61. On-plot sanitation in urban areas

This Technical Brief examines the key issues involved in providing sanitation to low-income urban communities. We clarify differences between *on-plot* and *on-site* systems, and discuss why people lack latrines, what users want, optimum plot size, and common operational problems and maintenance issues. The findings are based on extensive consultation with urban householders in Africa and Asia.

On-plot sanitation...?

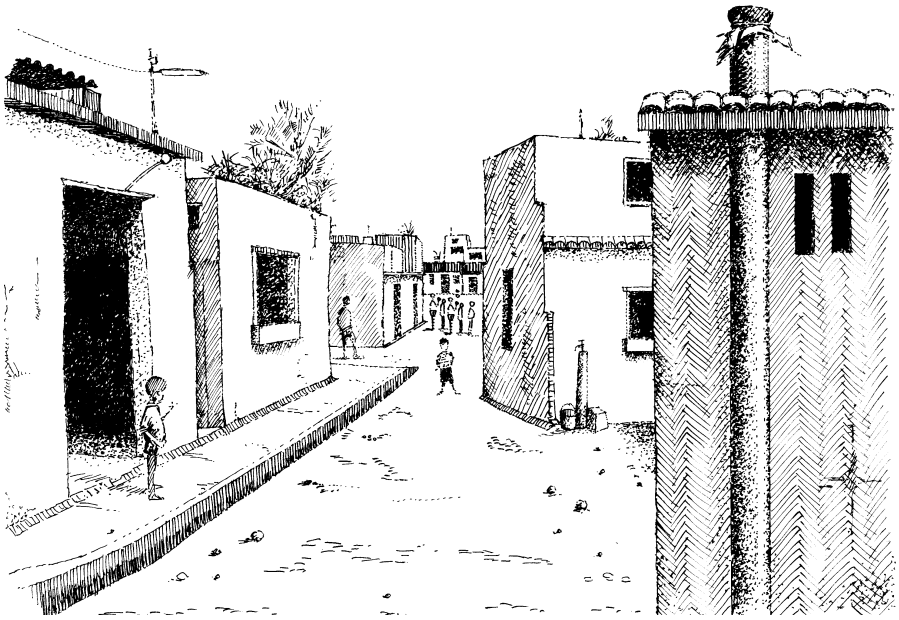
On-plot sanitation refers to types of sanitation that are contained within the plot boundaries occupied by a dwelling. Commonly, on-plot sanitation is equivalent to 'household latrine', but may also include facilities shared by several households living together on the same plot. Amongst the most commonly found on-plot sanitation technology types are:

- Unimproved pit latrines
- Lid-covered pit latrines
- Ventilated improved pit latrines
- Double-pit pour-flush latrines
- Pour-flush toilets to septic tank
- Bucket/pan latrines

By contrast, the more commonly known *on-site* sanitation includes communal facilities which are self-contained within the site, in contrast to sewerage and dry latrines where excreta is removed from the site.

Amongst some authorities and sector professionals there is an underlying feeling that whilst on-plot sanitation is appropriate for rural areas, it is generally unsuitable in the urban context, unless viewed as a (preferably short-term) route to 'better' forms of sanitation.

In practice, given the continuous growth of urban populations and the high incidence of low-income people in slums and peri-urban areas, there is no possibility of providing all urban inhabitants with sewerage. Other systems need to be employed. Well-maintained and constructed on-plot systems offer a viable alternative.



Guidelines

This technical brief presents five key questions which are central to the adoption of on-plot sanitation in urban areas, and provides specific guidelines in relation to each.

1. Why no household latrine?

Available literature emphasizes the importance of the lack of physical space in the urban environment as a key feature explaining the absence of household sanitation.

The factors which determine whether sanitation facilities are present or absent from the household plot are complex and diverse.

- A key reason is usually poverty and indebtedness, rather than lack of available space on-plot. The inability to save funds to invest in longer-term sanitation facilities, coupled with a low income, significantly restricts the choices that individuals can make.
- In cases where plot size is mentioned as a reason why a latrine has not been built, these cases are spread across a range of plot-size categories, rather than concentrating on the smallest size group.
- Plot sizes amongst households without sanitation are, on average, no smaller than those households where latrines are present.
- The relationship between cost, technology choice and income level is a complex one, which defies simple categorization. There is some evidence to suggest a relationship between unskilled employment and absence of sanitation, although this does not remain consistent for lower-cost latrine types. Similarly, skilled sources of employment are not the sole source of employment with higher-cost latrine types.

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Choices of sanitary technology are based on a variety of factors, of which cost is just one (important) consideration.

2. Will users be satisfied with on-plot sanitation?

There is very little available work on user satisfaction as regards latrine operation in urban areas, or on changes in attitude caused by experiences with latrine operation and maintenance.

Research findings based on extensive user consultation indicate:

- In all but one technology type, users express high degrees of satisfaction with their latrine (in excess of 80 per cent recording 'satisfied' or 'very satisfied'). Bucket/pan latrines record by far the highest levels of dissatisfaction (see Table 1).
- Many users do not *perceive* there to be a problem with their latrine. Where problems are recorded, the most common include 'emptying', 'smell' and 'insects', although absolute figures are low.
- Of these three problems, 'emptying' and 'smell' have the most impact on satisfaction levels and the ability of the user to use the latrine.

Levels of user satisfaction (% of cases)					
Type	***Very satisfied***	***Satisfied***	***Neither***	***Unsatisfied***	***Very unsatisfied***
Bucket/pan	4	29	19	44	4
Simple pit	22	68	3	6	1
VIP	17	67	6	8	2
Pour-flush	10	73	4	8	5
WC septic-tank	22	68	3	4	3

Table 1. Levels of expressed user satisfaction by technology type

Plot sizes (m^2)					
Type	***Mean***	***Median***	***Mode***	***Minimum***	***Maximum***
Pour-flush	146	90	54	14	3374
Simple pit	403	306	375	28	3300
None	466	432	630	11	2700
WC septic-tank	650	576	900	27	4500
Bucket	695	600	630	70	5772
VIP	825	630	630	60	4500

Table 2. Plot-size calculations for selected technology types

3. How does plot size constrain the use of on-plot sanitation?

Critics of pit latrines often claim they are unsuitable for small plots in urban areas. In Jamaica, regulations prohibit pit latrine construction in areas where the density is higher than ten houses per acre (23 houses per hectare); in Indonesia, regulations state that areas with over 250 persons per hectare shall be classified as densely populated and shall not use on-plot excreta disposal (Alaerts et al., 1991). A manual prepared for Habitat states that the pit latrine system (except VIPs) is 'unsuitable for use in even low-density urban developments' (Roberts, 1987). The smallest plot size recommended for twin-pit pour-flush latrines in India is $26m^2$ (Riberio, 1985). None of the criteria used appear to be based on reasoned argument or on evidence of performance.

- Significant proportions of households *with* sanitation facilities in working order were found on relatively small plot sizes: one third of all such cases were measured with plot areas of up to $150m^2$; just over 10 per cent on plots with an area not greater than $54m^2$; plot sizes of just $14m^2$ were found to have operational sanitary facilities (see Table 2).
- Levels of user satisfaction were not significantly affected by the incidence of small plot size.
- There is little indication that plot size determines technology choice. No definitive grouping or concentration of technology types was observed by recorded size categories.
- There is little indication that plot size is associated with particular operational problems. Where the most common latrine problems were noted, they were spread across all size categories.

4. What operational problems arise with on-plot sanitation?

The main problems associated with on-plot systems include odour and insect nuisance and groundwater pollution.

Odour and insect nuisance

Complaints about pit latrines most frequently mention odours and insect nuisance, yet there are few specific references to overcoming these nuisances in urban areas. Flies are a serious problem because they spread disease through feeding and breeding on faeces. Some types of mosquitoes (the *Culex* variety) breed in polluted water such as in wet latrines and may carry the disease filariasis. Controlling smells, flies and mosquitoes is, therefore, a high priority for reducing household and environmental health hazards.

In general, research findings suggest that the problem is not extensive; very few users *perceive* odour and insect nuisance to be a common problem with their latrine.

- Only 11 per cent of the total sample mention either odour (7 per cent) or insects (4 per cent) as a nuisance problem (although nuisance of this kind does have a significant impact on satisfaction levels).

- VIP latrines record higher than anticipated levels of odour and insect nuisance (see Tables 3 and 4). There is little conclusive evidence to suggest a link between odour and insect nuisance and the height of the vent pipe above the roof line, presence of fly screens, vent pipe colour and pipe diameter.

- Quantitative test results for insect nuisance indicate low absolute numbers of insects observed across a range of latrine types.

- Anecdotal evidence raises doubts about domestic latrines as the primary source of insect nuisance on-plot.

- Bucket/pan latrines register the highest nuisance levels of all latrine types.

Groundwater pollution

A problem that is noted in relation to on-plot sanitation is the potential for pollution of groundwater that is associated with these systems. Groundwater under or near pit latrines may become polluted, which can be a serious problem when it affects the quality of drinking-water drawn from wells and boreholes. Water in leaky pipes may also be contaminated if the pressure drops and polluted groundwater levels are above the pipes.

A particular problem in densely populated urban areas is the possible proximity of latrine pits and shallow wells on neighbouring plots. The key guideline is that a minimum distance of 15m, other than in fractured formations, between a pit and a downstream water-point, is normally sufficient to remove all contaminants.

Other critical points to note include:

- Determining the movement of viruses and bacteria in soils is extremely difficult, and involves a complex interaction of soil profile and hydraulic conductivity parameters, temperature, soil pH, and moisture-retention capacity. The clay content of the unsaturated zone is amongst the single most important indicators of the likely mobility of contaminants and their subsequent impact on groundwater pollution.

Insect nuisance (% of cases)					
Latrine type	***Cases***	***None***	***Tens***	***Hundreds***	***Thousands***
Bucket/pan	194	20	68	10	3
Simple pits	387	46	46	8	1
VIP	30	40	50	3	7
Pour-flush	386	71	24	5	0
WC septic-tank	127	79	21	0	0
All latrine types		54	38	6	1

Table 3. Incidence of insect nuisance by latrine type

Odour nuisance (% of cases)				
Latrine type	***Cases***	***No smell***	***Slight smell***	***Strong smell***
Bucket pan	253	10	70	20
Simple pits	388	54	37	9
VIP	48	40	54	6
Pour-flush	391	63	30	6
WC septic-tank	152	67	32	1
All latrine types		49	42	9

Table 4. User perception of the incidence of odour nuisance, by latrine type

- Larger-sized contaminants (helminths and protozoa) are normally effectively removed by physical filtration; bacteria are normally filtered by clay soils. Of most concern are water-borne viruses which are too small for even fine-grained clays to filter.

- Viruses *normally* die off within three metres of the pollution source, irrespective of soil type. Bacterial contamination is *normally* removed given sufficient depth of unsaturated soil (at least two metres) between the pollution source and water-point.

- Health risks associated with environmental pollution of groundwater must be set against the much greater hazard of open defecation, and contamination of the neighbourhood environment with excreta.

Open defecation is a serious health hazard

- If a health risk is demonstrable, investigate alternative water supplies through extending reticulation systems, as this is likely to be cheaper than centralized sewerage with treatment.

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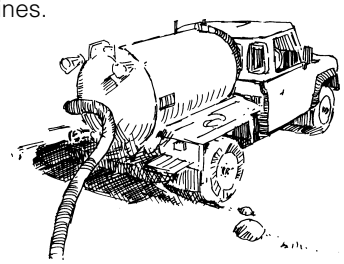
5. What happens when pits fill up?

The main guidelines relating to latrine emptying are twofold, and include advising householders that the filling/ emptying cycle is likely to be between three to six years and that they need to make their own arrangements for desludging. Secondly, emptying costs are strongly location-specific; anticipated emptying costs should be investigated with local contractors during programme planning. Other findings include:

- Manual methods of emptying tend to dominate, and are especially commonplace for simple pit and pour-flush latrines. As expected, mechanical emptying tends to be associated with VIP and septic-tank latrines.



- The responsibility for emptying latrines normally falls to either the users or the contractors. Contractors play an important role in the emptying of bucket/pan and pour-flush latrines.

- Of those latrines which had been emptied, most had been used for between six and eight years. Typically, they had been emptied once or twice.

- Rates for re-filling previously emptied latrines indicate that the majority fill up after three to six years.

- Where users expressed a problem with emptying, the three most important issues were frequency, cost, and hygiene.

Summary

On-plot systems *are* appropriate for low-income urban areas, and should be considered as viable, sustainable technology choices. This research work indicates that a variety of systems are found to be working well on small plot sizes, with limited odour/insect nuisance; without significant operational problems; and to the satisfaction of the end-user. Crucially, there is a significant gulf between the perceptions of professionals and those of the community when regarding the appropriateness of on-plot sanitation in the urban context. The findings show that professionals' understanding of key issues such as insect/odour nuisance, or the operational problems associated with on-plot systems, must be advised by the opinions and perceptions of those who actually use the system.

One of the most important features of the work on on-plot sanitation is that it focuses on the *perceptions* of the users. All too often, assessments and judgements on its effectiveness and appropriateness are made from a technologically biased and purely external perspective. Many evaluations are done by those who are hardly likely themselves to be regular users of improved pit latrines. Establishing the concerns of the users of on-plot systems in urban areas and reflecting these in the guidance is a critical task.

The findings presented in this Technical Brief are drawn from Research Project R4857, *On-plot Sanitation in Low-income Urban Communities*, of the Engineering Division of the Department for International Development (DFID). This work was based on extensive consultation with urban householders (1843 cases) in three countries in Africa and Asia.

Further reading

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