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Faecal sludge management in Bangladesh: an issue that needs urgent attention

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The rapid increase of fixed-place defecation has created a new challenge for faecal sludge management in Bangladesh. In the city, this challenge is acute due to factors like high population density, rapid and unplanned growth, inadequate service provisions and so on. This study in three cities of Bangladesh shows that in the absence of any safe emptying, transportation, dumping and treatment mechanism most of the sludge generated is going yet again to surface water, ultimately shattering the gains achieved through increased sanitation coverage. With the predominant on-site technologies, most septic tanks and pits in the cities require emptying which is largely done by manual sweepers. On the other hand, with the exception of Dhaka, no cities have designated dumping sites or treatment plants for faecal sludge (FS). Consequently, manual sweepers dump the sludge in nearby open drains or water-bodies. In Dhaka too, most safety tanks and pits are connected directly with the storm drainage system linked to open water body within the city or outside. This practice ultimately regenerates the risks of faecal matter re-entering the domestic environment. Poorer groups who dwell in unsafe environments suffer the most from this; however, the risk remains also high for those who practice safe sanitation.

Introduction

As many of the developing countries are moving towards increased sanitation coverage, the issue of safe handling of sludge has emerged as an important and challenging issue of concern. In the city, this challenge is even more acute due to the factors like high population density, rapid and unplanned growth, inadequate and often inaccessible service provisions. In cities where most households practice on-site sanitation, the emptying septic of tanks or pits, and transport of sludge to a safe dumping site for treatment becomes an emerging need. There is no doubt that if safe disposal of sludge is not ensured, gains achieved by increased sanitation coverage cannot be realized.

The importance of improved faecal sludge management (FSM) in reducing public health and environmental impacts is widely acknowledged. Research suggests that improved excreta management could reduce the diarrhoeal morbidity by 36 per cent (Carr 2001). A meta-analysis of 25 studies which investigated the association between sewerage and diarrhoea or related outcomes, including presence of intestinal nematodes show that sewerage systems typically reduce diarrhoea incidence by about 30 per cent or perhaps as much as 60 per cent when starting sanitation conditions are very poor (Norman, Pedley and Takkouche 2010). However, as most of the developing countries are still struggling to gain universal

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sanitation coverage; they are yet to put adequate emphasis on this important environmental need. This paper provides evidence from three cities of Bangladesh where in an absence of safe emptying, transportation and treatment facilities, most faecal sludge re-enters the environment with full potential for harming public health.

Country sanitation context

Sanitation is still one of the biggest challenges for Bangladesh although it has made some good progress in increasing sanitation coverage over the past 10 years. A well-coordinated effort by the government, non-government development agencies and other development partners as well as the introduction of the innovative Community-led Total Sanitation approaches have made it possible to bring down the proportion of open defecation from 43 percent in 2003 (SACOSAN 2008) to 4.4 percent of the population in 2011 (BBS 2011a). Despite this significant gain, the challenge still remains high as about half of the population do not have access to safe sanitation (BBS and Unicef 2010). This report suggests that only about 54 percent of the population has access to improved sanitation facilities which eliminate the potential for contact with human faecal matter, largely through water seals in toilets. Besides, 25 percent and over 15 percent of the population has access to shared latrines and unimproved sanitation facilities (largely open pit latrines) respectively. This means, however, that more than 95 percent of the population has access to latrine facilities irrespective of their quality.

Urbanisation and urban sanitation

Bangladesh is experiencing a rapid urbanisation process as more and more people from rural areas come and settle in the cities. Urban population in Bangladesh has grown from 5 percent in 1971 to 28.1 percent in 2010, suggesting that approximately 46 million people are currently living in the urban areas. The United Nations Population Division estimates that with current annual growth rate of over 3 percent, the urban population of Bangladesh will reach 53 million in 2015, representing just less than one third (30 percent) of the total population[4]. This unplanned but rapid pace of urban growth without commensurate development has posed huge challenges for the service agencies to provide necessary support to the growing population.

Urban sanitation in Bangladesh is a big challenge but is still an area overlooked by policy and programme. A recent gap analysis report says, "with sewerage system (only in parts of Dhaka city) and septic tanks (largely used in urban centres) discharging into open water bodies, the urban scenario falls far behind hygienic sanitation coverage in true sense. Growing slum population in the major cities and other secondary towns are still struggling to get within the purview of sanitation services primarily due to the issues of land tenure-ship. With the increase in sanitation coverage in urban areas using septic tanks and pit latrines, it is expected that faecal sludge volume will increase considerably within a few years. If collection and disposal systems are not in place, serious environmental degradation and associated health risk will increase" (Rahman 2009).

Methodology

This study was conducted in three cities in Bangladesh: Dhaka[5], Khulna[6] and Faridpur[7]. Data was collected during June to September 2011. Statistically representative samples were drawn randomly in

[4] World Urbanization Prospects: The 2009 Revision Population Database (http://esa.un.org/unpd/wup/unup/index_panel3.html)

[5] Dhaka accommodates more than one-third of the total urban population and about nine per cent of the total population of the country. Although, the average income is high in Dhaka, in absolute terms, a large number of people remain poor. Slums house nearly one-third of all residents of Dhaka and they continue to absorb most of the new migrants (Islam 2005).

[6] Khulna is the third largest city in Bangladesh. The population of the city was estimated to be around 1.2 million in 2009 and population density was 21,000 per sq km.

Khulna and Faridpur cities. In Dhaka, septic tanks and pits in the whole city do not require emptying as they are either covered by the sewerage networks or connected to the storm drainage or other drainage systems. Therefore, sample households were drawn from several pockets areas mainly in the fringe of the city which require emptying. A total sample of 467 household for Dhaka, 395 households for Faridpur and 358 households for Khulna were selected and interviewed using a semi-structured questionnaire. In addition, relevant stakeholders were consulted, secondary data were reviewed, pits and septic tanks emptying work were shadowed to generate accurate information.

Results and analysis

Latrine technology and usage practices: In Khulna, most household latrines have septic tanks and the number of pits is much less compared to the other two cities. In Faridpur and Dhaka cities, the distribution of septic tanks, pits and VIPs is almost equal.

Table 1: Access to different types of toilet

Toilet types	Dhaka %	Khulna %	Faridpur %
HH with no sanitation	0.77	0.77	1.98
HH with septic tank	38.90	67.98	32.22
HH with pit latrines	29.97	6.05	33.96
HH with VIP latrines	30.36	25.20	31.73
Total	**100**	**100**	**100**

Probably because of less land availability, the size of septic tanks and pits is smallest in Dhaka compared to the other two cities. Average size of septic tank is biggest (19.81 m^3) in Faridpur. The size of the pits is also biggest in Faridpur compared to the other two cities.

Table 2: Average size of septic tanks and pits (in m^3)

Tank type	Dhaka	Khulna	Faridpur
Septic tank	13.7	14.4	19.81
Pit	2.47	3.13	3.26

Access type of toilet: In Dhaka, the sample is not representative for the city. Therefore the picture that shows the access type might have been confusing. In the other two cities, households predominantly use personal toilets. In Khulna, the higher percentage of households use shared latrines. In some low income housing complexes, multiple families share a latrine. On the other hand, community latrines are mainly constructed by the NGOs in low income settlements which are usually used by an average of 20 families.

Table 3: Access types of toilets

Access type	City		
	Dhaka	Faridpur	Khulna
Personal	22.9	84.1	62.0
Joint	73.4	15.7	36.9
Community	3.6	0.3	1.1
Total	100.0	100.0	100.0

[7] A total of 135,837 people live in an area of 22.39 sq.km of the Faridpur city. The city is considered to be a high density city with an estimated growth rate of over 3.91 per cent annually. About 10 per cent of the city dwellers live in slums and squatter settlements in the city.

The average number of households sharing a latrine is much higher in Dhaka compared to the other two cities. Average 7.6 households share a latrine in Dhaka while 3.43 households share a toilet in Faridpur and 5.74 households per toilet in Khulna. However, the average user per septic tank/ pit is much higher in all the cities; 31.47, 14.85 and 7.24 respectively in Dhaka, Khulna and Faridpur cities. The difference between the user numbers in latrines and septic tank/ pit is mainly because in slum settlements several toilets share a common septic tank/ pit.

Emptying methods: In all three cities, manual emptying is the predominant practice. Compared to the other two cities, a higher percentage of households use mechanical emptying in Dhaka particularly because collected sludge cannot be dumped randomly in the slum settlements in Dhaka due to community pressure. That's why people prefer mechanical emptying so that sludge can be transported outside the neighbourhood. Mechanical emptying service is comparatively easily available in Dhaka being provided by two NGOs that also have other WaSH programmes in many of the studied slums. In the other two cities, this frequency is much less. Particularly in Khulna, only 2 percent households empty their pits or septic tanks mechanically. There is another option whereby emptiers use pump machines to drain out the liquid part from the tank first and then empty the solid part manually but this is seldom practiced.

Table 4: Methods of emptying

Method of emptying	Dhaka %	Khulna %	Faridpur %
HH that use manual emptiers	69.4	96.3	86
HH that use mechanical emptiers	30.1	2	13
Other	0.5	1.7	1

Emptying frequency: In Dhaka, most households emptied their tanks or pits at least once while this is much lower in Faridpur. This is probably correlated to the size of tanks/ pits and number of users per toilet. Tank and pit sizes were higher in Faridpur and lower in Dhaka. Again, frequency of emptying is also higher in Dhaka probably for the same reason. More than a quarter of the pits/ tanks have to be emptied more than once a year in Dhaka.

Table 5: Frequency of emptying

Emptying	**Dhaka %**	**Khulna %**	**Faridpur %**
Emptied at least once	92.50	83.00	77.00
Never emptied	7.50	17.00	23.00
Emptying frequency			
2-3 times / year	26.30	6.80	13.20
Once per year	4.90	0.00	2.60
Once every 2 years	29.30	16.70	23.80
Once every 3 years	15.50	11.90	10.30
Once every 4 years	6.80	11.60	13.20
Between 5 - 10 years	13.60	35.00	26.20
Over 10 years	3.50	18.00	10.60

In choosing a particular emptying process, most people consider the ease of availing of the service. For other people, the choice depends on a combination of factors, such as cost, flexibility of timing and ease of availing of the service. All these factors favour manual emptying. Therefore it is likely that most people use a manual emptying service.

Table 6: Reasons of choosing a particular type of emptying service	
Factors of choice	%
Cheap	23.8
Easy to avail	75
Flexible timing	10
Personally known	6.4

On the other hand, accessing mechanical emptying services from the municipality in the case of Khulna and Faridpur cities is quite a lengthy and bureaucratic process. If someone choses to use the service of a municipality, he has to go to the municipality to collect a form, fill and submit it to the appropriate department. He will then be given a date of inspection by the Municipality. It usually takes 2/3 days to get this date. The purpose of this inspection is to assess the size of the tank and distance of disposal site to fix the rate. Once the rate is fixed, he then has to deposit the money to get the date of the work. It usually takes about a week to complete this processing. Most people usually decide to empty their tank once it is overflowing. Therefore, they cannot wait for so long to use the service of the municipality. As a result, even though some people know about the availability of this service they avoid it. On the other hand, in Dhaka city, most interviewed households who used manual emptying do not know about the availability of mechanical emptying services provided by the NGOs. None the NGOs providing this service do any marketing about it.

Emptying fees: Quite naturally, the cost of manual emptying is comparatively low. As presented in the table below, mean cost of manual emptying was US$ 17.08, US$ 14.33 and US$ 12.6 in Dhaka, Khulna and Faridpur respectively. Quite surprisingly, the cost of mechanical and manual emptying is almost same in Dhaka. This is probably due to the fact that in Dhaka the mechanical service is provided by the non-profit organisations, which do not have any profit motive. They only try to recover their costs. The cost of manual emptying is comparatively high in Dhaka. In Khulna and Faridpur cities, the cost of mechanical emptying is about three times higher than the cost of manual emptying. In these two cities, although the services are provided by the Municipalities on no-profit basis, the cost for the households is higher due to corruption by the emptying staff.

Table 7: Expense of emptying and transportation			
	Dhaka US$	Khulna US$	Faridpur US$
Manually	17.08	14.33	12.60
Mechanically	17.26	39.52	37.52
Semi-mechanically	5.71	17.14	10.71

Willingness to pay: It is not very surprising that most people in all three cities are willing to pay to improve the prevailing situation of faecal sludge emptying and disposal services. In terms of money, the amount they could afford to pay is not very high – the average monthly amount a household could afford to pay is about US$ 1.

Table 8: Willingness to pay for the service			
Willingness to pay	City		
	Dhaka	Faridpur	Khulna
Yes	71.30	80.30	71.80
No	28.7	19.7	28.2
Total	100.0	100.0	100.0

Transportation and dumping: It is a great environmental concern that in most cases, collected sludge is not managed in an environmentally safe way. Sludge is released randomly ('here and there') or dumped into open drains or water-bodies which contaminate surface water. In 18.2 percent of the cases in Faridpur, 30.6 percent of the cases in Dhaka and 24.5 percent in Khulna, collected sludge is dumped in a particular place which is a designated site to dump solid waste. But in no cases does this prevent sludge form contaminating surface water.

Table 9: Destination of extracted sludge

What happen to extracted sludge?	City		
	Dhaka	Faridpur	Khulna
Dumped here and there	2.3	0.3	2.4
Dumped into open drain	43.5	4.2	30.0
Dumped in a particular place (undesignated)	30.6	18.2	24.5
Put into a mud-hole and covered with mud	8.3	75.2	39.7
Open Water Body	15.3	2.1	3.4
Total	100.0	100.0	100.0

Although collected sludge often goes into open, most people stated that they are aware of its negative consequences. In Dhaka, more than 60% of the respondents expressed their concern that putting sludge here and there contaminates water, affects human health and has negative consequences on environment in general. In the other two cities, although this percentage is lower compared to Dhaka, there is certain level of awareness among people about negative consequences of this act.

Table 10: Views about the consequences of sludge disposal

Parameters	**Dhaka %**	**Faridpur %**	**Khulna %**
Contaminate water	60.2	43.5	27.1
Human health	61.0	42.5	29.6
Environment	63.6	47.6	39.1

FSM emptying technologies

As mentioned in earlier sections, faecal sludge emptying in all three cities is overwhelmingly done by the manual sweepers. Faridpur and Khulna Municipalities and two NGOs in Dhaka also provide this service through vacu-tug machines. However, their service is constrained by a number of factors. The manual emptying is most hazardous as the sweepers usually do not use anything other than some buckets and a plastic drum for transport. These manual sweepers do not even use hand gloves to avoid contact with sludge. In few instances, they use pump machines to pump out liquids from the septic tank or pit and then manually empty the remaining solid sludge manually. This saves time but the liquid is usually pumped out to nearby drains, cannels or waterbodies. Thus, the method is extremely harmful for both the emptier and the environment.

The mechanical emptying systems available in the Khulna and Faridpur cities are not efficient enough and not a popular option in the cities although considering the market size (described in a later section), they have huge potential. In an absence of a proper dumping site for faecal sludge and functional treatment facilities, emptying and transportation through this system have only limited benefits. In the end, collected sludge through this system is dumped into open drains, canal and water-bodies.

On the other hand, the NGO-run emptying service is Dhaka is environmentally sound since the collected sludge is put into the sewer lines which then end up in the treatment plant. However, since a high number of septic tanks in Dhaka are connected illegally with the storm sewerage or other drainage systems, there is not much demand for the service provided by the NGOs.

Faecal Sludge Treatment Plant

In Faridpur, the only faecal sludge treatment plant was constructed in 2009 but has not been tested nor commissioned yet. As a result, some of the elements of the plant have already been damaged. The plant is located on the edge of the city, about 5 km away from the city centre. The size of the plant is 864 $feet^3$ and can treat 15.31 m^3 in six months treatment time. Therefore, the annual treatment capacity of the plant is 30.62 m^3 which can only serve 0.45% of the total volume of sludge generated annually in the city.

In Dhaka, a faecal sludge treatment plant was constructed by Dhaka WASA (Dhaka Water Supply and Sewerage Authority) at Pagla, Narayangonj on 300 acres of land in 1980. The plant was upgraded in 1992 with the support from JICA. It has a treating capacity up to 1.25 million m^3 of sewage and has 4 sludge lagoons for the treatment of sludge produced by the plant. The sewerage network in the city has 22 lifting stations. It serves the need of around 20% of sewage generated in the city (Rahman 2009). In Khulna, there is no treatment plant available but there is a plan to set up one taking a few years to become operational.

Dumping sites

There is no dumping site designated for FS in any of the cities; however, there are dumping sites available in Faridpur and Khulna used for solid waste (not designated sites although waste disposal is allowed to fill the land). These are also used to dump FS. Although it was not possible to collect data about the percentage of FS dumped into these sites, observations suggests that less than 5% of the faecal sludge is dumped into these sites. The sites are not very safe from an environmental point of view. There are many residential areas in close proximity and the liquid part of the waste directly goes to open water-bodies which are frequently used by people for bathing and washing purposes.

Demand vs. supply of service provision

In the absence of any sewerage network or drainage system, Khulna and Faridpur have relatively larger markets for emptying and treatment service provision compared to Dhaka. Dhaka has a sewerage network and a treatment plant which covers approximately 20 percent of the total sludge generated in the city. Although there is no study available; however, it is estimated that nearly 70 percent pits/ septic tanks in the areas that are not under sewerage coverage in Dhaka are connected to storm drainage system or other type of drains. These tanks and pits do not require any emptying service. As such, effective demand for on-site sanitation is quite low (only about 10%, as shown in the table below) compared to the sludge generation in Dhaka. On the other hand, as shown in the table below, coverage under OSS in Khulna and Faridpur is 98.23% and 98.5% respectively which demand emptying, safe transpiration and treatment. Therefore, it is assumed that both the cities have high demand of improved and affordable service. This demand is growing rapidly with the growth of population.

Table 11: Demand estimation for on-site sanitation in 3 cities

Description	**Unit**	**Dhaka**	**Khulna**	**Faridpur**
Market size:				
Total population (in 2011)	Number	15,018,594	1,728,760	146,667
Total Household (in 2011)	Number	3,337,470	384,169	24,840
Production of Faecal Sludge				
Total production of FS*	m^3	2,740,893	315,499	26,767
Coverage under sewerage system	%	20.00	0.00	0.00

Coverage under drainage	%	69.23	0.00	0.00
Open defecation, hanging, etc.	%	0.77	0.77	1.50
Coverage under OSS	%	10.00	98.23	98.50
Coverage under OSS	m^3	541,585	815,276	25,434
Treatment plant coverage				
Number of treatment plant	Number	1	0	0
Coverage by treatment plant	m^3	548,179	0	0
Coverage of treatment plant	%	20	0	0

*0.5 ltr per person per day including grey water

The market share of each category of service providers was assessed for 3 cities, as shown in the table below. The supply-demand gap analysis clearly suggests that the manual emptiers fully control the markets of on-site sanitation in all 3 cities. The mechanized emptying business therefore has huge potential to penetrate the markets which could effectively contribute to the reduction of environmental pollution caused by current improper management of faecal sludge.

Table 12: Present coverage by different categories of service providers

Description	**Dhaka**		**Khulna**		**Faridpur**	
	m^3	%	m^3	%	m^3	%
Coverage by informal providers (manual)	562,829	99.67	883,384	99.03	90,005	99.84
Coverage by formal providers (mechanized by NGOs)	1,860	0.33	0	0.00	0	0.00
Coverage by utility department (mechanized)	0	0.00	8,667	0.97	144	0.14
Total	564,689	100.00	892,051	100.00	90,149	100.00

Conclusions and ways forward

Despite the fact that there is huge business potential, the mere absence of proper FS management service in Bangladesh by the public and private sectors strongly indicates that there is a widespread lack of understanding and awareness about its health and environmental impacts as well as its economic value. This study also suggests that the regulatory mechanism is unclear, enforcement is seriously weak and government service agencies lack capacity, motivation and resources to handle this huge challenge. Despite good intentions, this state does not allow NGOs to play an effective role to improve the situation.

This study therefore highlights the importance of working at different levels and with different pilot approaches so that the successful working model can be scaled up. The country context as well as the regulatory framework demands that municipalities take responsibility for FS management. However, there is a serious lack of awareness; and huge resource and capacity gaps amongst the municipalities to manage FS. A potential way forward could be awareness raising as well as advocacy and lobbying at the national level based on a demonstrated business model of comprehensive FS management in municipalities by the NGOs in partnership with.

Government-NGO collaboration models could be limited to piloting service delivery models for emptying and transportation by the NGOs while Municipalities to allocate space for dumping and installation and running of treatment plants yielding bio-gas, compost, and so on. Different modalities should be experimented with different types of municipalities (large, medium and small) so that the successful demonstration of pilot schemes would be advocated for nationwide scaling up through public-private partnership.

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