

# Urban sanitation – lessons from experience

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*Providing adequate sanitation to people in rapidly growing cities, particularly those living in low-income areas, is one of the greatest development challenges of the 21st century. A number of conceptual approaches to meeting this challenge have been developed but these tend to assume conditions that rarely exist in practice. A more pragmatic approach is required, learning from what has and has not worked in the past.*

*The paper assesses some well-known sanitation initiatives in order to establish what worked, what did not work and why. The main focus is on schemes in South Asia, involving low-cost sewerage. The analysis reveals problems with systems, not least in the coordination between different stakeholders. Further examination shows that on-site sanitation systems experience similar problems relating to the disposal of faecal wastes. The paper concludes that we need to pay renewed attention to the physical aspects of sanitation provision but within the context of an increased awareness of the importance of overall systems and recognition of the realities of conditions in the field.*

**Keywords:** urban sanitation, low-cost sewerage, ecosanitation.

AS CITIES GROW, providing adequate services to their populations becomes both increasingly important and increasingly difficult. Difficulties are likely to be particularly severe in low-income areas, which are often densely populated, with small plots and narrow rights of way, and situated on low-lying or otherwise marginal land. In such conditions, sanitation and drainage provision can be particularly problematic.

In recent years, policy makers and researchers have developed concepts such as the Strategic Sanitation and Household Centred Environmental Sanitation approaches (SSA and HCES, respectively), Total Community-Led Sanitation (TCLS) and ecological sanitation. These conceptual approaches can contribute important insights but each tends to simplify reality and there is little evidence that any overarching approach has had any significant impact in the complex situations faced by the urban poor and those charged with

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doi: 10.3362/1756-3488.2008.004, ISSN: 0262-8104 (print) 1756-3488 (online)

delivering sanitation services to them. Some assume institutional conditions that are not present in reality. Wright (1997), for instance, stated that a demand-based approach to sanitation provision, and by implication the SSA as a whole, would only be possible if adaptable and flexible institutional systems already existed. Unfortunately institutional systems in most of the situations described in this paper have proved to be anything but adaptable and flexible. Unresponsive institutions, together with the technical challenge of providing sanitation in difficult conditions help to explain the lack of sanitation progress in low-income urban areas.

Progress is unlikely if we continue to rely on grand narratives and ambitious projects, which often seem destined to fail because they build on institutional foundations that are at best shaky and at worst almost non-existent. One possible way forward is to take a more incremental approach, paying greater attention, first, to the reasons why initiatives do or do not work and, second, to the steps to be taken to create the institutional conditions required for successful practice to be replicated and mainstreamed. The first requires that we are 'searchers' (Easterly, 2006) while the second requires that we never lose site of overall strategic goals.

This paper assesses a number of initiatives in an attempt to identify key issues that must be faced if there is to be progress. The main focus is on sewerage but on-site options are also examined. Based on this assessment, some themes to be addressed during the International Year of Sanitation are suggested.

### **Sewerage: An appropriate sanitation choice?**

It is sometimes assumed that sewerage is an inappropriate sanitation option for low-income areas, but this is not necessarily the case. The experience of many residents of informal settlements is that pour-flush toilets connected to sewers can be an affordable sanitation option provided that appropriate standards are used. Self-built sewers are common in Pakistan and can be found in many other places. The author has seen examples in India, Egypt, Indonesia and Yemen. Unfortunately, many self-built sewers are built to inadequate standards and are poorly constructed. Most discharge untreated wastewater to the nearest drain, sewer or water course. So, at best they represent a partial solution to sanitation problems.

Attempts have been made to deal with these deficiencies through a more structured approach to sewerage provision. Three examples are considered here: the work of the Orangi Pilot Project (OPP) in Pakistan; the sewerage component of a World Bank project implemented in an area in north-east Lahore, also in Pakistan, in the late

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Ambitious projects often fail because they build on shaky institutional foundations

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Pour-flush toilets connected to sewers may be an affordable option in informal settlements

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1980s and early 1990s; and the slum networking concept developed by Himanchu Parikh in Indore and other Indian cities from the early 1990s onwards.

### **The Orangi Pilot Project: Working from outside government**

OPP was established in 1980 and worked initially in Orangi Town, a large informal settlement on the edge of Karachi. It saw itself as a research organization whose objective was to analyse problems in Orangi and develop viable solutions through prolonged action research and extension education. It aimed to promote cooperative action and provide technical support for such action, explicitly avoiding any direct involvement in funding and implementing development schemes. After identifying sanitation and drainage as priority concerns of Orangi residents, it focused its efforts on sanitation improvements. Initial investigations revealed that some residents were already using pour-flush toilets linked to sewers and that this was the preferred sanitation option of most people. OPP's response was to encourage more people to provide their own sewer-ed sanitation, and to provide technical assistance so that their efforts would be more effective.

From the start, OPP emphasized that people should be wholly responsible for financing, implementing and managing their own local sanitation facilities rather than relying on government. This philosophy is encapsulated in its distinction between 'internal' and 'external' sanitation facilities. OPP believes that internal facilities, including toilets and house connections, local or lane sewers and the sewer or secondary drain to the nearest *nullah* (natural drainage channel), collector drain or trunk sewer, should be the sole responsibility of the community. Trunk facilities and treatment works should be the sole responsibility of government. The early focus in Orangi was on local or lane sewers, discharging to the nearest *nullah* or open drain. This strategy was helped by the fact that Orangi is quite hilly and traversed by *nullahs*. OPP quickly realized, however, that that wider coverage would require secondary sewers to collect the flows from lanes located some distance from possible discharge points. So, it encouraged communities to come together to plan and construct these sewers.

In the space of less than 10 years, over 92,000 households in over 6,000 lanes, over 90 per cent of Orangi's population, were connected to lane sewers. OPP records showed that 409 collector sewers had been laid through community efforts and, overall, community members had invested around Rs82 m, just under Rs1,000 per

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household, in improved sewerage. These figures are aggregated over a period of time but it is reasonable to assume that most investment took place between 1984 and 1990, during which time the average exchange rate was about Rs18 to US\$1, making the average household investment about US\$56. OPP quarterly reports reveal that around 40 per cent of the sewers had been laid with direct OPP support.

There were some problems. In 1996, the Water and Sanitation Program (WSP) commissioned two Pakistani consultants to report on OPP's work in Orangi in preparation for a regional workshop on strategic sanitation planning, held in Dhaka, Bangladesh, in early 1997. They reported that some sewers had become blocked over the years and in some cases had ceased to function. The findings were strongly contested by OPP but slides shown by the consultants provided qualitative evidence of problems, although the scale and severity of these problems could not be gauged. Two points are relevant here. First, an OPP survey in the early 1980s had revealed that many manhole covers were either broken or missing. This finding is consistent with observations elsewhere in Pakistan. Broken and missing manhole covers compromise the integrity of a sewer, allowing entry of solid waste and silt. In Pakistan, it is rare to see a sewer in a low-income area that is running completely freely. This links to the second point. OPP does not set out to create formal community organizations. Rather, it encourages each community to identify a 'lane manager', always a man, who will take the lead in mobilizing his neighbours to build a sewer and collecting funds as and when required to deal with maintenance issues, such as replacing manhole covers and clearing blockages. This approach is probably more realistic than the committee-based approach espoused by most international agencies but neither approach deals with one basic issue. People are unlikely to take action to clear obstructions in a sewer until the flow is blocked, by which time partial clearance may be difficult and complete clearance may be impossible. Subsequent sewer performance is likely to be unsatisfactory with a need for regular maintenance. Maintenance needs are likely to be higher in low-lying areas, where rapid silting may result from the common practice of running pumping stations with the wet well water level above the soffit of the incoming sewer in order to save on electricity.

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### **Engaging with government: Sukkur and Hyderabad**

Over time, OPP began to interact with other stakeholders, including various government departments, the World Bank, the Asian Development Bank, UNICEF and the Swiss Agency for Development

and Cooperation (SDC). Two projects are particularly relevant to the issues addressed by this paper, the Sukkur Urban Basic Services for the Poor project (UBS) and the Hyderabad Collaborative Katchi Abadi Improvement Program.

In Sukkur, the largest town in northern Sindh, OPP worked with UNICEF, the Sindh Katchi Abadi Authority (SKAA) and Sukkur Municipal Corporation (SMC) to sewer the contiguous low-lying settlements of Gor Takri, New Pind and Boosa Lane. The three *katchi abadis* (informal settlements on publicly owned land), cover an area of about 126 hectares. More than 10 hectares of this was covered by a wastewater pond, which had formed in the low-lying land left by old quarry workings. The project followed the OPP philosophy that local or lane sewers should be financed and managed by residents themselves while municipal authorities should be responsible for the external facilities. These included a pumping station and rising main which would discharge wastewater to the River Indus and allow the wastewater pond to be dewatered and turned into a public park. Because the area was generally low lying, work on the internal facilities could not begin until external work was complete. At first the project proceeded reasonably well and with the pumping station and rising main complete, laying of 'internal' sewers began. The original agreement between the various stakeholders was signed in 1990 and, by 1993, UNICEF was citing the project as an example of best practice. By 1994, serious problems had emerged, largely because SMC was not regularly operating the pumping station. OPP withdrew from the project as the lack of pumping led to serious problems for residents of the project settlements. A site visit in July 2007 revealed no trace of the community-built sewers, with residents reverting to open drains to dispose of their wastewater. The pumping station was in poor condition but still apparently operated intermittently and the wastewater pond remained. Clearly, the project had failed.

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Serious problems had emerged, largely because the pumping station was not being operated regularly

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The Hyderabad project, funded by the World Bank and SDC, involved both OPP and the Hyderabad Municipal Corporation (HMC). The project was to serve three *katchi abadis*, American Quarters, American Barracks and Gujrati Pura, with a combined population of around 41,000. The area is very flat and the nearest disposal point was over 1.5 km from the project area. So, as in Sukkur, the collector drain had to be constructed before people could come together to build local sewers. The original design, produced by the Hyderabad Water and Sanitation Agency (WASA), assumed pumping but OPP rejected this as being too expensive, pointing out correctly that the operation of the pumping station could not be guaranteed because of power cuts and the probability of poor maintenance. It



Gore Takri pond in Sukkur. This was to have been drained and replaced by a park under the UNICEF project.

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Sewerage is technically difficult in flat areas with poor solid waste collection and intermittent electricity supply

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produced its own scheme, based on the construction of a gravity sewer from the project area to the collector drain. This required that sewers were laid at very flat gradients, generally less than 1 in 1,000. This choice between unreliable pumping and flat gradients, which will inevitably lead to silting, is one that is often faced by sanitation planners. The author inspected the OPP designs in 1997 and there were several weaknesses. In particular, invert levels were not shown directly but as a measurement below the ground level, which was given to the nearest 6 inches (150 mm), hardly an adequate approach for such flat sewers, particularly as ground levels can vary significantly within a small area. Covers on larger manholes were set into the cover slab but were seated on a narrow lip, increasing the possibility that the cover would fall into the sewer. A site visit in 1997 revealed that the sewer was already non-functional owing to blockages and it did not appear that internal works had progressed very far. Different participants in the project drew different lessons from this experience but it does point to the fact that sewerage is technically difficult in flat areas with poor solid waste collection and intermittent electricity supply.

### North-east Lahore: Working through government

OPP advocates the use of appropriate standards and community management of construction to keep sewer construction costs to a level that is affordable to low-income communities. The World Bank-funded upgrading project in north-east Lahore also emphasized the need to develop appropriate standards, while procuring work through conventional contracts. The project had grown out of an earlier planning study undertaken by the Metropolitan Planning Wing (MPW) of the Lahore Development Authority (LDA) with consultant support. Because of its earlier involvement in the planning study, LDA retained responsibility for the upgrading work and this had important implications for ownership of the completed works and subsequent operation and maintenance, as we will see shortly.

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The project included improvements in sewerage, water supply, street paving and lighting and, largely unsuccessfully, solid waste collection

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The project covered a developed area of about 270 hectares with a population in excess of 100,000 people. The area had developed through informal subdivision of private land, which had resulted in narrow rights of way, many with insufficient width to allow road traffic. The area was generally flat so that pumping would be required for any wastewater discharged to sewers. In addition to sewerage and drainage, the project encompassed improvements in water supply, street paving and lighting and, largely unsuccessfully, solid waste collection. The integrated approach taken to these improvements was 'technical' and there was no formal community participation. However, designs did reflect lessons learnt from observation of earlier government and community initiatives, and schemes were amended on occasion in the light of information obtained during informal contacts between site staff and community members. This technical approach encompassed the search for appropriate standards. Locally produced spun-concrete sewers were laid in narrow lanes with a minimum cover of about 250 mm rather than the 900 mm or so required for those in conventional trafficked roads. This in turn allowed small chambers to be used rather than conventional manholes. The cost of local sewers was thus reduced to about Rs1,100 per household, a figure that was not very much higher than that of OPP sewers although the OPP price includes house connections, which are not included in the north-east Lahore price.

One of the challenges for sewerage planners in developing countries is to ensure that people connect to sewers once they are built. OPP responds to this challenge by making communities responsible for both house connections and lane sewers, reasoning that no one is going to pay for a lane sewer and then not bother to connect to it. The approach taken in north-east Lahore was different. Existing open drains, brick built with an *in situ* concrete channel section, were to be covered with precast slabs and divided into short sections,

each of which would collect wastewater from a number of houses and discharge it to a sewer. In practice, most of the drains had to be rebuilt because they were in poor condition, had flat gradients or both. This increased the cost and so experiments were made using 100 mm and 150 mm diameter concrete pipes rather than covered drains for these shared house connections. These were successful but by this time it seemed that the covered drain approach had been generally accepted as the way forward by LDA and so the use of covered drains continued.

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To reduce pumping costs, the design was based on separating storm and waste water where possible

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To reduce pumping costs, the design was based on separating storm and waste water where possible. Access streets and lanes were brick paved and carefully graded to allow storm run-off to run on the surface until it reached larger distributor roads, where it was directed into covered storm drains. Sewage flows were to be discharged to a new trunk sewer being constructed along the boundary of the project area under another World Bank-funded project. The flat terrain meant that careful design was required to ensure that drainage systems worked as intended and that wastewater flows could be directed to sewers under the larger storm water drains. Raising street levels was avoided because this would tend to divert storm flows into houses.

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People sometimes lifted the light manhole covers to sweep solid waste into sewers

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The generally good quality of construction showed that formal contractual arrangements could produce good results and the World Bank project officer described it as the best upgrading scheme that he had seen. However, operational problems with drains and sewers quickly emerged. There was a tendency for people to misuse facilities, lifting the relatively light manhole covers to sweep solid waste into sewers. No individual or organization took responsibility for the shared covered drain connections and their integrity was compromised as householders broke cover slabs to allow flows to enter the drains from new wastewater outlets. In at least one case, residents dealt with a blockage in a sewer by making a cross-connection so that sewage could be diverted into the storm drain. Most seriously, the Lahore Water and Sanitation Agency, WASA, did not accept the standards and allocated few resources to operating and maintaining the facilities. Operation and maintenance problems were exacerbated by severe delays in constructing the off-site sewer as the contractor ran into difficulties and abandoned the work. Without this sewer, flows had to be directed to an existing collector drain and the resulting lack of fall meant that sewers were surcharged and so subject to rapid silting. When inspected in 2005, systems were still working but were clearly suffering from poor maintenance. Storm drains were heavily silted and had thus lost much of their capacity.





This shows the screen chamber on the inlet to the pumping station, Daska, Pakistan. The incoming sewer is surcharged and the resulting reduced flow velocity will lead to silting in the sewer.

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The project recognized the need to link in-slum services with city-wide systems

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### **Indore and the slum networking concept**

The Indore Slum Improvement Project (ISIP) was implemented between 1990 and 1997 in the Indian state of Madhya Pradesh. It was funded by the British Overseas Development Administration (ODA), the forerunner of the Department for International Development (DFID). Like the north-east Lahore project, it took an integrated approach to slum service improvement, recognized the need to link in-slum services with city-wide systems, and was located in a development authority rather than a municipality. The project was to cover a significant proportion of the slums in the city. Diacon (1997) states that the project provided direct benefits to 450,000 people, but this appears to be the target figure rather than the population actually covered by the project. Site visits reveal that many slums in the city have not been upgraded.

Infrastructure upgrading in Indore was based on the slum networking approach developed by Himanchu Parikh, an Ahmedabad-

based consulting engineer. The basic premise of the slum networking approach is that slums form a network that coincides with the natural water courses in a city. So, efforts to improve sewerage and drainage in slums can form the basis for improving these services in the city as a whole. Slums will not then be seen as separate from the city but rather as integral with it and its systems. In practice, slums form wherever land is available and reasonably cheap, which may be along water courses but can equally be on steeply sloping land, in old brick workings. Nevertheless, the basic premise that slum services should be integrated into city-wide systems is an important one, also recognized in north-east Lahore and by OPP, which has been rather lost in recent bottom-up approaches to slum improvement.

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Any misuse of the system by householders would affect them directly rather than the community as a whole

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The drainage philosophy adopted in Indore was similar to that followed in north-east Lahore. Roads were kept below the level of adjacent houses, with storm flows carried on the road surface, which was of brick or concrete to reduce the risk of damage. The main conceptual difference was that the Indore sewers were designed to accept storm flows while those in north-east Lahore were designed to be largely separate. In fact, the cross-connections made in north-east Lahore meant that this difference was more theoretical than real. Small gully chambers were to be placed on house connections to catch solids and ensure that any misuse of the system by householders would affect them directly rather than the community as a whole. There are similarities here to OPP's advocacy of the use of *haudis*, small interceptor chambers, on house connections. This practice appears to have been found unnecessary in Orangi at a fairly early stage, presumably because of the good falls available. However, it has been continued by the NGO Anjuman Samaji Behbood (ASB) in Faisalabad, which follows the basic OPP model and is said by Mr Ahmad Nazir Wattoo, ASB's founder, to greatly reduce problems with blockages.

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Resident community volunteers were involved in the planning of services and their subsequent maintenance

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Diacon (1997) describes the approach to community involvement in Indore. Meetings were held with local groups, as a result of which resident community volunteers (RCVs) were identified, one RCV for 20 families. The RCVs were all women and were considered to be spokespersons for the groups that they represented. All the RCVs in an area were members of a neighbourhood committee, which was to be involved in the planning of services and their subsequent maintenance.

The project won a number of awards, the most prestigious being an Aga Khan Award and the 1993 World Habitat Award. Yet, it clearly was far from being a complete success. According to Verma (no date), who was a member of the team that evaluated the project for DFID in 1996/7, the survey carried out as part of the evaluation revealed that only 34 per cent of 565 households surveyed had a sewer connection

while as many as three-quarters of households connected to the sewer had no on-plot water supply. Unless people connected to the sewer, the road as drain concept could not work. Problems with the scheme started to emerge fairly early and, perhaps because of these problems, Indore Municipal Corporation (IMC) was not prepared to take over responsibility for operation and maintenance of the works.

In such circumstances, it is perhaps not surprising that the neighbourhood groups were unable to guarantee maintenance, particularly as the Community Development Wing in IDA, set up to support them, was disbanded at the end of the project. DFID itself concluded that the project's impact had been limited. Its project memorandum for the ongoing Madhya Pradesh Urban Services for the Poor Project (MPUSP) states that lessons learnt from Indore include the need for greater stakeholder participation and for municipal reform and an enabling policy environment. Yet, as indicated above, the Indore project did involve a strategy for enabling community participation. Indeed, this strategy seems remarkably similar to that currently being followed in the MPUSP. Taken together with the difficulties with community maintenance already noted in relation to Orangi, this raises some fundamental doubts about the wide-spread assumption that communities can and will maintain sewers.

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These programmes raise doubts about whether communities can and will maintain sewers

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Sewers do not work if there is a limited water supply or solid waste collection is inadequate

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### **On-site and ecological sanitation**

On the basis of her analysis of Indore, Verma questions the viability of integrated approaches to infrastructure provision in low-income settlements. However, the examples given in this paper suggest that coordination between different service providers is essential if systems are to work. Sewers do not work if there is a limited water supply or solid waste collection is inadequate. One possible response to difficulties in ensuring adequate coordination is to promote on-site sanitation options. These appear to be self-contained and manageable by households acting alone so that they are not affected by the coordination problems that constrain attempts to develop sewerage sanitation. On-site sanitation should certainly play an important role where population density is relatively low. In higher density areas, on-site disposal of excreta can be combined with off-site disposal of sullage and storm water, usually via open drains. Regardless of this, it seems likely that people will connect to a drain or sewer once it is available and so save themselves the difficulty and expense of having on-site pits and tanks emptied. This is what is reported to have happened in Baldia, a large informal settlement near Orangi in

Karachi, where a soakpit project was implemented with UNICEF support in the early 1980s (Bakhteari and Wegelin-Schuringa, 1992). When the author visited Baldia in the 1990s, sewered sanitation, much of it implemented through community efforts, was certainly the norm.

In practice, on-site systems present other problems, the most intractable of which is dealing with faecal sludge from leach pits and septic tanks once these are full (see article by Boot in this edition of *Waterlines*). Conventional vacuum tankers can provide desludging services where there is sufficient right of way. In some countries vacuum tanker services are provided by the public sector but these services, though cheap, often have insufficient capacity to provide a service to everyone. Private operators are more expensive and are likely to discharge untreated wastes at the nearest convenient place, threatening the environment and public health. Where vacuum tankers are not available or dwellings are in locations that they cannot reach, informal sector workers may be employed to empty tanks by hand using primitive equipment (Saywell and Cotton, 1997). This practice is inconvenient for households, threatens the health of the workers and suffers from the more general environmental and health drawbacks associated with indiscriminate dumping.

Efforts to improve faecal sludge collection and disposal systems have focused on the development of hygienic systems for collecting sludge from low-income areas with limited rights of way and treatment of sludge to make it safe for disposal. Examples of collection initiatives include the MAPET system in Dar es Salaam, Tanzania (Muller and Rijnsburger, 1994), and the Vacu-tug system, which was piloted in Kibera in Nairobi, Kenya (<http://www.unhabitat.org/categories.asp?catid=548>), and subsequently used in a modified form in Dhaka, Bangladesh (GHK 2005). Both these technologies were developed with assistance from international organizations but desludging technologies have also been developed in India. The MAPET and original Vacu-tug systems suffer from low capacity, 200 litres for the MAPET and 500 litres for the Vacu-tug, and have a limited range because of their low speed. Low capacity increases operational costs because of the increased number of trips that have to be made to remove a given volume of sludge. The low speed means that the technologies are only viable where there is a suitable disposal or transfer station close to the point from which sludge is collected. In theory, both systems are intended to be attractive to entrepreneurs, who will replace the unhygienic informal emptying systems that prevail in most cities. In practice, both have struggled to cover their operational costs and this suggests that there is little chance that either will play a large part in future efforts to improve faecal sludge collection services. The Dhaka variant on the Vacu-tug, in many ways a different

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These technologies are only viable where there is a suitable transfer station close to the collection point

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machine, is faster and has a capacity of 1,800 litres but even so has barely covered its operational costs.

Arguably, limited demand is a basic constraint on efforts to expand improved pit-emptying systems. Septic tanks and leach pits are often connected to open drains so that they continue to function even when they are full, albeit with limited impact upon the effluent quality. In any case, householders do not empty pits themselves and may have limited concern for the well-being of the workers who carry out the work. They are mainly concerned about their own immediate environment and have little concern for the wider environmental impacts of their actions. Perhaps as a result of this, initiatives to treat sewage sludge, and indeed wastewater, to make it safe for reuse have rarely got beyond the pilot stage. The author visited a number of municipal sludge treatment plants in Indonesia in the early 1990s but all were either unused or severely underused.

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People are more interested in latrines, which are a private good, than in safe wastewater and sludge disposal, which is a public good

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This raises a basic issue for sanitation professionals. We all repeat the mantra that efforts to improve sanitation must be demand led and it is certainly true that sanitation facilities that are imposed upon people without consultation are likely to fail. Incomplete and unused twin pit toilets provided under programmes such as the Government of India's Integrated Low Cost Sanitation (ILCS) scheme are evidence of this. However, it is not surprising that people are more interested in latrines, which are a private good, than in safe wastewater and sludge disposal, which is a public good. This suggests a need for an increased emphasis on creating informed demand for sanitation improvements. This is particularly true of ecological sanitation, which some would argue offers the only sensible way forward in a world that will become increasingly resource-deficient in future years. Ecological initiatives are reported to have gone to scale in China but in other countries they do not appear to have gone beyond the pilot stage. The author has seen three small-scale examples in India and the Philippines. All three were in locations where space was available. In a fishing community in San Fernando in the Philippines, residents were even using urine to water bonsai trees! The real challenge for ecological sanitation as for other forms of on-site sanitation is to devise manageable systems for removing wastes from densely populated urban areas. Interestingly, wastes from dry toilets were originally removed by farmers, both in 19th-century Britain and, more recently, in cities such as Kabul in Afghanistan. The farmers did not charge for this service, their motivation being the value of the wastes as fertilizer for their land. Such systems tend to break down as cities become larger and the distances from which wastes have to be collected become too great. The challenge is greater when the intention is to re-use urine, since this requires systems to first remove both urine and faecal solids, then treat them to

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The real challenge is to devise manageable systems for removing wastes from densely populated urban areas

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an acceptable standard and then deliver them to farmers. It remains unclear whether such systems can be sustained.

### Conclusions and lessons for the Year of Sanitation

This paper has shown that even the most innovative initiatives have struggled to make a real impact on the sanitation needs of the urban poor. As we enter the International Year of Sanitation we must recognize that urban sanitation presents problems that have not yet been solved. There is clearly a need to focus on complete sanitation systems rather than individual system elements, whether these are toilets, sewers or treatment plants (Netherlands Water Partnership 2006). Just as Water and Sanitation Decade in the 1980s gave us the concept of appropriate technologies, we could usefully now focus on appropriate sanitation systems.

It is clear from the examples given in this paper that unsolved questions remain in relation to the physical aspects of sanitation systems: for instance how to deal with wastewater in flat areas and how to develop affordable technologies for the removal of faecal sludge from septic tanks and leach pits. However, most if not all of these



Waste stabilisation pond in Khairpur, Pakistan. The weed growth shows that even the simplest technologies will suffer if basic maintenance is neglected.

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Most of these  
problems have an  
institutional dimension

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problems have an institutional dimension. The challenge is not to develop technologies that might work in ideal circumstances but rather those that will work within the context provided by local institutions. There is a need for further research on how technologies operate when institutional arrangements are less than ideal. For instance, it will often be difficult to ensure that interceptor tanks on sewer house connections will be desludged, but where good sewer maintenance cannot be guaranteed, they may still offer a better option than connections directly to the sewer. The north-east Lahore example suggests that the generally accepted practice of separating foul and storm flows may be difficult to apply in many developing country situations. What are the design implications of this?

Linked to this, there is a need to develop the capacity for sanitation system design and implementation within developing countries. This should cover the public and private sectors and include civil society organizations where appropriate. The aim should be to develop knowledge of the way in which sound theoretical principles can be used to understand and respond to the sometimes difficult challenges presented by reality, particularly in low-income areas.

All the sewerage initiatives described in the paper experienced difficulties with coordination between different stakeholders. OPP and north-east Lahore illustrate two responses to the widely recognized difficulty of ensuring that households connect to sewers. However, neither is without difficulties. North-east Lahore illustrates the need to develop clear guidelines on who will be responsible for maintaining shared sewer connections. The OPP approach in effect moves the interface between private and public provision beyond the plot boundary but the Sukkur experience shows that coordination problems can occur at this boundary. The immediate problem in Sukkur appears to have been the failure of SMC to regularly operate the pumping station. Beyond this, there was arguably a need for communities to pay some form of tariff to SMC to cover the operation of the 'external' system, something that is not explicitly allowed for in OPP's division of financial responsibilities between communities and government.

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Problems can arise at  
the boundaries  
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More generally, north-east Lahore and Indore illustrate the problems that can arise at the boundaries between project areas and city-wide systems. The brief examination of on-plot systems shows that similar coordination problems often arise with systems for collecting and disposing of faecal sludge. This problem is recognized and most international agencies now attempt to work directly through municipalities and other service providers rather than development authorities, whose remit does not extend to operation and maintenance of facilities. The challenge now is to find ways of ensuring that municipalities and specialist operating agencies have the

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Institutions and the people within them often resist change

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willingness and capacity to implement improved sanitation systems. Capacity can be increased by training but it is important to recognize that institutions and the people within them often resist change. This is illustrated by the reluctance of Lahore WASA to even consider the north-east Lahore standards. OPP's concepts have had a strong influence on Pakistan's National Sanitation Policy (Government of Pakistan, 2006) but there is still a long way to go before these are accepted by engineers working at the municipal level. In Faisalabad, for instance, the DFID-funded Faisalabad Area Upgrading Project used OPP-style chambers for many years but government engineers eventually reverted to using more expensive standard government designs, despite the fact that the OPP design had given no problems. This is a complex subject but perhaps one way forward is to develop a systematic approach to testing and documenting new standards and approaches. This will help to ensure that subsequent actions are 'evidence based'. This will only work if there is greater willingness to examine them critically and modify or reject those aspects that are found not to work. Over and above this, there is the intractable problem of government systems that reward conformity and can penalize experimentation and innovative thinking.

International agencies recognize the need for a greater emphasis on institutional issues and have developed instruments such as the World Bank's Development Policy Loans (DPL) to address the need for higher-level reform. Budget support is also increasingly used by international agencies and may be accompanied by efforts to develop improved policies. Such initiatives are grounded in overarching concepts that may not be immediately relevant in every country and/or to sanitation. For instance, the World Bank says that, among other things, DPL aims to promote competitive market structures, create an environment conducive to private sector investment and encourage privatization and public-private partnerships (<http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/0,,contentMDK:20120732~menuPK:268725~pagePK:41367~piPK:51533~theSitePK:40941,00.html>). Market structures may be relevant to efforts to improve in-house sanitation, which has private good characteristics, but their role in the wider environmental aspects of sanitation is not immediately obvious.

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Regardless of this, while efforts to facilitate policy change are clearly necessary, they are unlikely to be effective unless they are accompanied by and build upon efforts to improve systems and procedures. Such efforts must be based on a sound understanding of the existing situation and should draw on the lessons learnt from analysis of initiatives such as those described in this paper. The need for improved coordination between different stakeholders has been highlighted here but it is necessary to go beyond general statements



to ascertain what this will require in practice in specific situations. Systems within organizations also need to be improved. For instance, Hasan (1997) notes that efforts to train SMC engineers in the OPP approach were undermined because engineers were no sooner trained than they were transferred.

All of the examples illustrate the need to improve operation and maintenance and the OPP and slum networking experience suggests that community management is not the panacea that it is frequently assumed to be. There is a need for further research on what communities, and indeed the private sector, can and cannot be expected to do. The issue of who pays for what operational costs is critical and has not been sufficiently addressed to date.

The examples described in this paper suggest that solving urban sanitation problems will only be possible if we are prepared to be Easterly's 'searchers' but that we search in a way that is firmly founded in sound analysis of problems and possibilities, with particular reference to how approaches can be institutionalized and taken to scale. This is the challenge that faces us in the years to come.

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