

The challenge of servicing on-site sanitation in dense urban areas: Experiences from a pilot project in Dhaka

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The Millennium Development Goals advocate the need for increased coverage of improved sanitation, but they omit to recognize the importance of latrine maintenance to uphold sanitary conditions. This paper describes a pilot initiative in Bangladesh to improve the traditional method of manual desludging of leach pits and septic tanks. Dushtha Shasthya Kendra (DSK), an NGO based in Dhaka, operates a motorized desludging system to remove the waste from on-site sanitation. Although DSK has found there to be a considerable demand for this service from households, institutions and commercial properties, it is only recently that income covers operational and maintenance costs. However, this is not sufficient to repay capital investments, which limits the capacity of DSK to scale up the operation or other NGOs to replicate the service in other areas. In addition, the problem of sludge disposal has only been partially solved, which highlights the need to develop a citywide strategy for faecal sludge management incorporating transfer stations and off-site treatment.

Keywords: faecal sludge management, pit latrines, Dhaka

DHAKA, BANGLADESH, IS ALREADY ONE of the largest cities in the world and continues to grow at an alarming rate, exceeding 3 per cent a year (UNFPA, 2007). In 1990, the city was the 26th largest in the world with a population of 6.6 million, but by 2015 (the date that the Millennium Development Goals are expected to be attained), it is projected to become the fourth largest with a population of 21.1 million (UNDESC, 2003). Dhaka's slum population has doubled in a decade to reach 3.4 million in 2006 from 1.5 million in 1996 as a result of heavy rural-urban migration (OneWorld South Asia, 2008). The density of the population is extreme especially amongst the urban poor living in slums, where it is estimated to be as high as almost 900 per

Dhaka is projected to be the fourth largest city in the world by 2015

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acre; 8–10 times higher than the average city population density (CUS et al., 2006).

Approximately 30 per cent of Dhaka's population are estimated to be connected to the city's sewerage network (ADB, 2004), which is operated by Dhaka Water Supply and Sewerage Authority (DWASA). The remaining 70 per cent rely on various forms of on-site sanitation, which includes both 'improved' facilities in the form of pour-flush toilets connected to leach pits or septic tanks and 'unimproved' facilities, which include public and shared latrines as well as more obvious unsanitary forms of sanitation such as bucket latrines and hanging latrines (in accordance with the definitions of 'improved' and 'unimproved' adopted by the WHO-UNICEF WHO/UNICEF Joint Monitoring Programme, 2006).

Public service providers are not officially permitted to service slums

Official service providers, including DWASA, are not officially permitted to service slums and, as a result of this, basic infrastructure and urban services related to water supply and sanitation are completely inadequate. Although the majority of households have on-site sanitation facilities, the arrangements for collection and disposal of faecal sludge are vastly inadequate. As a result, many latrines become unsanitary or unusable, resulting in poor environmental health conditions and a correspondingly high incidence of diarrhoeal and other sanitation-related diseases.

Manual pit emptying was pronounced illegal in the 1980s

The traditional method of pit emptying involves the manual removal of excreta by sweepers (most of whom are from the *Methor* caste), which has extremely high occupational health risks and is one of the most degrading professions in the world. The Government of Bangladesh pronounced this practice illegal in the 1980s but, owing to the lack of any alternative, it continues today throughout Bangladesh, notably in urban areas where the need is greatest. In Dhaka, most sweepers were originally employed by Dhaka City Corporation (DCC), but when this activity was banned the majority continued to be employed as DCC street sweepers and garbage collectors. However, many continue to provide pit-emptying services for private households as a means of earning extra income.

Sweepers dump untreated faecal sludge indiscriminately into the city's drainage channels

Owing to the illegitimate nature of their activities, sweepers normally work at night. As well as working in the dark, they are often intoxicated in order to be able to face the stench. This means that they do not clean the pits or tanks properly and may cause a mess as they pass through houses with buckets of human excrement. Although the service is far from adequate, households are at the mercy of the sweepers who often demand exorbitant prices, as they know that households have no alternative.

The other problem is that there is nowhere for the safe disposal of faecal sludge since the 'trenching grounds' operated by DCC were closed down at the same time that manual collection of night soil was

banned. As a consequence, sweepers dump untreated faecal sludge indiscriminately into the city's drainage channels or surface water bodies, which has major implications for environmental health conditions and causes widespread pollution.

Background and project initiation

Dushtha Shasthya Kendra (DSK), an NGO based in Dhaka, has been working in the slums and squatter settlements of Dhaka since the early 1990s. Initially, the NGO concentrated on promoting primary healthcare within slum communities. But in 1991, DSK initiated an urban water and sanitation (watsan) programme when it became apparent that many health problems were directly related to poor water supply, sanitation and hygiene behaviour.

The first activities in DSK's 'watsan' programme involved the installation of communal water supply points and sanitation blocks in two squatter settlements in the industrial district of Tejgaon with financial support from WaterAid Bangladesh. But, although access of the urban poor to latrines improved in target slum communities as a result of DSK's intervention, a sanitary means of removing and disposing of faecal sludge from these facilities remained a problem.

According to Chowdhury and Amin (2006), dumping of human waste after cleaning pit latrines and septic tanks is the most difficult environmental problem faced by WaterAid's urban programmes. Hoque et al. (1994) also previously found that the design of double alternating pit latrines, provided by WaterAid, was not well accepted by the urban poor because of the need for de-sludging, and the failure of this routine maintenance activity had contaminated the environment of the urban poor.

As a result, WaterAid Bangladesh discussed with DSK and other NGO partners working in Dhaka the idea of introducing a system for servicing on-plot sanitation systems. Subsequently, WaterAid agreed that DSK would manage a pilot project for collection and transportation of faecal sludge from latrines and formed a steering committee with other NGO partners to help oversee the project.

The primary aim was to develop a sustainable and affordable mechanism for servicing on-site sanitation facilities in order to improve environmental health conditions in slums. Concurrently, the project aimed to develop small-scale private sector involvement in the operation and management of the service, and to work with government agencies to adopt sustainable and safe disposal mechanisms for human waste.

Inspired by UN-Habitat's initiative in Kenya, WaterAid imported a Vacutug to Bangladesh and handed over the responsibility for its

The emptying and disposal of human waste from pit latrines is the most difficult environmental problem

Vacutug aims to provide an inexpensive pit emptying method where access is a problem

operation to DSK. Designed by Manus Coffey Associates (based in Ireland), Vacutug aims to provide a simple and inexpensive method for emptying pit latrines in areas where access by other forms of desludging equipment is not possible. Vacutug is virtually unknown in Asia apart from in India where the NGO Sulabh International has been using it to desludge public toilet blocks.

Early experiences

DSK started the Vacutug operation in December 2000 in the Baunia-band slum, but soon encountered technical limitations. In many locations, the machine was too big to access latrines via the narrow lanes and didn't have sufficient power to operate a long pipe to reach inaccessible latrines. In addition, the operation was constrained by slow road speeds and limited sludge storage capacity and, therefore, DSK could not respond to requests from areas that were far from its base in Mirpur.

In an attempt to resolve these technical problems, Vacutug Mk II was designed (also by Manus Coffey) but manufactured locally by Mirpur Agricultural Workshop and Training School (MAWTS) in Dhaka. Vacutug Mk II has a stronger pump than Vacutug Mk I but, owing to its greater capacity, Mk II takes between 10 and 20 minutes to fill, whereas Mk I only takes between 5 and 10 minutes.

Unlike Mk I, Mk II was not self-propelled but was mounted on a trailer to attach to a vehicle in order to offer greater mobility to reach difficult areas whilst enabling the collection and transportation of substantially greater volumes of faecal sludge within one operation. To achieve this, the system was designed to comprise two components: a larger 1,900-litre capacity tank and a 200-litre 'baby' tank to use as a satellite to the main Vacutug machine. However, DSK did not have success using the baby Vacutug and decided to discontinue using it mainly because of the lack of a driving engine. The baby Vacutug engine was mounted on a rickshaw wheel, which had to be pushed manually, but staff found this to be difficult over longer distances. The alternative was to lift it onto the vehicle, but this proved to be difficult owing to the weight of the equipment.

Financing arrangements

The capital cost of Vacutug Mk I was borne by the UK Government's Department for International Development (DFID), whereas the cost of Mk II (\$4,400) was borne by WaterAid. However, this did not include the cost of the vehicle to tow the equipment. Subsequently, Mk II started operation in July 2001 when WaterAid negotiated with

Mark II was designed to offer greater mobility combined with collecting greater volumes within one operation



A vehicle tows the Vacutug Mark II

DFID who subsequently lent a jeep to tow Mk II and provided the cost of O&M of the vehicle and the salary of a driver.

However in March 2002, following a change in policy in provision of direct assistance, DFID withdrew the vehicle and the service was suspended for about a year. Mk II finally resumed operation in April 2003 when DSK bought a second-hand pick-up truck at a cost of approximately \$7,500 with additional support from WaterAid who provided a grant for over 30 per cent of the capital costs.

Management arrangements and staffing

DSK is responsible for the operation and management of the collection service and the management unit is responsible for drawing up work schedules, implementation of the schedule, maintaining accounts and reporting to DSK head office and the steering committee. There are five full-time members of staff who are employed to operate

DSK employs local staff from slum areas who are provided with protective equipment and clothing

the service, a supervisor, one head operator, two full-time assistant operators and a driver. DSK is viewed to be a good employer offering a reasonable wage, good working conditions and access to a health programme. DSK employs local staff from slum areas who are provided with working clothes and protective equipment such as gloves and boots.

Benefits and perception of the Vacutug service

Compared with the traditional means of cleaning latrine pits and septic tanks, the Vacutug service has been very well received by its customers. Table 1 provides a summary of the advantages of the Vacutug service compared with the disadvantages of the traditional service from the householders’ perspectives.

The service is cleaner and is considered to be more efficient than the traditional practice. Housewives are notably praiseworthy of the service as the cleaning of pits used to be a regular source of dispute between neighbours. The Vacutug service is also considerably more hygienic from the perspective of the operators who do not come into direct contact with the excreta.

Despite the loss of extra income from cleaning pits, the initiative has relieved sweepers from a degrading vocation involving human excreta. However, it is unlikely that DSK can meet the demand in Dhaka and therefore the sweepers believe that there will always be work available for them and do not perceive Vacutug to be too great a threat to their livelihoods.

The service is cleaner for the households and for the operators

Table 1. Advantages of the DSK service compared with the traditional service

<i>Traditional sweeper service</i>	<i>DSK service</i>
Sweepers demand three or four times the cost of the Vacutug service.	Operators are well behaved.
It is difficult to supervise their service and they are not punctual.	The rate is fixed and the service is good value.
They do not fully clean the pits/septic tanks.	Service is quick and efficient.
They often break the pit lining when cleaning the pits.	Does not break rings/slab in the process.
They work very late at night requiring households to arrange extra security or stay awake.	Prestige to service users.
They arrive with insufficient people required to do the job.	Tension-free operation resulting in fewer problems between neighbours.
The sweepers cause a mess, which can result in arguments and social tensions with neighbours.	Readily available and easy to place order.
It is difficult to find them when needed.	Households do not have to stay awake at night.
Sweepers dispose of pit sludge into nearby drains or ditches.	No mess in the home and more hygienic.
	Smells much less than traditional cleaning.



The operators are provided with protective clothing

Finding an appropriate place to safely dispose of the faecal sludge has been an ongoing problem

Sludge disposal

Finding an appropriate place to safely dispose of the faecal sludge has been an ongoing problem. The wastewater treatment plant could not be used as it is too far from Mirpur (approximately 15 km). DSK discussed the matter with DWASA who gave permission to dispose of the waste at two pumping stations (one in Mohammadpur and the other in Tejgaon itself). Unfortunately these are not always easily accessible and, where there is no sewer line for disposal, the operators have no option but to dispose of the sludge into water bodies or ditches. This practice, apart from polluting the environment, is also difficult in view of the large concentration of people in Dhaka.

Demand and financial assessment

Initially, the sight of the Vacutug on the streets of Dhaka caused considerable interest, which increased awareness of the service. However,

in order to inform residents about the service and stimulate demand, DSK produced promotional leaflets and organized community discussions after Friday congregations in some areas of Mirpur and Tejgaon. As well as serving slum communities, DSK also responds to requests from households in middle and higher-income neighbourhoods, schools and other institutions and factories, some of which are located in other parts of the city.

Initially, DSK faced opposition from local sweepers who saw the Vacutug operation as competition

Users either place a request for the service via the management office in Mirpur, directly to the Vacutug operators or indirectly via the sweepers on the basis of a commission. Initially, DSK faced opposition from local sweepers who traditionally cleaned pits and septic tanks as the Vacutug operation was seen to threaten their source of income. In response, DSK decided to offer a 10 per cent commission to encourage sweepers to bring in orders.

The number of days the Vacutug service is in operation varies considerably depending primarily upon the demand, but also the number of public holidays in each month (see Figure 1). Compared with the very early days of operation, the number of working days has increased considerably and is now observed to be an average of 20 days a month, which equates to utilization efficiency in the region of 60–70 per cent.

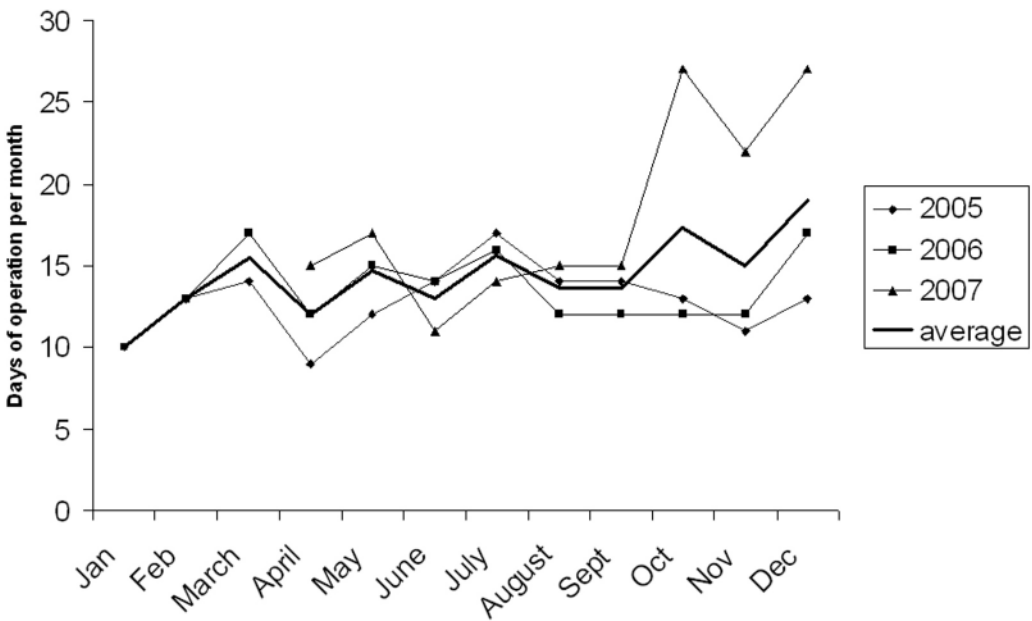


Figure 1. Utilization: Number of days of operation per month

Tariff and clients

The service that DSK offers is approximately 3–4 times cheaper than the cost of employing sweepers to do the job manually. The standard fee for a single full load of Mk II is \$16 and in theory the charge is based proportionally on the amount of sludge removed. It is difficult to measure the size of the pit/septic tank, and so the operator can estimate the volume by touching the tank and sensing at what level the metal is cooler as the sludge is generally quite warm.

However, in practice, lump-sum charges are usually applied irrespective of total quantity of sludge removed. The concessionary rate offered to poor households in slums and squatter settlements is subsidized by the more affluent households (for a leach pit as little as \$3 is charged for slum dwellers). The charge depends upon the number of Vacutug loads required to clean the sludge.

The owners of septic tanks living outside slums are charged the full rate, whereas an average 5-ring pit latrine generally requires cleaning once every three months and costs \$6 (an equivalent of \$2 per month). Most septic tanks require between 1 and 2 full loads costing between \$24 and \$32 depending on the location of the septic tank.

In addition to the latrine desludging service for households, DSK provides a service for industries and institutions with septic tanks. For instance, BRAC, the largest NGO in Bangladesh has employed the Vacutug service for its head office. DSK has also responded to a request from an industrial enterprise in Saver, which is about 15 kilometres from Mirpur. The cost of cleaning an institutional septic tank depends significantly upon the volume of septage that is removed. Owing to the large volumes of septage involved, cleaning the septic tanks of institutions and factories is a comparatively large job that fetches payments of up to \$200 depending on the size. It is estimated that this accounts for 20 per cent of the income from Vacutug while approximately 30 per cent comes from customers with septic tanks and the other half comes from slum communities (see Table 2).

The concessionary rate offered to poor households is subsidized by the more affluent

DSK also provides a service for industries and institutions with septic tanks

Table 2. Relative proportions of income from different clientele per month

	<i>Average income (taka per month)¹</i>	<i>% of total</i>
Slums	374,800	51
Industries (septic tank)	145,400	20
NGO (septic tank)	71,440	10
Residences (septic tank)	133,500	18
Others	9,900	1

¹ There have been significant currency fluctuations during the period covered by this project. At the end of 2003, 1 US dollar fetched 60 taka whereas at the end of 2007, 1 US dollar was worth 70 taka. For the purpose this paper, the currency rate used was 65 taka = 1 US\$.

Revenue and profitability

Revenue and expenditure data show that the service operated at a net loss during the period December 2000 to July 2003. On average, the losses during this period were almost 30 per cent per annum. However, more recently, increasing demand has translated into rising revenue. Accounts indicate a continuing decrease in the gap between income and expenditure as a result of increasing revenue from a greater number of serviced latrines. The revenue from the operation has gradually improved (see Figure 2) and is now sufficient to cover staff salary, but not the regular operation and maintenance expenses and garage rent, or the capital cost and depreciation of the Vacutug or the vehicle used to tow the Vacutug.

The revenue from the operation now covers staff salaries but not the regular operation and maintenance or the capital cost

Scaling up: Opportunities and constraints for replication

Technical constraints

Although the Vacutug is relatively simple to operate, DSK staff have identified a number of technical challenges that need to be addressed. The inability of Vacutug to clean pits that are more than 2 m deep and the fact that it remains difficult to reach pits more than 30 m

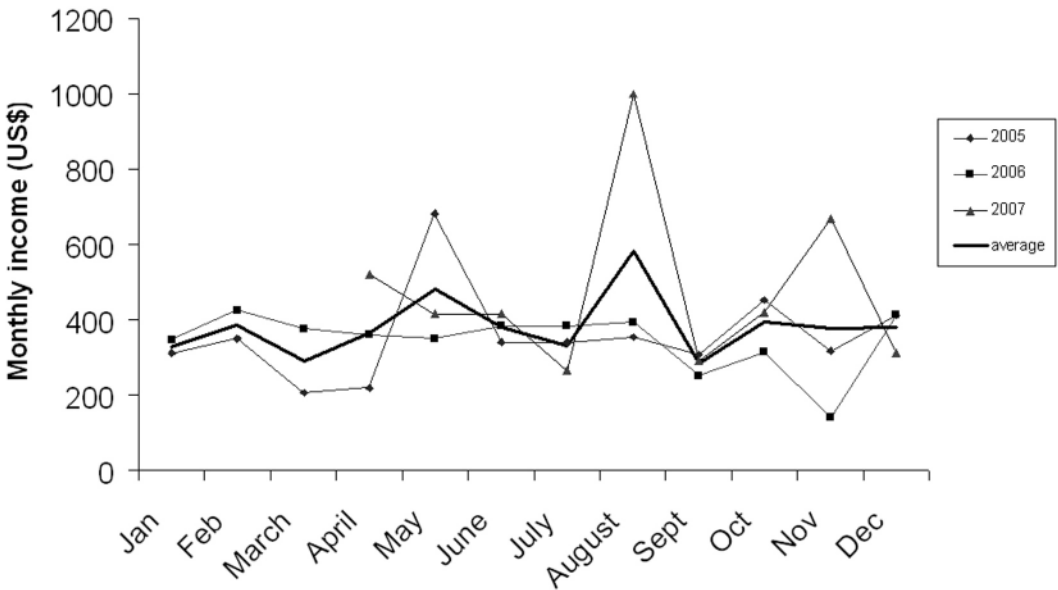


Figure 2. Average monthly income, 2005–2007

There is therefore a need for further technological development for Mark II

from streets or in very narrow alleys suggests that there is a need to strengthen the power of the pump. In addition, it is difficult to manoeuvre the trailer in narrow lanes and there is a need to redesign the vehicle to reduce total length. There is therefore a need for further technological development for Mark II, which may result in a design that is more akin to a traditional desludging truck with the tank fixed on the chassis of a small truck as opposed to towing it behind a vehicle.

Sludge disposal

One of the main constraints to the service is the lack of sludge disposal points. DWASA supports the operation by giving permission to DSK to dispose of faecal sludge at two sewage pumping stations. To a certain extent, this would be overcome if DWASA were to grant permission to discharge at other pumping stations. Nevertheless, it is not always convenient or economical to transport the waste to these locations. In addition, the authorization is not permanent and there is always a possibility that DWASA might reverse its decision, which would affect the viability of the Vacutug operation.

Because Dhaka WASA limits the volume of faecal sludge to be discharged into its sewers, DSK must seek alternative ways of managing the waste disposal problem. If there were locations in each neighbourhood throughout the city where faecal waste could be discharged, then the efficiency of operations could be improved significantly because the Vacutug would not need to spend so much time in the congested streets of Dhaka transporting the waste to one of DWASA's pumping stations.

One option is to treat the waste locally, but areas that are potentially suitable locations for installation of treatment facilities are being filled in by urban expansion and development, and the rising cost of land precludes its use for land-intensive development. In high-density urban areas, land is too scarce to construct land-intensive systems, but in peri-urban areas where the housing is less dense, decentralized systems may be more appropriate.

Many city corporations have land which is not in use and may be made available for sludge treatment. DCC might be persuaded to reopen 'trenching grounds' which is where sludge used to be disposed. But these were discontinued in the mid-1980s at the same time as bucket latrines were declared illegal and therefore this is likely to be viewed as a regressive move. In addition, negative public perception about the proximity of waste treatment facilities may constrain this possibility.

Another option might involve the installation of transfer stations – either permanent installations (possibly combined with public toi-

Locations are needed in each neighbourhood where faecal waste can be discharged

lets to increase acceptability to local residents) or a large truck, parked temporarily, into which the Vacutug can empty its load prior to bulk transportation to areas where large centralized treatment facilities are situated. However, this approach would require considerable support from DCC to invest in the necessary infrastructure that is required for the management of faecal sludge arising from a city the size of Dhaka.

Demand and ability to respond to demand

The total number of users of the service remains relatively low in relation to the scale of the problem

Demand for the DSK service has been increasing, as is evident from the increase in monthly income, but the total number of users of the service remains relatively low in relation to the scale of the problem. Although the utilization rate has increased, there is a need to look in more detail at the number of clients served per day and consider ways in which this may be increased. The main constraint to this is undoubtedly the availability of sludge disposal points.

Since the Vacutug has only recently begun to show potential for profit, there has been little interference from the local *maastan* (powerful men who control local businesses to extort money). However, although still a minor problem, organized extortion may transform into a difficult problem.

A more concerted advertising campaign should stimulate demand to make the operation more profitable

The other challenge is to convert the tremendous need for service throughout Dhaka into demand. All stakeholders including DSK recognize that the weakness of the operation lies in promotion. Publicity in the form of leaflets, word of mouth, local discussions and a few neighbourhood meetings has not been sufficient to reach the bulk of potential customers. A more concerted advertising campaign involving targeted publicity and social marketing tools to promote the service should stimulate demand to make the operation more profitable, which might subsequently attract interest from private sector financiers and operators.

However, there are limits to how much DSK would be able to respond to significant increases in demand as there is currently only one Vacutug in operation. The current scale of operation is manageable and an appropriate strategy for scaling up of the existing operation would need to be developed with the various other members of the steering committee to decide which other NGO partners would be best placed to initiate a service in their areas and how to co-ordinate rather than compete with the existing DSK service.

Financial issues

There are various factors that may influence the financial viability of the DSK service. Firstly, the desludging service must operate on a commercial basis and therefore full cost recovery is imperative for

Without an increase in the charges it is unlikely that the service can be commercially viable and therefore of interest to the private sector

sustainability. The deficit between income and expenditure has closed now but revenue is not enough to pay back the capital investment and does not cover the depreciation of the machinery and vehicle.

Thus, the venture could not have been started without the funding from DFID and WaterAid to cover the capital investment to purchase the equipment. In the initial stages DFID also subsidized the vehicle costs to tow the desludging equipment and WaterAid also provided additional funding to meet shortfalls between revenue and expenditure. But, capital finance remains a problem (being dependent on external sources of funding). There may still be opportunities for private sector investment, but this will be dependent on the systems demonstrating that they can operate on a sustainable basis and offer profitable returns on the investment. In addition, without a substantial increase in the charges it seems unlikely that the service can be truly commercially viable and therefore of interest to the private sector.

The charge levied by DSK is low but this is not necessarily because residents are unable or unwilling to pay but is related to the fact that DSK is not in a position to increase the charge. In fact, DSK has been forced to abandon its policy of commercialization as a result of pressures from funding bodies (namely DFID/WaterAid), who are not supportive of suggestions to increase service charges. This is because these external donors uphold the idea that the grant aid should be used to subsidize the operation and believe that communities themselves can manage the operation at the local level. The arguments put forward by these organizations is that this is the best way to ensure that the service is affordable by all households – including the poorest.

Management and institutional framework

Although the service aims to operate in the same way as a commercial enterprise, its legal status remains ambiguous as it is still managed by an NGO. Therefore, the question remains as to whether it will remain an NGO initiative or whether it should become a private commercial enterprise and, if so, when this transformation should occur and who should be responsible for the transfer of responsibility.

Without the cooperation from DWASA, the disposal of waste would be highly problematic. The current management of DWASA remains supportive of DSK but a change in management at a high level could put an immediate stop to the service. Therefore, sustainability of Vacutug requires political support to establish effective linkages with local government, especially for disposal of faecal sludge. Even though the national policies stated by national government indicate that this type of initiative should be actively encouraged, the lack of official political support and the lack of a funding mechanism to support capital investments required act as significant constraints to scaling up.

The lack of official political support and the lack of capital investments are constraints to scaling up

Concluding remarks

There is evidently a chronic deficiency of sanitary arrangements for servicing on-site sanitation in Dhaka and a lack of adequate facilities for disposal of faecal sludge, which invariably results in a massive pollutant load and major environmental health hazards. This situation with regard to faecal sludge management is repeated in many other cities throughout Asia and other parts of the world.

Increased pit latrine coverage may not result in sustainable health gains without considerable investment in pit emptying services

Bearing this in mind, and considering the fact that the sanitation MDGs fall under Goal 7, which aims to promote environmental sustainability, it is questionable whether the increased coverage expected by the MDGs will result in sustainable and equitable health gains without a considerable investment in pit emptying and disposal services such as is illustrated by DSK's pilot project in Dhaka.

The initiative described in this paper provides an example of a pilot project that aims to address localized problems for the collection and disposal of faecal sludge. The main benefit of the project is that local residents, including low-income slum dwellers living in congested areas, are provided with a service to empty on-plot sanitation facilities at an affordable cost.

There are considerable opportunities for scaling up the service in urban areas throughout Bangladesh, but DSK has not been successful in encouraging private sector involvement in faecal sludge collection. Until there are some changes relating to the provision of financing and tariffs – specifically related to the use of subsidies for donor agencies, then NGOs such as DSK will probably remain the most appropriate organization to manage this type of operation.

There are many NGOs involved in WATSAN projects that would be interested if grants were provided for capital investment to set up the enterprise. However, to date there has been little replication by other NGOs and only the Population Services and Training Center (another NGO based in Dhaka supported by WaterAid) is planning to start up a similar service.

DSK set out to operate the service on a commercial basis and it has been shown that there is potential to operate the service on a financially sustainable basis. However, due to the high initial investment in the latrine-emptying machine, recovery of full capital cost is not expected to be viable. In addition, at present DSK does not have to pay WASA for disposal of faecal sludge into the sewers, neither does it have to account for treatment costs.

Although the initiative is seen to be successful at the local level, the lack of finances to pay for capital costs means that there is limited potential for scaling up without the provision of grants or potentially soft loans for NGOs and small businesses and also the freedom to charge at market rates which should increase the commercial

At present there is limited potential for scaling up without the provision of grants or soft loans for NGOs

viability. Although WaterAid and DSK have raised awareness of the need for sanitary arrangements for collection and disposal of wastes from on-site sanitation, and have managed to enlist the support from DWASA, there is a lack of higher-level institutional support and a policy framework to promote an enabling environment.

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