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SELECTION CRITRIA FOR APPROPRIATE SANITATION IN THE PALESTINIAN RURAL AND SEMI-URBAN COMMUNITIES

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ABSTRACT

About 60% of the West Bank population are located in rural and semi-urban communities. The concept of appropriate sanitation systems for those communities has been either ignored or forgotten. Decision-makers and planners tend to restrict their planning and design to conventional "western" sanitation systems, which require high investment and high operation and maintenance skills and do not cope with rural capabilities. This led to a slow infrastructural development in Palestine whose water resources and environment are polluted. No comprehensive studies have been made to investigate the key factors influencing technology selection of sanitation systems in Palestine. The selection criteria for sanitation systems are critically reviewed and discussed. A special reference is given to technological, financial, socio-cultural and environmental factors. Based on these factors, the adoption of a focused sanitation strategy for rural and semi-urban areas is recommended. This will assure successful implementability, effective cost recovery, and sustainability of projects.

Keywords: rural and semi-urban communities; water resources; selection criteria; sanitation systems; infrastructural development; implementability; sustainability; Palestine.

INTRODUCTION

Palestine, as all the Middle East countries, is suffering from water scarcity and environmental pollution. The governmental, non-governmental and international planners recognize the severity of the sanitation situation in Palestine. Unfortunately, most of the plans are formulated as proposals to attract external funds for implementation of sanitation projects. In addition, most of the plans and studies are restricted to conventional "western" practices, which are meant to serve urban communities neglecting the local conditions and the capabilities of the rural and semi-urban communities. Few research studies to investigate the applicability of low-cost treatment technologies for domestic wastewater are being conducted (Gearheart *et.al*, 1994; Zimmo

et.al, 1999; Al-Sa'ed, 2000). This has resulted in a slow development in the Palestinian sanitation sector.

According to the census carried by the Palestinian Central Bureau of Statistics (1997), the West Bank population is about 1.6 million inhabitants distributed in 11 governerates as shown in Annex 1. About 60% are located in rural and semi-urban communities where the financial resources, as well as, the operational and management expertise are very limited. About 20% of the West Bank population are connected to conventional sewerage systems. Large wastewater treatment plants exist in three cities of the West Bank, but none of them achieved the required treatment efficacy. There are different plans for increasing the number of treatment plants in urban areas, some of them are under construction, but all have high capital costs and adopt sophisticated technologies.

The rural and semi-urban communities mostly depend on cesspits for disposal of their excreta. The collected wastewater (grey and black) either percolates into the soil or evacuated and discharged untreated into dry wadi beds (Annex 2). These practices might have adverse impacts on the groundwater, environment and public health. The high excavation cost and frequent desludging characterize these cesspits. Septic tanks are used in few locations scattering in the West Bank, where separate or combined domestic wastewater is collected in concrete tanks (single or double compartment). The liquid effluent either infiltrates into the ground or used for garden irrigation.

Sanitation systems that have been proven suitable for one country are not necessarily suitable for another and vise versa. In this paper, the selection criteria for sanitation systems in the West Bank are reviewed and discussed. Since the process is not purely technical, other important factors like financial, economical, socio-cultural and political will be investigated (Abu Madi, 1999).

PROBLEM DEFINITION

The problem in Palestine can be summarized as follows:

1. Planners and decision-makers emulate Western sanitation practices to formulate strategies and guidelines for management of Palestinian wastewater. They consider conventional sewerage for collection and sophisticated technologies for treatment (activated sludge, trickling filter, etc.). These systems do not cope with the financial and operational capabilities of the rural and semi-urban communities and lead to a slow development of sanitation infrastructure.
2. Excess dependency on the external funds led to humiliation of local funds that could be used to implement alternative and low cost sanitation systems. However, the external funds are limited and time consuming. This phenomenon slows the process of solving the sanitation problems.
3. Lack of studies that investigate the applicability and feasibility of various types of sanitation systems in the Palestinian rural and semi-urban communities.
4. Uncontrolled disposal of excreta using cesspits threatens the water resources, pollutes the environment and endangers the public health. The karstic geological conditions enhance rapid infiltration and increase the risk of groundwater contamination.

5. The increasing demand for domestic and agricultural water uses under water scarcity conditions is pressing.
6. Lack of knowledge about alternative sanitation systems and poor financial resources limit the work to use of cesspits.
7. The population is distributed in 646 localities with population densities ranging between 20 and 100 c/ha, except in few localities like refugee camps it ranges between100 and 500 c/ha.

KEY FACTORS INFLUENCING TECHNOLOGY SELECTION

Technical suitability

Technical suitability is a fundamental factor that determines whether a proposed technology can function under the prevailing conditions in the West Bank or not. The technical suitability and applicability of a sanitation facility should consider the following design aspect:

a) **Climate:** The climate in the West Bank is characterized by a short rainy winter and dry summer. The mean annual temperature ranges between 15 - 20 ^{o}C. Temperatures of the coldest month (January) are 6 – 12 ^{o}C, whereas, they range between 24 - 34 ^{o}C for the warmest month (August). The annual rainfall is 100 – 700 mm. Despite the small area of the country, the climate varies from one part to another.
b) **Community size and population density:** The population of the West Bank is distributed in 646 localities. About 619 localities ihibit population between few hundreds and 10,000 inhabitants, which is classified as rural and semi-urban. Those represent about 60% of the total population (Annex1). This means that low population number and density characterize the Palestinian communities.
c) **Water consumption:** Most of the rural and semi-urban communities are characterized by having low water consumption (20 – 90 l/c/d). About 78% of the West Bank households are connected to water distribution networks, while 17% have private supply systems and the rest have no piped water (Annex 3). In general, the water supply systems are unreliable and the water supply is intermittent.
d) **Wastewater production and characteristics:** The low water consumption causes low wastewater production. Therefore, the produced wastewater (kitchen and toilet) has high concentrations of BOD and COD. About 24% of the households are connected to public sewerage, while 73% use cesspits for disposal of excreta and the rest 3% have no sanitation system (Annex 2).
e) **Required effluent quality:** No standards exist for wastewater treatment. Applying the WHO (or other) standards impose advanced treatment which is costly and complicated. In addition, the wastewater management strategy is focused on urban conditions.
f) **Availability of expertise:** The rural and semi-urban communities lack the expertise for operation and maintenance of conventional sanitation facilities.

However, most of technologies that have been practiced worldwide are well documented and explained in the literature. They have to be reviewed and compared with the aforementioned conditions.

Socio-cultural acceptance

Socio-cultural considerations are among the most, if not the most, decisive factors in the selection criteria of sanitation systems. Cultural beliefs vary widely from one part of the world to another. Therefore, it is not possible to generalize the validity of socio-cultural issues related to disposal and reuse of wastewater. This led Cross (1985) to the conclusion that a thorough assessment of the local socio-cultural context is always necessary (Mara and Cairncross, 1989; Hespanhol, 1995).

People in the West Bank are Muslims by majority, and they live in clans (Hamolah) where individuals are much dependent and influenced by the clan and the society. There, religion, traditions (culture) and politics influence the perception of individuals, clans and societies. Any sort of change in the society is not accepted without being permitted by those actors. However, most of them are not rigid, but subject to conditional change except for some postulates and taboos like Taharah and Najassah (impurities). Table 1 shows the main targeted groups of public whose opinions and perceptions are crucial.

Therefore, it is important to develop a list of sanitation and reuse systems that are preferred and encouraged by the communities and do not contradict with their socio-cultural and religious values.

Table 1: Types of public whose opinions are decisive

Targeted group	Type of acceptance required
Households within the community	To use or connect to the sanitation system
Farmers	To use reclaimed water on large scale (agriculture)
Households	To use reclaimed water on small scale (gardens)
Households within the country	To buy/consume crops irrigated by treated wastewater
Community leaders and the NGOs	To encourage the beneficiaries
Government (local authorities)	To put standards and regulations

Affordability

Affordability is defined as the timely availability of financial resources to cover capital as well as recurring expenditures by the users and it is very fundamental for success of sanitation projects (Loetscher, 1999). According to Wright (1997), beneficiaries often pay part or even nothing of the total costs while the rest is complemented by other sources such as subsidies and external funds.

Kalbermatten (1999) criticizes the traditional planning of urban environmental services, where true local affordability is usually ignored especially when these services are financed by a combination of available government grants, user charges and general revenues. Too much reliance on outside funds usually causes a deficiency of commitment of the users towards the proper use and maintenance of the service, ultimately leading to degrading infrastructure.

This leads to a conclusion that there are two types of affordability. One is ability to pay for the total costs where no subsidies or financial aid exist, and the other is ability to pay for part of the costs where the remainder is complemented.

Loetscher (1999) gave two basic ways of dealing with the affordability issue in decision aid. Either one might introduce criteria to assess what project beneficiaries can afford, or one might simply provide cost estimates for all alternatives and leave to the users the decision regarding which of these are affordable. The first one will lead to exclusion of options in which beneficiaries might be interested. While in the second approach, judgment of affordability is left for decision-makers without any elimination of alternatives based on cost.

Table 2 illustrates the economic burden on household categories to pay for water and sanitation in the West Bank. It is shown that people in rural and semi-urban areas spend from 4 - 13.87% of their income on water supply and sanitation, although both services are inadequate and unsatisfactory. Moreover, the water consumption is very low in the rural and semi-urban communities compared with that in urban ones. This leads to the conclusion that the small communities will suffer financially because if they increase their water consumption their expenditure on water and sanitation will drastically increase.

Table 2: Estimates of the economic burdens on households to pay for current water supply and sanitation in the West Bank *

Community Class	Average Income (US$/c/y)	Water supply costs: Piped Networks (US$/c/y)	Water supply costs: Rainwater harvesting (Cistern) (US$/c/y)	Water supply costs: Vendors (Trucking) (US$/c/y)	Sanitation costs: Cesspit (US$/c/y)	Sanitation costs: Sewerage network (US$/c/y)	Total spent (US$/c/y)	% of income spent
		12	-	-	31	-	43	5.73
		12	-	-	-	22	34	4.53
Rural		-	20	-	31	-	51	6.80
< 3,000	750	6	20	-	31	-	57	7.60
inhabitants		-	-	73	31	-	104	13.87
		6	20	20	31	-	77	10.27
		12	-	-	33	-	45	5.29
		12	-	-	-	22	34	4.00
Semi-urban		-	20	-	33	-	53	6.23
3,000-15,000	850	6	20	-	33	-	59	6.94
inhabitants		-	-	73	33	-	106	12.47
		6	20	20	33	-	79	9.29
		26	-	-	-	17	43	2.87
		26	-	-	60	-	86	5.73
Urban		13	20	-	60	-	93	6.20
> 15,000	1,500	13	-	51	60	-	124	8.27
inhabitants		9	20	20	60	-	109	7.27
		9	20	20	-	17	66	4.40

* The design period for cisterns and cesspits are assumed 10 years, and for sewerage systems 20 years. Some additional costs were added to include plumbing costs, emptying, and maintenance costs for cesspits. Pumping costs and maintenance costs were included for cisterns. For sewerage systems, in addition to construction costs O&M costs were included.

Willingness to pay

Willingness of beneficiaries to pay (WTP) for sanitation and use of reclaimed water depends on their recognition of the projected benefits and their ability to pay (Cairncross *et. al*, 1980; Snell, 1997).

WTP can be assessed by the "revealed preference method" (DFID, 1996). It is based on extrapolation from what the households and beneficiaries are currently paying for other services, and what other comparative communities are paying for similar services. For instance, WTP for sewerage can be estimated by investigating what beneficiaries without this facility are paying (cesspits construction and emptying) and/or by knowing what other similar communities are paying for sewerage.

The DFID (1996) and Kalbermatten (1999) recommend and suggest guidelines for "contingent valuation method" (CVM) as the best technique to assess WTP (sometimes it is called "stated preference method"). However, some criticize the CVM because it depends on what people say rather than what they do (Snell, 1997). Snell recommends that "yes/no" questions are better than "open-ended" ones and "face-to-face" interviews or telephone interviews are better than mail surveys.

Age Arild Tiltness (1998) conducted a survey on the ability and willingness to pay for sewerage services in Palestine. The survey was conducted on few hundreds of households in two cities (Nablus and Gaza). The results showed that about 50% of all interviewed households do not want to pay a regular bill for the sewerage service, while the average willingness to pay stands at 5 NIS (1.2 US$) a month. In addition, about 20% of the households, which are not currently connected to sewerage network, do not want the service because they cannot afford it.

It is expected that the ability and willingness to pay are lower in rural and semi-urban communities due to the low income and the high construction cost of conventional sewerage.

Community involvement

Community involvement in all phases of the sanitation project guarantees successful implementation, effective cost recovery and responsibility for operations and maintenance. Even if the construction costs are covered by governmental or external funds, the beneficiaries have to cover the recurring costs and a certain degree of operation and maintenance is needed. Usually, decision-makers and planners come from urban communities (local or foreign) and their knowledge about the rural needs and capabilities is limited. Therefore, it is also a fundamental issue to consider community involvement while formulating any sanitation strategy in the West Bank. Involving the different categories of public helps in identifying the specific needs and capabilities of their community. Eventually, this increases the sense of ownership and further responsibilities about the project.

Moreover, the expectations of the Palestinian rural communities are very high. They believe that their sanitation project will be funded by the government or by an external

fund agency. This makes them wait for a sanitation system, which is similar to that in the urban areas. Hence, applying any unfamiliar system, even if appropriate, may be rejected unless the community is aware and convinced by this system.

Political considerations

The political context is very complicated in the West Bank concerning the control of land, water and Israeli settlements. A large number of the Palestinian land all the water resources are under the Israeli control. The spread of the Israeli settlements in the West Bank complicates the problem. These settlements are accused to dispose the untreated wastewater (domestic and industrial) in the wadis close to the Palestinian communities. Therefore, solving the sanitation problems in the Palestinian communities has to be implemented in parallel with that of the Israeli settlements (Al-Sa'ed, 2000).

CONCLUSIONS AND RECOMENDATIONS

In addition to the limited financial resources and expertise, low population number and low density characterize the Palestinian communities. Selecting the suitable sanitation systems for these communities requires investigation of different alternative systems. Conventional "western" systems require high investment costs and high level of operation and maintenance, which do not cope with the prevailing rural capabilities. A focused sanitation strategy for the rural and semi-urban communities is recommended. This will assure successful implementability, effective cost recovery and sustainability of the sanitation projects. Moreover, dependency on the external funds causes a slow development in the sanitation sector. Therefore, more attention should be given to solving the sanitation problems with local resources by choosing low-cost and appropriate technologies.

REFERENCE

Abu Madi, (1999). *Incentives and Constraints for Sanitation and Wastewater Reuse Strategies in Irrigation in Palestine*. PhD Research Proposal, IHE – Delft, The Netherlands.

Age Arild Tiltnes, (1998). *Ability and Willingness to Pay for Water and Sewage Services in Two Palestinian Cities: Results from a Household Survey in Nablus and Gaza City*. Fafo-paper 1998:17, Oslo.

Al-Sa'ed, R., (in press). *Obstacles and Chances to Cut Pollution Load Discharges from the Urban Palestine*. Palestinian First Environmental Meeting, Palestinian Polytechnic Institute, Hebron.

Cairncross, S., Carruthers, I., Curtis, D., Feachem, R., Bradley, D. and Baldwin, G., (1980). *Evaluation for Village Water Supply Planning*. John Wiley and Sons, UK.

DFID, (1996). *Willing to Pay But Unwilling to Charge: Do Willingness-To-Pay Studies Make A Difference*. Field Note, UNDP-World Bank Water and Sanitation Program - South Asia, India.

Gearheart, R., Bahri, A. and Al-Hamaidi, M., (1994). *Wastewater Treatment and Reuse Strategy for Gaza and West Bank: Water and Wastewater Sector*. Palestinian Economic Council for Development and Reconstruction.

Hespanol, I. M., (1997). *Water Pollution Control*, Published on behalf of UNEP, WSSCC and WHO. E & FN SPON.

Kalbermatten Associates, Inc., (1999). *Study to Identify Gaps, Issues and Constraints in Urban Environmental Sanitation*. A Study funded by the Department for International Development (DFID), UK, and executed by the UNDP/World Bank Water and Sanitation Program. Report No.1, Preliminary Identification of Gaps. Kalbermatten Associates Inc. Washington, DC., USA.

Kalbermatten, J. M., Middleton, R. and Schertenleib, R., (1999*). Household-Centered Environmental Sanitation*. Swiss Federal Institute for Environmental Science and Technology, Switzerland.

Loetscher, T., (1999). *Appropriate Sanitation in Developing Countries: The Development of a Computerised Decision Aid*, Advanced Wastewater Management Centre, Brisbane, Australia.

Mara, D. and Cairncross, S., (1989). *Guidelines for the Safe Use of Wastewater and Excreta in Agriculture and Aquaculture: Measures for Public Health Protection.* WHO, Geneva.

Snell, M., (1997). *Cost-benefit Analysis for Engineers and Planners*. Thomas Telford Publications, London, UK.

Wright, A. M., (1997). *Toward a Strategic Sanitation Approach: Improving the Sustainability of Urban Sanitation in Developing Countries*. International Bank for Reconstruction and Development/The World Bank, Washington, DC. USA.

Zimmo, O. R., Al-Sa'ed, R. and Gijzen, H., (In press). *Comparison Between Algae-Based and Duckweed-Based Wastewater Treatment Differences in Environmental Conditions and Nitrogen Transformations*. Water Science and Technology.

Annex 1: Number of population in the West Bank *

Population category	Total Number of localities	Number of population in each governerate (inhabitants)											Total number of population in each category	% of population in each category
		Beithlehem	Jerusalem	Nablus	Ramallah and Bireh	Hebron	Salfit	Qalqiliya	Tulkarm	Tubas	Jenin	Jericho		
>15000	13	21947	18967	100231	45989	201957	0	31772	33949	0	26681	0	481493	30.1
10000-15000	14	23524	12893	13187	0	50602	0	0	10080	11771	37878	14744	174679	10.9
9000-9999	6	0	0	9496	9391	28445	0	0	0	0	9110	0	56442	3.5
8000-8999	2	8001	8975	0	0	0	0	0	0	0	0	0	16976	1.1
7000-7999	10	0	14845	7774	0	7054	7103	0	14824	7640	14796	0	74036	4.6
6000-6999	13	19979	6717	6564	6144	18830	6061	0	12822	0	6494	0	83611	5.2
5000-5999	16	5199	5555	17144	10840	10253	0	5871	21932	0	11061	0	87855	5.5
4000-4999	23	13777	13750	12995	17988	13181	0	4371	4412	8650	9072	4581	102777	6.4
3000-3999	33	7037	10461	17436	33536	3220	7442	3101	6064	0	22189	3178	113664	7.1
2000-2999	55	5077	5229	27217	35427	9295	15429	6955	7025	0	18241	2896	132791	8.3
1000-1999	114	10892	13052	32617	36575	16170	8816	10372	9159	4621	23559	1470	167303	10.5
<1000	347	16657	3452	6731	9558	31265	1837	6826	8763	2534	16218	4632	108473	6.8
Total	**646**	**132090**	**113896**	**251392**	**205448**	**390272**	**46688**	**69268**	**129030**	**35216**	**195299**	**31501**	**1600100**	**100.0**

Annex 2: Number of households and sanitation services in the West Bank *

Service	Total	Number of households in each governerate of the West Bank											% of the total number of population
		Beithlehem	Jerusalem	Nablus	Ramallah and Bireh	Hebron	Salfit	Qalqiliya	Tulkarm	Tubas	Jenin	Jericho	
Public sewerage	62909	5679	4082	20995	6539	10439	0	5091	5807	0	4124	153	23.9
Cesspits	191773	16490	14109	21411	27043	44519	7684	6182	16344	5424	28287	4280	73.0
No sanitation systems	7364	454	744	459	1088	2784	139	125	136	361	431	643	2.8

Annex 3: Number of households and water services in the West Bank *

Service	Total	Number of households in each governerate of the West Bank											% of the total number of households
		Beithlehem	Jerusalem	Nablus	Ramallah and Bireh	Hebron	Salfit	Qalqiliya	Tulkarm	Tubas	Jenin	Jericho	
Public water network	204473	21472	17779	32238	31342	43309	6162	9108	17317	2898	18621	4227	77.8
Private system	43918	843	641	8229	2187	10187	1307	1728	4516	1921	11975	384	16.7
No piped water	14205	345	540	2408	1185	4278	358	569	467	968	2615	472	5.4

(*) Data source: Palestinian Central Bureau of Statistics, population census of 1997 (real numbers).