Low cost sewerage

Peter Kolsky describes circumstances where sewerage systems may be appropriate, and outlines the key issues to consider.

Safe disposal of domestic water and human waste plays an important role in the control of diarrhoeal diseases. Recent issues of *DD* have highlighted some practical aspects of water supply and sanitation for low-income and refugee communities. These have focused in particular on low-cost alternatives to conventional engineering methods for the disposal of human waste in rural and peri-urban areas. These low-cost alternatives (e.g. VIP latrines and pour-flush toilets with soakaways) cost much less than conventional sewerage, are much easier to build, and are easier to manage by individual families.

There are, however, some situations where sewers (pipes for removing used domestic water and human waste) are the most appropriate technology. For example, where water has been piped into houses in areas of high population density, some form of piped sewerage is the only way to avoid flooding the area with sewage (the mix of used water and human wastes).

If domestic water use is high, people need a safe way to dispose of sewage. If a sewerage system does not exist, sewage flooding will spread faecal contamination.

In these circumstances, some form of sewer or septic tank will be more appropriate than latrines or pour-flush toilets. The choice between sewers and septic tanks is usually based on consideration of population density, soil conditions and cost.

Septic tanks

Septic tanks are simple systems that let the solids settle out of the waste water and sewage, before the liquid filters into the soil. Where population density is low, and where soils can absorb water easily (e.g. sandy soils with a low groundwater level), some form of septic tank can provide a safe and economic means of sewage disposal. The tank itself does not treat the sewage, and the water flowing out of it is highly contaminated; it is the soil into which the contaminated water flows that does the real 'filtering' of the sewage. If the water coming out of a septic tank system cannot be absorbed by the soil (and therefore runs along the ground), it becomes a significant environmental health hazard and a septic tank is not an appropriate sewerage system. **Note**: septic tanks should not be sited too close to drinking water supplies and pipes, in case the pipes have breaks in them and drinking water becomes contaminated by sewage being absorbed by the soil in the surrounding area.

Sewers

Sewers are pipe systems that remove sewage from the home and neighbourhood. They should be considered where water use is high, and septic tanks cannot be used. Even where septic tanks are technically feasible, sewers may still be a cheaper or better option, depending upon the housing density, the local experience with sewers and septic tanks, and the wishes of the community.

Conventional sewers, as first developed in Europe and North America, are expensive; in 1978[1], they cost about US$400/household/year. One of the main reasons they cost so much is because they are often quite deep, thus requiring a lot of excavation. They are deep for two reasons:

- the slope of the pipes must be relatively steep, so that the sediment from human waste moves and does not settle out and block the pipe; and
- pipes must be sufficiently deep (about a meter) to avoid being broken by car and lorry traffic on the ground above them.

Two different systems have been developed that save money by allowing sewers to be shallower.

Small bore sewers use a settling compartment, like a septic tank, outside each house to catch solids before they flow into the sewer. This means that the sewer pipe itself can be smaller and laid with a flatter slope, because it carries only the liquid, since solids have already been deposited in the tank. Such systems are most appropriate where septic tanks have already been installed.

Shallow sewers are like ordinary sewers in that they carry both the liquid and solid parts of the sewage. The sewers are shallow

Self-managed sanitation

The Orangi Pilot Project (OPP) is a non-government organisation working in Pakistan. Orangi is a large unplanned slum on the edge of the city of Karachi, with a population of 800,000. The OPP has undertaken a number of development projects, but is best known for its model of low-cost sanitation.

The project recognises development on two levels. *Internal development* consists of constructing sanitary latrines in the houses, sewerage lines in the lanes, and small sewerage collectors downstream of the lanes. The project's experience shows that local people, organised by lanes, can finance, manage, and maintain this internal development. *External development* consists of constructing large drains and collectors along main roads, main trunk sewers downstream of collectors, and treatment works, which the project believes is the responsibility of the government, and which local people cannot undertake. Integration of internal and external development is critical – the OPP and the Karachi Municipal Corporation have signed a contract to work together in the future.

The sewer built by local people.

At present, 70 per cent of the lanes in Orangi have underground sewerage lines built under this programme, and 345 'secondary' drains, downstream of the lane drains, have been constructed. This represents sanitation improvements for nearly 70,000 homes since 1980; and a dramatic impact on the immediate environment of slum dwellers in Orangi, at a fraction of the cost of government programmes.

Women take action

Amman Nagar (B) is a low-income community located in an abandoned water reservoir in Hyderabad, India. Because of the area's inherent drainage problems, recent slum-upgrading work in this community has included the construction of some large open drains, although it did not include sewers for each street. Nevertheless, a number of streets have sewers, funded by the residents themselves, which lead to the open drains.

In one of the lanes, the prime mover for this was a woman named Youssef Bi. Several years ago, her family built a twin-pit sanitation system, which she claims the municipality was supposed to clean out periodically. The municipality did not do so, but Youssef Bi did not complain; her family had no title to the land on which they were living and had no wish to attract attention to themselves. As a result, the toilet failed, and the system overflowed into the lane. Other houses had similar problems, with the result that the area was soon flooded with sewage. Youssef Bi went to the local slum improvement committee (composed entirely of men) and asked them to consider building a sewer to connect to the open drain. They were more concerned, however, with other problems.

Youssef Bi and her friends, and the sewer that they arranged to have constructed.

Photos: Peter Kolsky

Undeterred, Youssef Bi talked to the women in the other twelve houses of her lane, and succeeded in obtaining a contribution of 500Rs (US$25) from each to build a sewer. She contributed a little bit more, and then hired a contractor to build the sewer; the job was done in two days. After their success, the lane on the opposite side of the open drain followed suit, and now four lanes have built their own sewers. They have had no blockages in eight months, but anticipate collecting 5Rs per household to cover the cost of unblocking the sewer, should that problem arise.

because they are built where there is no vehicle traffic. Shallow sewers are often located in the back yards of houses to avoid traffic, or they may be placed under streets in communities where traffic is unlikely ever to be very heavy.

Community participation

At least as important as the development of lower cost technical solutions has been the evolution of community participation in low-cost sewerage. Traditionally, central authorities have taken responsibility for entire sewerage networks, on the basis that all drains up to the individual property boundaries are public property and that maintenance is best done by a single organisation.

In some areas, however, municipal authorities are beginning to think about devolving responsibility for small local sewers to community groups or non-government organisations. This can be done because the small branches are technically simple, and because they can be managed more closely by the community than by municipal authorities. The Orangi Pilot Project, and the stories of individuals such as Youssef Bi in slums without organised projects, show the potential for such efforts.

Sewerage checklist

1. Where does the waste go? A sewer for one street can create a problem for the neighbours if it is not planned properly.

2. Is the system technically feasible? Some help from the local sewerage board, if they are willing to break with traditional engineering standards, can save problems. Low-cost sewerage requires significant technical input from an engineer or technician. It also depends on availability of adequate water supply, the slope of the ground and the soil not being too rocky.

3. Is the plan socially feasible? A lot depends on how much the community wants sewerage, and whether it makes sense for them to manage the construction, as in Orangi, or whether they expect the municipality to do it. If people choose the community based option, it makes sense to start small and learn as you go.

4. Does the system fit together? A little work with levels at the beginning (with the help of trained engineers or technicians), and some knowledge of the plans of the sewerage board, can help assure that low-cost sewers from many streets fit together properly. Otherwise, upstream sewers may be unable to empty into downstream sewers that are too small or at a higher elevation.

5. Is it necessary? Other technologies (latrines, pour-flush toilets and soakaways) are cheaper, simpler and easier to implement. Sewers should only be considered where water consumption is high, and should be weighed carefully against septic tanks or similar soakaway systems, which may be simpler to organise, and can solve the problem locally.

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1. Small-bore sewers: Kalbermatten, J M, et al., 1980. Appropriate technology for water supply and sanitation. Vol 2, a planner's guide, Washington, D.C; World Bank.

Further reading

Septic tanks: *Cairncross, S, 1988. Small scale sanitation. Ross Institute Bulletin No. 8, LSHTM.*

Shallow sewers: *UNCHS (Habitat), 1986. The design of shallow sewer systems. UNCHS (Habitat), PO Box 30030, Nairobi, Kenya.*