Using local organizations to design low-cost sanitation systems in Pakistan

Nadeem Afzal

Piped water had been provided to the informal settlements of Quetta, Pakistan, but most houses had inadequate sanitation. This article describes how one organization, QKAEMP, worked with local community organizations to implement a low-cost sanitation system connected to the main sewer.

Quetta, the provincial headquarters of Balochistan Province, is the twelfth most populous city of Pakistan. Quetta's population growth has outstripped its town planning and provision of services, and nearly half of the city's population lives in settlements of low-income, owner-occupied housing known as *katchi abadis*. Most of these settlements were unplanned, making the provision of infrastructure a challenge for local government. Unhygienic sanitation conditions, choked stormwater drains, and inadequate solid waste management characterize these areas. Most of these settlements have been legalized, and officially incorporated within the jurisdiction of Quetta Municipal Corporation (QMC), and many have been provided with piped water, but sanitation infrastructure has not yet been provided to most of these settlements. This poses a severe health hazard from epidemic and endemic diseases, especially water-borne disorders.

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What was needed was a community-based sanitation initiative building on the principles of sustainable development. The Quetta Katchi Abadis Environmental Management Programme (QKAEMP) has been set up to encourage communities to carry out internal development (within the community) and let local government concentrate on the development of external infrastructure. The project focuses on sanitation issues and is being undertaken by a consortium of community organizations and the Pakistan Institute for Environment-Development Action Research (PIEDAR), with funding from the Royal Netherlands Embassy.

The project is based on social mobilization for sustainable, self-reliant environmental management. It includes a major capacity-building component aimed at local non-governmental organizations (NGOs), community-based organizations (CBOs) and lane organizations (LOs). Since a financial contribution is coming from the community itself, it is vital to involve community members in all aspects of planning, design and implementation. Specific training is provided to selected individuals in technical aspects, solid waste management, health and hygiene and social mobilization. This training is vital to ensure that the technical skills required to operate and maintain the system are available from within the community.

Sanitation system

There are various types of sanitation systems that can be adopted to improve the health and environment of a community. Selection of the most appropriate system depends on the cultural, social, economic and technical situation of the community.

Generally, water is mainly used for bathing, cooking, and washing laundry. The minimum amount of water usage for toilet flushing is considered to be around 2 litres per person per day (l/p/d). However, in the *katchi abadis* of Quetta the average water consumption for all purposes is around 60 l/p/d. The majority of *katchi abadis* in Quetta have some form of piped water supply; however, in many cases the supply is intermittent. The absence of a continuous supply restricts the amount of water available, especially for flushing toilets.

The high density of population in these settlements necessitates a sewer system, as on-site sanitation (such as septic tanks and dual-pit latrines) is not a viable option. However, conventional sewer systems require large amounts of water to flush the excreta and to ensure the flow of solids. Since water supplies are limited, an intermediate sanitation system was selected

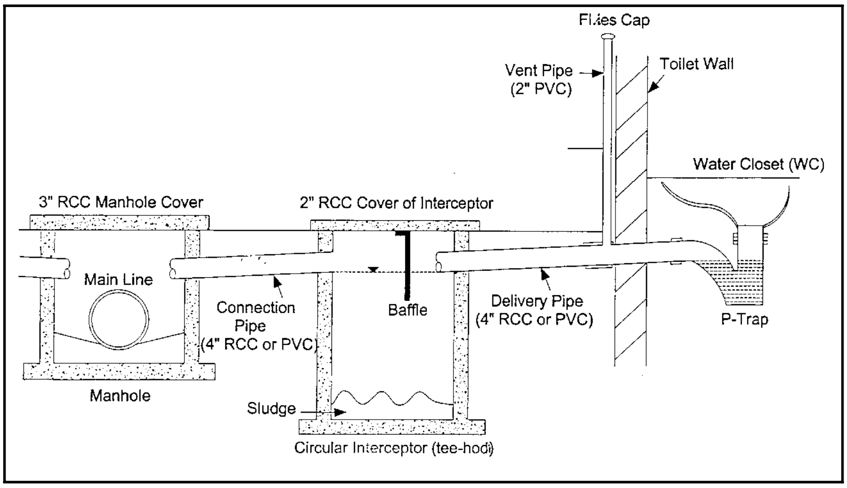

Figure 1
Connection between the toilet and the manhole

which retains solids on-site in an interceptor while the liquid is transported off-site through a small-bore sewer. The interceptor (*tee-hodi* in Urdu), usually around 1.5 feet in diameter (45 cm) and 2 feet in depth (60 cm), is connected to the lane sewer, and the solids settle into the *tee-hodi* while only the wastewater flows into the sewer. On average, this interceptor or *tee-hodi* can serve the needs of six people for six months before it requires cleaning. In such a system, a smaller diameter pipe is used which can also be laid at much lower gradients and shallower depths.

The overall system is shown in Figure 1, and has the following components:

- Connection from house to *tee-hodi*.
- Interceptor tank or *tee-hodi* where floatable and settleable material are removed by quiescent settling, and foul gases are removed by a vent pipe at the entrance to the interceptor.
- Service line – normally a 4-inch diameter (100 mm) reinforced cement concrete (RCC) or PVC pipe – connecting the interceptor to the manhole.
- Circular manholes are provided at major junctions for maintenance. These are connected to the collector main – normally 6- to 15-inch diameter (150 mm to 380 mm) RCC pipe – that takes the effluent by gravity to the receiving body or treatment plant. The depth at which the main is laid varies according to external street loads and environmental conditions.

The principal technical advantages of this system over conventional designs are its low liquid-flow requirement, the avoidance of sewer blockages, workability under low gradients, and the longer life of the pipes due to less corrosion. The economic advantages of this system include: ease of operation and maintenance, low costs, and the short period needed for construction. In addition, a social benefit arises from actively involving the community throughout all phases of planning, cost-estimation, procurement, and construction: people are better prepared to undertake the operation and maintenance of the system and are then ready to act collectively on other issues.

Engineering design and cost estimation

The collection and conveyance of a community's wastewater from the various sources where it is generated is the first step in its effective management. In designing a gravity-flow sanitary system, the area to be sewered must have a comprehensive preliminary investigation, not only to obtain the data needed for design and construction but also to record pertinent information about the local conditions before construction begins. In order to design the sewer system, the following seven-step guideline has been introduced.

Step 1. Preliminary investigations. Gather field data, obtain willingness of community.

Step 2. Preparation of area maps and ground profile.

Step 3. Design work for sewer. A computation table, based on an Excel spreadsheet, displays both the data and computed results in an orderly sequence for subsequent use, and therefore saves time. The user simply enters the required data in three columns and the computer calculates and fills in the remaining columns, except the last three columns, which can be filled with the assistance of a hydraulic graph. With this computer software, and by inserting levels of the area, the computer can draw ground and sewer profiles.

Step 4. Cost estimation. Since local funds are involved in the construction of the system, community members are eager to know exactly how the money is being spent. Accurate cost estimation is therefore important. A simple, user-friendly computer program has been developed by PIEDAR to assist communities, lane organizations, CBOs, NGOs and others in estimating the actual cost of the materials required in designing the type of sanitation system described. Any computer-literate person can operate the software: all that the user needs to enter into an input sheet is a short set of cost and dimensional variables (such as costs of materials

Cost Estimate for Lane Sewer

Output Sheet

Sr. No.	ITEMS	Quantities		COST in Rupees
1	Excavation including T-hodi & Man-hole	2404	Cft	2404
2	RCC pipes for 6 inch dia	50	Nos	6000
3	RCC pipes for 4 inch dia	20	Nos	2000
4	PVC pipes for 3 inch dia	12	Nos	2400
5	2 inch sand cushion	25	Cft	150
6	Cement for pipe connection	5	Bags	1200
7	Cement	85	Bags	20400
8	Sand	300	Cft	1800
9	Aggregates	600	Cft	3600
10	Steel only for covers (T-hodi & MH)	200	Kg	4400
11	Cost of steel cutting & binding			1500
12	Jute for pipe connection			500
13	Cost of 9 inch pipe + excavation			55000
14	Cost of 12 inch pipe+ excavation			0
TOTAL				101354
Labour charges @ 10% of total cost				10135
Cost for Transportation/wastage@ 3% of total cost				3041
Grand Total (in Rupee)				**114530**
Cost per Rft				**77**
50% share for lane residents (in Rupee)				**57265**
Contribution for each household (No. of houses)			80	**716**

LEGEND

Please note that Blue color may be used for giving in-put data.

Figure 2
Example of cost calculations produced by the software

and the main dimensions of the system). The software automatically calculates the cost of each component in the system and indicates the exact amount of material required and its cost. These are presented in a simple printed output sheet (Figure 2).

This software has now been tested by QKAEMP in different areas and with different community partners; it has also been used by NGO partners in Quetta with no engineering background. They have all found the software to be accurate and easy to use and have reported that the learning time for non-engineers is less than 30 minutes. In actually executing the construction of systems in various locations it has been found that the error range is in the order of around 5 per cent. Further testing and validation of the software is still going on, but experience suggests that this software may also be useful for other sanitation projects using intermediate-sized sewer systems that include interceptors or *tee-hodis*.

Steps 5, 6 and 7. These cover materials procurement, construction and operation and maintenance of the sewerage system.

Achievements

This approach to sanitation provision is being implemented by local NGOs, the urban basic services cell of QMC, with community participation. A number of LOs are functioning in the selected *katchi abadis* and more than 20 000m of sewer lines have been laid since August 1998. Communities are pleased with the situation and continue to invest in common property, such as street paving, from their own money. QKAEMP has taken the approach of assisting the community to identify the problem and its solution as much as possible, and ensuring that the criteria for programme planning and implementation are known and accepted by everyone. It is recommended that local government promotes similar community development projects within a wider urban development process through partnership-building and joint decision making among relevant organizations within Quetta.

The following lessons learned are also important:

- Low-income communities gain confidence and pride when they develop and manage the process themselves.
- The programme helps to build community mechanisms for management and maintenance as community members work together to address their problems and to develop linkages with neighbouring communities.

The experience shows that with the participation of the community, cost-effective programmes can be developed and implemented, that provide a tremendous boost to community organization.

about the author
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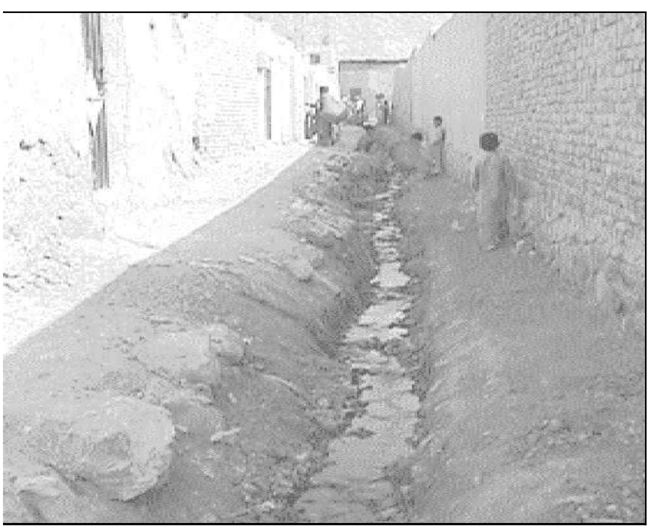
Condition of the lane before laying the sewer ...



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