Israelis to reduce their fresh water quotas, and thus eliminate the historic rights they have to the underground water. This is a condition they will never accept under the present political situation.
- The Israeli Occupation imposes heavy taxation on the Palestinians residing in the Territories, claiming the revenue is invested in the development of the area. On the other hand, the Palestinian population believes that only a small fraction of the collected taxes are reinvested in the public service. For that reason, sometimes the community refuses to contribute or pay dues for any public service they receive, which they consider a right already paid for. This was the case in the sewage projects' operational cost: the communities refused to pay any dues for that purpose, therefore creating a lot of financial difficulty to the municipal structures whom the projects' maintenance and operation were entrusted with.

Conclusion and recommendations

The Gaza Strip water situation is presently considered to be at the crisis level. Scientists envisage a grimmer future in terms of the availability of drinking water for the ever-growing population in the Strip. Therefore, no possible solutions to this problem should be discounted, in spite of all the obstacles which may be encountered in implementing them.

Reducing the percentage of the fresh groundwater utilized for irrigation should continue to be the priority solution. Until now, the treated sewage remains as the most appropriate alternative for the fresh irrigation water, due to its economic feasibility and sustainment compared to other approaches.

This is the reason for the UNDP and the concerned Palestinians to maintain continuous efforts to overcome the obstacles facing sewage treatment and re-use projects. For their efforts to be fruitful, the right environment will have to be established and correct approaches adopted. This can be ensured, by drawing the appropriate lessons from the previous experiences encountered.

Within this context, the following recommendations can be made:

a. To involve the communities directly in all the project formulation stages: identification of needs, defining objectives, activities required, type and size of inputs, expected outputs, distributing roles and responsibilities..etc;

b. To integrate in any project framework an element concentrating on the enhancement of the counterpart institutional capacity;

c. To utilize Palestinian consultants in designing the required schemes and support them with all the technical know how needed;

d. To research and study the different alternative designs for sewage collection, conveyance, treatment and re-use, in order to define the most appropriate methods and technologies to be utilized in the Gaza Strip;

e. To launch a community awareness campaign which aims at raising the people's knowledge of environmental health issues, the importance of maintaining their sewage collection schemes and ways to do it, the water crises prevailing in the country and the vitality of treating sewage both for environmental and economic purposes;

f. To launch another specialized educational campaign targeting the farmers and covering the following: Their contribution to the water crisis, the importance of modifying their present irrigation schemes, the viability of treated sewage as an alternative for irrigating with fresh water, the methods of treatment and all related monitoring control and health precautions required;

g. To construct a demonstration plant for treatment and irrigation. Such a plant could be utilized for the research and the public education purposes;

h. To encourage the formation of a central sewage authority for the Northern Region of the Gaza Strip including the Gaza City. Such authority would comprehesively manage all the sewage schemes within the designated region.

References

Dr. H.J. Bruins, Ir. A. Tuinhof, Ir. R. Keller (1991) *Water in the Gaza Strip* final report to the Government of the Netherlands.

United Nations (1991) *Israeli Land and Water Practices and Policies in the Occupied Palestinian and other Arab Territories.*

United Nations (1992) *Water Resources of the Occupied Palestinian Territories.*