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AFFORDABLE WATER SUPPLY AND SANITATION

Affordable sanitation for low-income communities

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WITH HALF THE world's population lacking adequate sanitation, WHO's goal of *health for all by 2000* is unlikely to be achieved. A major difficulty, as in much other development, is shortage of funds. A postal survey conducted by WEDC in 1992 showed quite clearly that the most common reason for people not having latrines is that they cannot afford the cost of the types of sanitation being advocated in programmes and projects.

For many years *affordability* has been a major theme of international endeavour in our sector. Efforts have often been made to restrict the cost of providing water and sanitation to five per cent of average income, or the cost of sanitation alone to two or three per cent of income. In fact, many people pay much more than this when they perceive the value of what they get, or have no alternative. For example, the World Bank noted that in Onitsha, Nigeria, water cost slum-dwellers 18 per cent of the household income (World Bank, 1992). So it is now realized that *willingness to pay* is as crucial as affordability. The two must be considered together. What people say they can afford is usually what they are willing to pay.

Without outside funding, no expenditure on sanitation can be afforded by those with no income and by those at lowest sub-subsistence levels. They have to resort to open defecation, otherwise known as 'free-ranging' (Figure 1).

While this practice may be satisfactory for scattered rural communities, health hazards and difficulty in finding private places make it unsuitable for communities. Affordable improvement can be achieved by digging a hole and covering the excreta, as Moses commanded the children of Israel in the Sinai desert.

In some places low-income villagers set aside 'defecation fields' for open defecation. This leads to the danger of spread of hookworm unless sandals or other footwear can be afforded. Hookworm transmission can be reduced, at no cost except for labour, by forming ridges and furrows. People defecate in the furrows and walk on the ridges .

In urban and peri-urban areas various forms of 'dry latrines' have often been considered as low cost. In terms of construction alone the expenditure is undoubtedly low, as little more than a shelter is required. A receptacle of some sort completes the initial cost. Cheap containers for faeces are common. In India baskets were once usual, and I have seen old car or lorry battery cases, paint tins and discarded cooking oil tins employed. However, when the true total cost of a dry system is calculated it turns out to be an expensive option. Regular emptying of the container involves time, either by a paid scavenger or by a member of the household. The system is now universally condemned, but for many millions of people in many countries it remains in use as an affordable system

A somewhat similar system is 'wrap and carry', which from the users' point of view costs little or nothing. It is practised in many places world-wide. Defecation is onto a leaf, paper or plastic sheet, which is wrapped and dumped on vacant land or a refuse tip. A book published in the United States (Meyer, 1989) recommends wrap and carry for people enjoying the open air, it is*not* suitable for developing countries, even though its cost may be low. An exception is wrapping infants' faeces and putting them in latrines.

Pit latrines

By far the most common sanitation system in developing countries is one form or other of pit latrine. Pit latrines can be low cost, but many donors and other agencies make designs that are too expensive for low income people. Much of this paper is concerned with selecting designs, materials and methods of construction to make pit latrines affordable.

The basic purpose of a pit latrine is to concentrate excreta in one place, a hole in the ground, rather than depositing it indiscriminately.

In the pit faeces decompose, gradually forming a residual humus-like material that has no smell and is free from the pathogens that transmit diseases such as diarrhoea and worms (Figure 3).

Figure 1. Open defecation

Figure 2. Defecation furrows

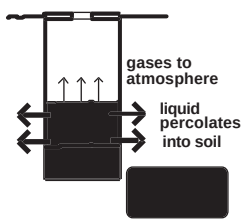

Figure 3. Function of a pit latrine

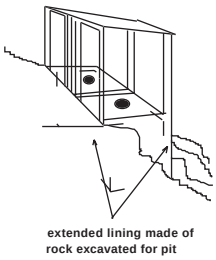

Figure 4. Latrine at George Brook

Figure 5. A basic latrine

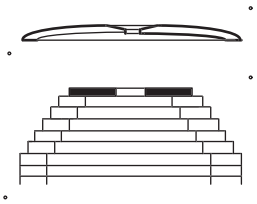

Figure 6. Domed slabs

However, in a pit which remains in use the decomposed humus is covered by fresh excreta that may be malodorous, may contain pathogens and may provide an ideal breeding place for flies. Dealing with these three problems (smell, germs and flies) are the fundamental issues that have to be considered to make a pit latrine sanitary and satisfactory for users. Users also require privacy, so some form of shelter is required and the nature of the shelter drastically affects the cost (and hence the affordability) of a latrine.

The pit itself

In relation to the *whole life cost* of a latrine, the largest possible pit is usually cheapest. A single small pit is initially cheaper than a large pit, but will not last long. Dividing the construction cost by the years during which the latrine can be used, the annual cost of a small pit may be high. The total annual cost per household (TACH) of large pits is likely to be lower. If the soil in which a pit is dug is stable when wet and dry, the size can be large enough to last for many years. I have looked down large pits that have used by African families for more than twenty years. The accumulated excreta was still two or three metres below the top.

Pits in unstable soil must be lined to prevent collapse of the sides. 'Standard' designs by external agencies often show these made of bricks, concrete rings or mass concrete, but in many locations cheaper locally-available material is used. For example in 1993 for the more-or-less standard twin pit pour-flush latrine in India the government and agencies like UNICEF paid householders 2400 rupees. In a village near Mysore latrines with the same design were built for 750 rupees. The saving was due to lining pits with stone obtained during well-digging and using lime mixed with a little cement for mortar in the shelter (Paramasivan, 1993).

Excavation is difficult where a pit latrine is built on rock or boulders. Raising the lining and floor increases the volume available for storage of solids. A compensation is the use of excavated rock or boulders for the lining, reducing the cost. Recently I saw an example of this in Freetown on a steeply-sloping hillside (Figure 4).

The floor slab

Crude latrines are found in some places. A couple of boards or logs are placed across the pit for users to put their feet when defecating. This leaves the excreta exposed, with resultant smell and fly nuisance and chance of spread of disease (Figure 5).

A floor slab with a squat hole overcomes these problems (Figure 6). Where termite-resistant timber is available, an inexpensive floor can be made of logs, usually covered with a layer of gravel or mud. In many areas local craftsmen have developed techniques for making smooth hard mud floors which can be kept clean. Advantage should be taken of these skills, particularly where cement is expensive or difficult to obtain. Low cost improvements can be made with a thin 'skim' of mortar using a cooking oil tin-full of cement. SanPlat slabs can also be used - as discussed below.

Reinforced concrete (RC) slabs are normal for sanitation programmes where low cost is not a major issue. Costs become high for large diameter pits and we have already seen that in the long run large pits achieve savings. Three ways of providing cheaper concrete slabs for large pits are domed slabs, corbelling and enlarged excavation below the topsoil.

Domed slabs, as developed in Mozambique, need no steel reinforcement. They are thinner, lighter and cheaper than normal RC slabs and can be made by relatively unskilled people.

Corbelling with blocks, bricks or rock is suitable for linings that are circular in plan. A saving in the cost of RC slabs was obtained in low income areas of Karachi where fourteen sandcrete blocks (one part of cement to eighteen parts of sand) were used for the main lining and the corbelling reduced rings to seven blocks at the top.

Occasionally firm soil (or soft rock) is suitable for a large cavern-like excavation. A cost-saving small slab can be used with a lined shaft through soft soil near the ground surface (Figure 7).

Overcoming smell, flies and disease

Many users of crude pit latrines complain about bad odours and fly nuisance. Flies feeding on faeces are responsible for much transmission of disease. Flies, smells and health hazards are also, of course, major reasons for replacing indiscriminate defecation and dry latrines, and are associated with unsanitary emptying of full pits.

Three methods are commonly used for preventing nuisance from flies and smells in pit latrines. These are water seals between pits and latrine shelters, using tight-fitting lids and ventilating the pit in VIP latrines.

Water seals are the most effective of the three and are the first choice wherever water is used for anal cleaning and sufficient water for flushing is available. Lowest in initial cost is a slab and trap over a single pit. This system has been widely adopted in Bangladesh, where concrete rings are usual for the pit lining. Minimum cost, and hence maximum affordability, is for two rings. However, shallow two-ring pits have a short 'life', so may not be least cost in the long run..

Twin pits used alternately have become more-or-less standard 'best practice' in India. From technical and health points of view they are excellent and give best whole life value. Considerable subsidies were available in the past, but failed to benefit the poorest people.

In Medipur in West Bengal ten alternatives were offered at prices ranging from US$ 10 to $100.Ò All were pour-flush pit latrines. Apart from the two on the left, all can be upgraded by the householder, either by building a shelter or by constructing a second pit (Figure 8).

Past experience of wooden lids for squat holes has not been good, even in the United States (Wagner & Lanoix, 1958). However, the introduction of SanPlats in southern Africa has proved that tight-fitting concrete lids can be effective in controlling flies and smell. The secret lies in casting each lid in its own squat hole. Thin 600 mm square SanPlats reinforced with chicken wire can be made locally for a few dollars and are therefore generally affordable by low income communities. They only weigh about 35 kilograms (less than headloads carried every day by women) and can be fitted over traditional pole and mud floors. Where termite-proof wood is unobtainable SanPlats are made the same size as RC slabs. In addition to controlling flies and smells, they provide an easily-cleaned surface near the squat hole.

The ability of Ventilated Improved Pit (VIP) latrines to control flies was proved twenty years ago (Morgan, 1977). Since then thousands have given satisfactory service wherever solid material is used for anal cleaning. Some have rectangular shelters with doors, others are spiral in plan without doors (Figure 9).

Many VIP latrines are fine structures, of which the owners are very proud. Foreign donors are often anxious to give 'the best' to the people they are trying to help. Consequently it is not unusual for a project to provide a few dozen very good VIPs, each costing several hundred dollars. If the funds had been used to help householders build their own low-cost varieties the overall benefit would have been infinitely greater.

In Zimbabwe Peter Morgan has developed a range of VIP latrines in addition to the well-known spiral type. He has rectangular VIPs using one bag, two bags, three bags and four bags of cement, with corresponding reduced cost. The one bag VIP has sun-dried brick walls and a thatch roof.

Ingenious variations have been introduced elsewhere, such as the type shown in Figure 10. This was built in Tanzania entirely of 'bush sticks', mud, cow dung and thatch. A particular feature is ending the spiral wall at the vent pipe, which has an effective locally-made fly-proofing at the top (Mugenyi, 1993).

Alternating pits

Building latrines with small pits seems an obvious way to make them affordable. The trouble is that they only last a short time before becoming full. I recently saw the folly of this practice in Freetown, Sierra Leone, where the many householders I spoke to spent an average of twenty dollars a year to have their pits emptied. The method of emptying there is similar to that common in West and East Africa, Myanmar and elsewhere. Solids removed from the pit are dumped elsewhere on the plot or nearby,

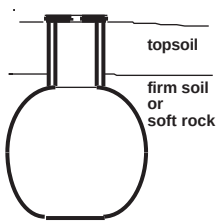

Figure 7. Cavern excavation

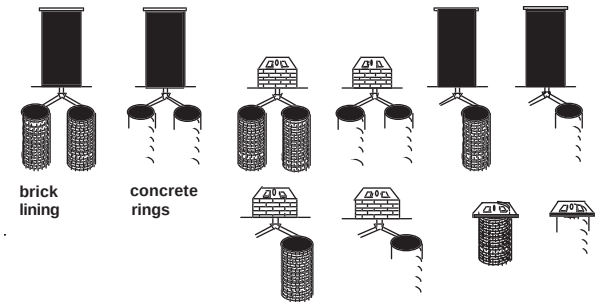

Figure 8. Twin pit latrines

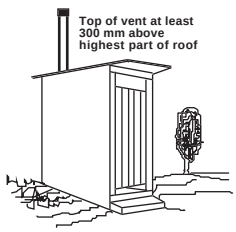

Figure 9. A VIP latrine

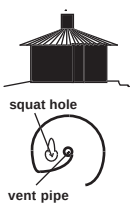

Figure 10. VIP latrine, Tanzania

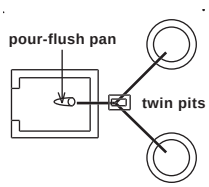

Figure 11. Twin pit arrangement

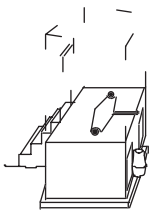

Figure 12. A compost latrine

with or without a thin covering of soil. Because the solids include recently deposited faeces the practice is unpleasant, and may be malodorous, fly-ridden and a serious health hazard, especially where worm infection is prevalent.

Building twin or double pits is cost effective, sanitary and is a valid alternative to large long-life pits. Each of the pits (or each chamber of a double pit) is only large enough for two or three years' accumulation of solids (Figure 11).

Compost latrines

Compost latrines, like the Multrum, are high cost and not affordable by low income people. Batch types, as shown in Figure 12, have been successful in Vietnam and Guatemala, but are only appropriate where there is a positive demand for compost.

The latrine shelter

Almost everywhere where there is a demand for latrines the main reason is not health benefit (or its converse a reduction of disease) but convenience and privacy. Convenience is best ensured by providing each household with its own latrine, although this is rarely possible for multi-occupancy buildings such as apartment blocks.

A screen made, for example, of bamboo and grass mats, provides privacy, which is especially important for women - there are many accounts of the distress experienced when women without latrines have to hold themselves until after dark. For UNICEF's programme in Bangladesh it was claimed that an affordable home-made bamboo shelter over a pit latrine should be the backbone of the sanitary revolution. In Botswana some concrete floor slabs were made with holes into which upright poles could be inserted by householders to make a simple shelter (Wilson, 1983).

However, in the early 1980s Bangladeshis were asked what they thought of latrines that were provided free. Most householders said the quality of the shelter was more important than the type of technology. Latrines were used more, especially by women, if the shelter was good (Gibbs, 1984).

Adding a roof provides protection from rain, sun and wind. In Srinagar many householders built shelters without roofs for pour-flush latrines. Wind-blown debris, leaves, twigs and the like caused malfunctioning (Sarma & Jansen, 1989)..

Because shelters are visible they provide status and a good shelter is often highly prized. This is fair enough where owners can afford to pay. Outside agencies also want status, so provide a few fine shelters which cannot be replicated by local people. It is not unusual to see blockwork latrine shelters well plastered and painted in villages where all dwellings are mud-walled and thatch roofed.

The following reasons have been given for the resistance of agencies to use appropriate cost-effective methods which lead to affordable sanitation (Amos, 1993):

- they are unwilling to adopt standards that are inferior to those in developed countries;
- professionals are reluctant to prepare schemes they regard as inferior to best practice;
- external funding agencies often insist on standards which they consider will protect their investment;
- innovative schemes require substantial research and design investment and have more risk than conventional designs.

Engineers, bureaucrats and politicians of national and local governments are often equally unwilling to adopt appropriate affordable practices for the same reasons.

Perhaps professionals should appreciate that the 'best practice' for preparing schemes is that which benefits the greatest number of people because they are affordable.

With so many millions of low-income people in need of adequate sanitation it is absurd that considerations such as those listed above should stand in the way of achieving progress towards sanitation and health for all by 2000.

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