Landscape Analysis and Business Model Assessment in Faecal Sludge Management: Extraction and Transportation Models in Bangladesh

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Final report – Bangladesh

20 October 2011

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Executive Summary

A well-coordinated effort over the past few years in Bangladesh has made it possible to reduce the rate of open defecation significantly. However, this rapid increase of fixed place defecation through different on-site technologies has created a new challenge of faecal sludge management that is yet to receive attention. This study which is part of a multi-country study coordinated and funded by the Bill and Melinda Gates Foundation provides evidence from three major cities of Bangladesh that in an absence of any safe emptying, transportation, dumping, treatment and disposal mechanism in the country, most of the sludge generated are going again to the surface water that ultimately shatter the gains achieved through increased sanitation coverage.

With predominant on-site technologies, most septic tanks and pits require emptying at certain interval, which is mostly done manually by the sweepers. The emptied sludge is usually dumped in nearby open drain or water-body. This practice ultimately regenerates the risks of faecal matter re-enter into the domestic environment. Poorer groups who mostly dwell in unsafe environment are most sufferer of this; however, the risk remains also high for those who practice safe sanitation.

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. Regulatory mechanism is unclear, enforcement is seriously weak and government service agencies lack capacity, motivation and resources. Despite good intentions, this state does not allow NGOs to play an effective role to improve the situation.

This study also suggests that without a comprehensive system, mere introduction of a business model comprising one or two components by private sector agent may not be a standalone solution to address this huge problem. It is therefore important to work at different levels and pilot different approaches so that the successful working model could be scaled up.

The country context as well as the regulatory framework demands the municipalities to take the responsibility of FS management. However, there are serious lack of awareness; and huge resource and capacity gaps amongst the municipalities to manage FS. Awareness raising as well as advocacy and lobbying at the national level based on demonstrated business model of comprehensive FS management in municipalities by the NGOs in partnership with municipalities could be a potential way forward.

Government-NGO collaboration model could be limited in piloting service delivery models for emptying and transportation by the NGOs while Municipalities to allocate space for dumping and installation and running of treatment plant yielding bio-gas and compost (under experimentation by WaterAid). Different modalities should be experimented in different types of municipalities (Large, medium and small). Successful demonstration of pilot schemes would be advocated for nationwide scaling up through public-private partnership.

1. INTRODUCTION

As the countries in the developing world are moving towards increased sanitation coverage, the issue of safe handling of sludge has emerged as an important and challenging issue of concern. Cities of which most parts practice on-site sanitation, emptying septic tanks or pits, and transporting sludge to a safe dumping site for treatment becomes an emerging need. If safe disposal is not guaranteed, gains attained by increased coverage are shattered.

There is a serious dearth of research and literature; however, anecdotal data shows that when full, latrines are emptied either mechanically or manually. While mechanically emptied sludge can be transported and disposed of several kilometres away from people's homes, the manually emptied sludge from low income areas is usually deposited into nearby lanes, drains or in open piece of lands. These practices represent a significant risk to public health and have a high disease impact on emptying operators, their families, the households living in the immediate area and on vulnerable populations in latrine-based cities. As a result, the existing research tends to focus on health risk implications and the impacts of such practices on the environment.

Research about faecal sludge emptying and transportation service delivery is both limited and weak. There are considerable knowledge gaps about faecal sludge emptying as a service, and its effectiveness as a component or an integrated part of cities sanitation service provision. Indeed, most focus on either household latrine acquisition or on treatment/reuse options. Existing data and knowledge about the market drivers and constraints on non-piped sanitation services, from the time the pit is emptied to when the contents of the pit are disposed off (whether at a treatment site, or directly into the environment), is extremely limited to non-existent.

It is acknowledged that for the extraction-transportation market segments, governments play a limited role- with most of the work conducted by private individuals and organizations (MSMEs), often on an informal basis, with limited involvement and oversight from government / utilities. Further, while there is some individual knowledge of pit emptiers and truckers, and some high level rapid assessments of septage management, there is extremely limited research that provides useful information to inform investments by governments, donors, or development partners in a way that will benefit low-income.

Given this state of knowledge, Bill and Melinda Gates Foundation has initiated this research project, conducted in five countries in Asia and five countries in Africa to explore the areas of governance, management, business and operating models for faecal sludge extraction, transfer, and transportation. This includes a mapping of how transactions happen between or among service providers and individual households, government agencies, treatment and disposal sites, and other customers, as well as the technologies used, the market size and business models. The purpose of this

research is to inform the sanitation sector, for the purpose of informing more in-depth empirical research and investments by governments, donors and other development partners, in order to develop a better understanding of this area of sanitation service delivery. This report presents the finding of Bangladesh country study.

2. COUNTRY BACKGROUND

2.1 County context

Bangladesh is considered to be one of the densely populated countries in the world with over 160 million people[1] in a land area of just 147,570 sq km. Although, the country faces a number of micro and macro economical challenges, in the recent past, the country has maintained a steady growth rate. The MDG progress report[2] suggests that the country has been convincingly moving towards achieving most of the MDG targets except maternal mortality and achieving universal water and sanitation. Most importantly, the report suggests that the country is on track to achieve targeted prevalence of poverty by 2015, however, rising inequality is offsetting some of the gains in poverty reduction, the report noted.

The recent government data suggests that the incidence of poverty has come down to 31.5 per cent in 2010, which was 40 per cent in 2005. The depth and severity of poverty have also declined. Poverty gap has declined from 4.6 per cent in 2005 to 3.1 per cent in 2010 and squared poverty gap has declined from 1.3 per cent in 2005 to 0.8 per cent in 2010. As a result, the overall calorie intake per capita per day also increased by 3.6 per cent and other indicators of quality of life improved. The report further suggests that the concentration of income has slightly decreased. The Gini co-efficient of income decreased to 0.458 from 0.467 in 2005[3].

2.2 Country sanitation status

Sanitation is still one of the biggest challenges for Bangladesh although it has made some good progress in increasing sanitation coverage during 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 (CLTS) approach has made it possible to bring down the percentage of open defecation from 43% in 2003 to 4.4% in 2011[4]. Despite this significant gain, the challenge still remains high as about half of the population do not have access to safe sanitation[5]. The 2010 WHO-UNICEF Joint Monitoring Program (JMP) report shows that only about 53% of the population has access to improved sanitation facilities. Besides, 25% and over 15% of the population has access to shared and unimproved sanitation

[1] 2010 World Population Data Sheet - Population Reference Bureau
[2] GoB, 2010, The Millennium Development Goals: Bangladesh Progress Report 2009
[3] Bangladesh Bureau of Statistics, 2011, Household Income and Expenditure Survey 2010 (Preliminary Report), Statistical Divsion, Ministry of Planning, Government of Bangladesh.
[4] *Ibid.*
[5] GoB and Unicef, 2009, Progotir Pathey: Multiple Indicator Cluster Survey 2009 (Volume 1: Technical Report)

facilities respectively. This means that more than 94% of the population has access to latrine facilities irrespective of their quality.

2.3 Urbanisation and urban sanitation

Bangladesh is experiencing a rapid urbanization process as more and more people from rural areas come and settle in the cities for variety of reasons. Urban population in Bangladesh have grown from 5 per cent in 1971 to 28.1 per cent in 2010, suggesting that approximately 46 million people are currently living in the urban areas. The United Nations Population Division estimates that with a current annual growth rate of over 3 per cent, the urban population of Bangladesh will reach 53 million in 2015, representing just less than a third (30 per cent) of the total population[6]. This unplanned but rapid pace of urban growth without commensurate development has posed a huge challenge for the service agencies to provide necessary supports to the growing population.

Urban sanitation in Bangladesh is a big challenge but still an area that is 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 (FS) 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"[7].

3. METHODOLOGY

3.1 Situation analysis methodology

This study was conducted in three cities in Bangladesh: Dhaka, Khulna and Faridpur. Data was collected during June to September 2011 by a group of 8 trained research assistants. Fieldwork in each city was supervised by two supervising staff and technical experts of the project. The study is based on two types of information: household level information and business level information.

At the household level, considering 95% confidence level, 5% margin error and at best (50%) probability of picking a choice of sample as well as Probability Proportional to Size Cluster Sampling Technique, a total sample of 467 Household for Dhaka, 395 Households for Faridpur and 358 Households for Khulna were selected and

[6] World Urbanization Prospects: The 2009 Revision Population Database (http://esa.un.org/unpd/wup/unup/index_panel3.html)
[7] Rahman, M. M., Sanitation Sector Status and Gap Analysis: Bangladesh, Global Sanitation Fund, WSSCC, September 2009

interviewed. In Khulna and Faridpur, respondents were selected from each city Wards[8]. This means that the finding of the study is valid for the whole city. In Dhaka, all the city Wards do not require emptying as they were linked with either sewerage or storm drainage systems, so households were selected from nine pocket areas in different Wards where some households are required to empty their pit or septic tanks at a certain frequency. Even in a pocket area from which sample households were selected for interview, not all households need to empty their pit. Those who do not have any way to connect their tanks to any type of drain only need emptying.

In Khulna and Faridpur, Wards were considered as Primary Sampling Unit (PSU) and allotted number of households was selected by a serpentine procedure. In Dhaka, this procedure couldn't be employed since number of households that require emptying is not much and they were difficult to find out. Location specific population data is not available in Dhaka.

In each city, a supervising researcher was available in the field to provide support to the interviewer as well as on the spot checking of data quality and validity. The household level interview data were entered, processed and analysed on SPSS.

Business level information was mainly collected by the financial expert of the research project and one research assistant with finance background. The financial information was analysed on Excel. Important stakeholders in different cities were interviewed by the key research members.

3.2 Household survey design

The household survey was designed to explore a number of issues in line with the common analytical framework used in the study for all 10 participating country studies. The issues include, socio-economic profile of the household, living condition of the household including access to drinking water, sanitation facilities, service of FS extraction, perception on improvement, conditions of improvement, involvement and role to be played by each category of stakeholder. Overall, the survey data was useful to describe the following issues for a city:

- Water and sanitation coverage in the city;
- Types of on-site sanitation facilities and their distribution in the city;
- Quantity of faecal sludge produced per year;
- System and scale of FS extraction and transportation (manual, mechanical)
- Frequency of FS extraction and transportation;
- Cost of the service (current and expected);
- Challenges faced by households;
- Willingness to improve FS Management (FSM) in the city by the households

[8] Faridpur city is divided into 9 Wards and Khulna city is divided into 32 Wards. Ward is the smallest local government unit.

3.3 FSM practices and data collection

Faecal Sludge (FS) is the partially or fully decomposed or even un-decomposed residue of faecal matters. In Bangladesh the main sources of faecal sludge are on-site sanitation systems like septic tanks and pit latrines. In the treatment of faecal matters, the settled residues of primary clarifier are termed as Primary Sludge, while residues of secondary clarifier after biological treatment are called Secondary/Activated Sludge but both are of faecal origin. Faecal Sludge Management (FSM) involves collection, transportation, treatment and disposal of faecal sludge. In this report, collection (emptying) and transportation have been given greater emphasis in the absence of adequate off-site treatment and disposal facilities of FS in Bangladesh.

Information on FSM practices was collected in each city using a number of techniques. However, since much of the emptying is done by the manual sweepers, a number of emptying and transportation work was directly observed by the research assistants in all 3 cities (5 in Faridpur, 5 in Khulna and 3 in Dhaka). Detail information (time and duration, number of sweepers, tank size, equipments used for emptying and transportation, dumping sites, cost, etc.) was recorded in a pre-designed observation format. Twenty manual sweepers were also interviewed in each city. Only in a few cases, households in all 3 cities used mechanical emptying. The work of these emptier were also shadowed by the research assistants and observations recorded for analysis. In Faridpur and Khulna, sweepers, drivers, and staff members of the municipality responsible for mechanical emptying (staff in the conservancy department) were interviewed.

3.4 Methods to validate financial data

Financial information of the mechanical service providers was collected by the business consultant of the research project. In all cases, the consultant was allowed to check the books and financial records of the service providing agencies. This was mainly possible because the two agencies (two local NGOs: DSK and PSTC) that are providing mechanical services in Dhaka are supported by WaterAid, and there are on-going programmes of WaterAid with the Municipalities of Faridpur and Khulna. This relationship was important which mainly created access of the researchers to important financial information. Manual emptiers do not keep any record of their income data. So, they were asked to recall their income for the last 3 emptying services, the average of which was considered as their income.

3.5 Treatment plant and dumping site model

There is no treatment plant or designated dumping site for FS available in Khulna and Faridpur cities. However, in Khulna there is an official dumping site available for domestic waste disposal. In Faridpur, an informal dumping site is available for the same purpose. Both these sites were observed if any FS sludge were dumped in those places. These sites do not charge any fee, therefore, do not generate any revenue. In

Faridpur, there is a new FS treatment plant constructed recently which is not yet in operation. However, detailed information about its capacity, technical design, etc was collected. FS will be anaerobically digested in this small-scale treatment plant and the digested sludge will be used by a nearby solid waste composting plant to produce manure for sale. In Dhaka, there is one official sewage treatment plant available which receives sludge through a piped sewer network. The treatment plant only covers about 20% of the total sewage generated in the city[9]. FS is allowed to be emptied in the designated manholes of the sewer network. But the private emptiers discharges FS in any nearby sanitary or storm drainage manholes or even in any low lying ditch.

3.6 Determination of financial flows and key stakeholders

Manual emptiers directly charge the households for their services. Municipal authorities in Khulna and Faridpur have their designated staff members to provide emptying and dumping services. Two NGOs in Dhaka city which are involved in FS emptying business have full time and on call basis employees for emptying and dumping activities.

3.7 Market size calculation, FS production and collection computation

The market size in different cities has been assessed in two ways: a. theoretical analysis, b. empirical analysis.

Theoretical analysis is based on the population size, number of household and two separate rates for faecal sludge production in pit latrine and septic tank. The figure is adjusted by considering only the on-site sanitation requirement. Pits and septic tanks connected to sewerage system, storm sewerage, etc do not require any emptying service. These facilities have been excluded to come up with the actual demand. Therefore, this analysis is valid for all three cities in general.

Empirical analysis is based on the same population size and number of household. However, the number and size of pits and septic tanks drawn from survey findings have been the basis of calculation. Therefore, this analysis is valid for whole city of Khulna and Faridpur but part of the Dhaka city.

3.8 Financial analysis methodology

Income statements were prepared for the agencies (NGOs and municipalities) engaged in mechanized emptying. Income statements for manual emptiers were also prepared to compare their performance with the mechanized emptying. A detailed analysis of financial viability was done on the business model proposed for 3 cities in

[9] Rahman, M. M., Sanitation Sector Status and Gap Analysis: Bangladesh, Global Sanitation Fund, WSSCC, September 2009

Bangladesh. The analysis covered income statements, break-even points, IRR, NPV, ROE, etc along with the change in inflation rate and level of efficiency of the company in different years.

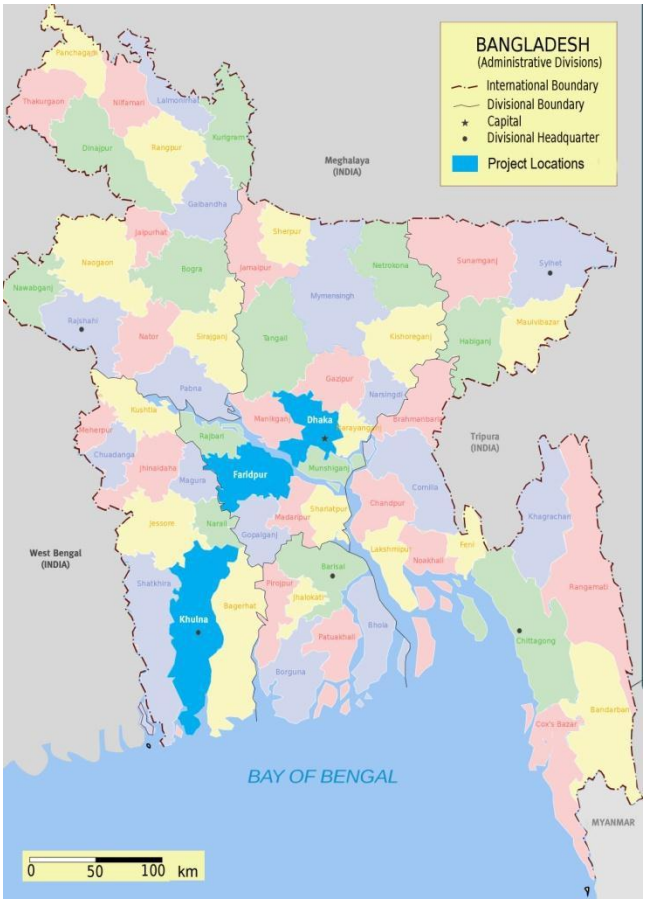
4. RESULTS AND ANALYSIS OF URBAN FSM PRACTICE

4.1 *Situational analysis of extraction/transportation*

4.1.1 Demographics of the three cities

Dhaka: The capital of Bangladesh, Dhaka is the city with the highest population growth in the world. With its current population of more than 14 million, and with its current growth rate of over three per cent, Dhaka bears the distinction of being the fastest-growing cities in the world. Nearly half a million migrants flow into Dhaka each year to try to make a living in the city due to various push and pull factors. If this trend continues, predictions show that by 2025, Dhaka will be home to more than 20 million people[10] — larger than Mexico City, Beijing or Shanghai.

Dhaka accommodates more than one-third of the total urban population and about nine per cent of the total population of the country in an area of 797 sq km. Population density, therefore, is extremely high with 27,700 people living per square kilometre. 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 every year.[11]



Khulna: Situated in South Western part of the country, Khulna is the third largest city in Bangladesh. It's an industrial city. Its economy experienced an upsurge in the 1990s with the rapid growth of shrimp cultivation and processing and the establishment of two major universities. The population of the city was estimated to be around 1.2 million in 2009 and population density was 21,000 per sq km. The number of private (non-institutional) households in the city was estimated to be

[10] United Nations Population Division: World Urbanization Prospects: the 2009 Revised Population Database. (http://esa.un.org/unpd/wup/unup/p2k0data.asp)

[11] Islam, N. 2005. *Dhaka now: Contemporary Urban Development*, Bangladesh Geographical Society, Department of Geography and Environment, University of Dhaka.

in the order of 250,000 and is increasing by around 8,000 annually[12].

Faridpur: Faridpur is one of the oldest municipalities in Bangladesh. Situated in the central part of the county, the city is about 150 km away from the capital city. It was established in 1869 and then upgraded into a category A municipality in 1986. Like other municipalities of the country, Faridpur is also divided into 9 wards and is governed by an elected Mayor and a team of nine Ward Commissioners. A total of 1,35,837 people live in an area of 22.39 sq.km of the city. The city is considered to be a high density city with an estimated growth rate of over 3.91 per cent annually. About 68 per cent of the people own their house in the city and the remaining 32 per cent live in rented house. About 10 per cent of the city dwellers live in slums and squatter settlements in the city. Poverty level is very high in the city. Among non-slum households, nearly 90 per cent have monthly income less than the national average income (US$ 164) and less than the national average income for urban areas (US$ 235.38). Among the slum households, not a single household has income more than the national average income[13].

4.1.2 Drinking water supply coverage

There is piped water networks in all the cities included in this study. However, this piped water coverage is not full for any of the cities.

Dhaka: The whole city is covered under the piped water supply system. However, not all the households have legal access to piped water. The slum dwellers, which are about one third of the whole city, are not legally entitled to get a water connection in the dwellings. So they usually get illegal connections from a nearby pipe line. For the last few years, some NGOs facilitated a process whereby some slum dwellers are provided with legal connections. In these cases, a water-point is installed for a group of users. Coverage data for this type of special access is not available.

On the other hand, since the water supplied through this piped system in some areas is not satisfactory in terms of bacteriological and aesthetic quality, a good number of people now using purified water for drinking purposes, supplied by some private water companies. Coverage data is not available for this group of special consumers.

Khulna: piped water supply system covers about 60 per cent of the city but about 95 per cent of the city dwellers do not use this water for drinking purposes because of high level of salinity in the supplied water. They, therefore, use privately owned tube-well water. Like Dhaka, slum households in Khulna also do not have access to piped network. They therefore use tubewell water for their drinking and other purposes.

[12] http://www.khulnacity.org (official website of Khulna City Corporation)
[13] Faridpur Municipality, 2010, Situation Analysis Report, Second Urban Governance and Infrastructure Improvement (Sector) Project (UGIIP-2)

Faridpur: piped water supply system covers about 65 per cent of Faridpur City. Like Khulna, despite having access to piped water, many people in this city do not drink piped water but the reason is different. Faridpur is one of the cities in Bangladesh with very high level of arsenic and iron contamination in ground water[14]. The city operates a iron-arsenic removal plant but many prefer to drink privately owned tubewell water which they test and rely on. Like other cities, slum dwellers in this city do not have access to piped water service, so they completely rely on tubewell water.

4.1.2 Sanitation coverage

Open defecation is negligible in the cities of Bangladesh, which is less than one per cent on an average according to 2011 data. However, in terms of safe sanitation, the situation is not very satisfactory. City wise data is not available to have a sense of real picture.

Dhaka: sanitation coverage scenario in Dhaka is quite mixed. About one-fifth of the city is covered with a sewerage network, although this figure is estimated by the service providing agency. Rest of the city should ideally be having onsite sanitation but due to a lack of enforcement, a huge number of septic tanks and pits are connected with the storm sewer networks and other surface drains. These facilities require emptying at regular intervals to increase retention capacity and on-site treatment efficiency. As the faecal matters find alternative way to enter into storm drains, the households do not feel the urge to empty their septic tank or pit latrine. In slum settlements, shared latrines are most common[15].

Khulna: there is no sewerage network in Khulna city. Therefore, most of the toilets are onsite facilities, like pit latrines or septic tanks. Toilets with septic tanks are much higher. 68.4 per cent toilets have septic tanks and the remaining 31.6 per cent toilets are with pit[16]. Despite the fact that the city has a drainage network, households seldom connect their septic tanks with the drainage network like Dhaka city.

Faridpur: there is no sewerage network in Faridpur city. Therefore, most of the sanitation facilities are onsite system with pit or septic tanks. Toilets with septic tanks are not much compared to the situation in that of Khulna. About 32 per cent toilets have septic tanks, 65 per cent toilets are with pit and the remaining 2% do not have a toilet[17].

4.2 Institutional and legal framework

Urban sanitation services are carried out by various agencies and authorities. The water, sewerage and storm-water drainage sector in Dhaka come under a governance

[14] GoB and Unicef, 2009, Progotir Pathey: Multiple Indicator Cluster Survey 2009 (Volume 1: Technical Report)
[15] Rahman, M. M., Sanitation Sector Status and Gap Analysis: Bangladesh, Global Sanitation Fund, WSSCC, September 2009
[16] Source of data: Landscape data collected by the survey.
[17] Source of data: Landscape data collected by the survey.

and legislative framework specifically applicable to Dhaka i.e., the Water and Sewerage Authority (WASA) Act (1996). In Khulna too, the Khulna WASA is responsible for the same. In the cities where no WASA has yet been established, the respective Water Supply and Sewerage Sections of City Corporations[18] or Municipalities[19] are responsible for WSS services. Faridpur municipality looks after the WSS services in Faridpur town.

According the Local Government Act (2009, section 50, sub-section 2), it is the duty of the Municipality to manage all types of wastes that include FS, solid waste, liquid and industrial wastes. Further to this, Schedule II of the Act describes the responsibility of a municipality in detail under 'Public Health' sub-section, which empowers the municipality to do the needful permitted under this Act. As per this act and provisions, the municipality will provide/identify places for dumping of wastes and instruct the city dwellers to follow the guidelines for dumping of wastes. But, this does not include faecal sludge while the definition of 'garbage' (stated in Section 2 of the Act) includes the issue of faecal sludge. Although the municipality supposed to prepare and disseminate detail guidelines, this is not yet done. The respective authorities in the municipality are not aware that they suppose to prepare such guidelines.

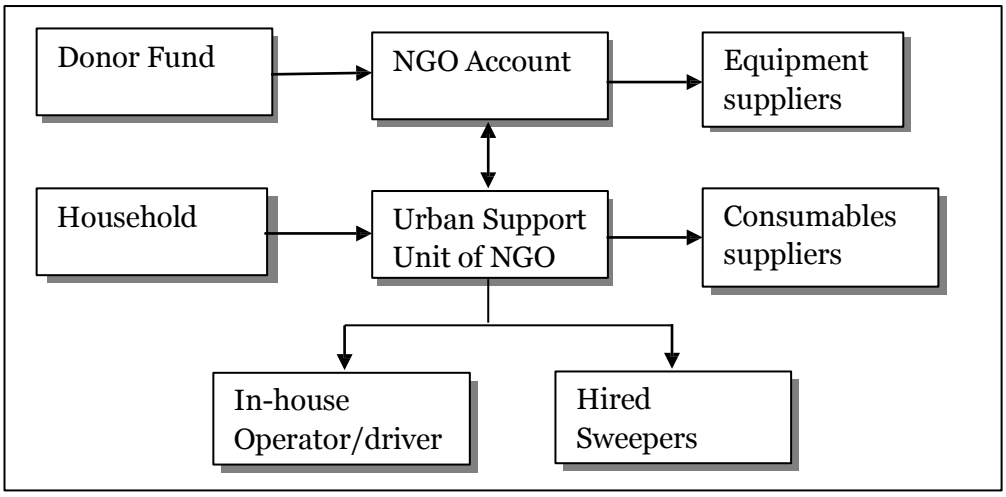
District office of the Department of Environment is an important governmental body to oversee environmental issues at the local level. Presently, their focus is only on water and air quality checking and reporting. They never undertook any initiative or measure against FS contaminating surface water of the city.

NGOs usually do not take any separate licence for their for-profit activities. However, to start with a private business, one has to take a trade licence which is issued by the Municipality with a nominal fee (US$7).

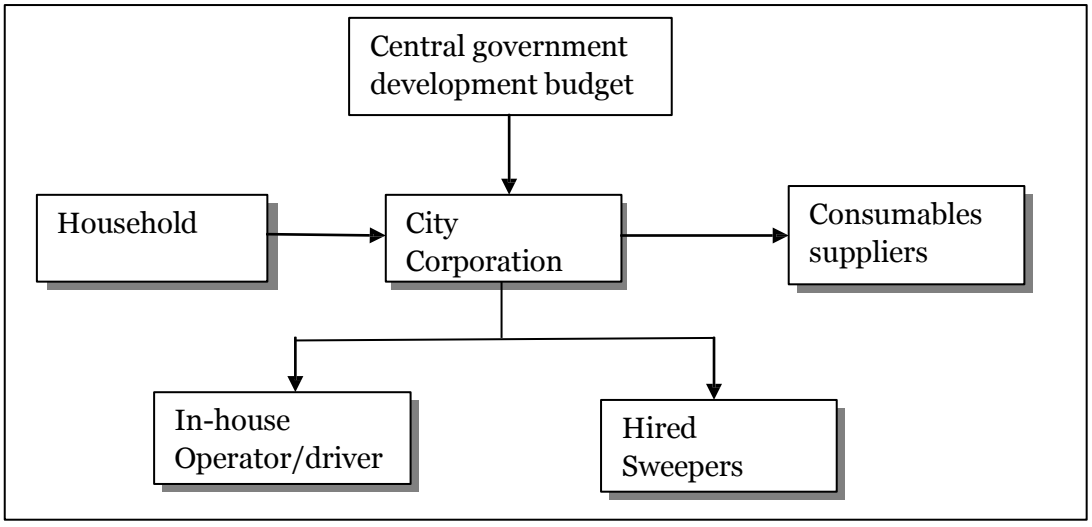
4.3 Flow of money chart FSM transactions

Dhaka: The two NGOs which have been providing mechanical FS emptying services in Dhaka cities are Dustha Shystha Kendra (DSK) and Population Services and Training Centre (PSTC). They initiated the services with financial and technical support from WaterAid. The mechanized FS emptying activities is being provided by both these organisations in a more organised way but they operate almost like a commercial venture. The fee they charge for the service is different for different economic group of clients. For example, low income groups in the slum settlements get a subsidised rate while the industries get a higher rate. The financial flow diagram of NGO operation may be viewed as follows:

[18] City Corporations are usually big cities that include the Capital the Divisional Towns and several other big cities.
[19] Refers to small and medium towns.



Khulna: Although Khulna WASA (Water and Sewerage Authority) was established in 2008 and started its operation in 2009, the sanitation and sewerage related activities are still being carried out by the Khulna City Corporation – KCC. For mechanical emptying purpose, KCC has two tank lorry toed by tractor and equipped with suction pump. KCC procured the lorries and tractors under a project supported by Asian Development Bank (ADB). KCC charges a fee of BDT 2000 (US$ 28.57) for providing service to a household. In addition, they have 5 containers to provide transportation service but collected sludge is usually dumped into open water. As such, the money flows from customers (household, institutions, and industries) to the KCC.



Faridpur: The mechanical emptying service available in Faridpur is provided solely by the Municipality through a vacuum tug (Mark 1). This was procured by partial funding support from Practical Action (an INGO). The contribution of the municipality came from its annual development grant that comes from the development budget of the central government. The municipality charges BDT 2000 (US$ 28.57) for a tank size 10 ft or more deep and BDT 600 (US$ 8.57) for a tank size less than 10 ft deep. However, operators usually charge a higher fee to the households based on their tank size and distance of the disposal point. The fixed fee is deposited to the Municipality account

and the difference is taken by the operator. The flow chat shown above for Khulna city is also applicable for this city.

For the private sector in general, the service of the banking and non-banking financial institutions as well as donor funded projects to finance small and medium entrepreneurship are available in all the cities and they can extend financial/leasing support to FS businesses. Collateral is a mandatory requirement, loan is usually granted for a period of 5 years with 15-17% interest rate.

4.4 FS emptying business owners' profile

As mentioned earlier, FS mechanical emptying in the non-governmental sector is only available in Dhaka. Both the NGOs are registered with the Department of Social Welfare, Government and Bangladesh as well as NGO Affairs Bureau, GoB. The profiles of the two NGOs are given below:

Table 1: Business Owners' Profiles

Description	**DSK**	**PSTC**
Year of establishment	1989	1978
Legal entity	National NGO	National NGO
Commencement of FS emptying business	2000	2009
Source of initial funding	Water Aid	Water Aid
Truck/vacu tug in operation	1 (2 m^3 capacity)	1 (2 m^3 capacity)
Manpower (regular)	3	1
Manpower (on call basis)	1	3
Area coverage	Dhaka city	Dhaka city
No. of pit/septic tank emptied in last year	280	20
Average charge per trip	US$ 7.14	US$ 7.14

DSK gets more trips compared to PSTC is mainly because DSK has a big sanitation programme in the low-income communities in Dhaka City. The toilet structures they construct for their beneficiaries usually take the service from them. DSK has long been in this business. Therefore, they have relatively larger client base who regularly seek the service.

4.5 Household survey results and analysis

Family and income: Average household sizes in three cities are almost similar, as presented in the table below. However, these households sizes is a bit higher compared to the national level household size which is 4.4[20]. The average household per month income and per capita per month income is not very different across the cities.

[20] BBS, 2011, Population & Housing Census: Preliminary Results 2011. Statistical Division, Government of Bangladesh.

Table 2: Basic features of the respondent households

City	Mean Family Size	Mean HH income/month US$	Mean Per capita/month income US$
Dhaka	5.17	244.77	47.34
Faridpur	5.21	258.13	49.55
Khulna	5.30	257.77	48.62
Total	5.22	253.56	48.57

Source: Household survey data

Access to services: Most of the households in all 3 cities have access to electricity connections. Not all households have access to piped water. In Dhaka, a higher percentage of households have piped water in their house. The remaining households in Dhaka do not have water lines in the house but they collect water from shared water points. In Khulna, 41.6% households have access to piped water but they hardly used the piped water for drinking purpose.

Table 3: Access to services

	City		
	Dhaka %	Faridpur %	Khulna %
Electricity	95.7	98.7	99.4
Piped water	74.1	65.3	41.6
Cooking gas	43.5	0	0.3
Land phone	5.6	9.6	13.1

Source: Household survey data

Cooking gas lines are only available in Dhaka but many households do not have access to this facility. In Faridpur and Khulna, there is no gas line but only a few households use liquefied petroleum gas (LPG). Mobile phone is now very cheap and affordable to many households that is why land phone was used a proxy to economic status. Data suggest that not many households in any of the cities have land phone line.

Utility bills: Charges are not very high for either of the utility services. On an average, households in Dhaka spend 7.77% of their monthly income for their monthly utility bills. In Khulna, the utility bill is 5.87% of the average monthly income which is 5.04% in Faridpur.

Table 4: Expenses for services

Services	**Dhaka** US$/Month	**Khulna** US$/Month	**Faridpur** US$/Month
Water bill	4.28	1.39	1.77
Phone bill	6.27	5.47	3.24
Electricity bill	7.82	8.27	8.01
Solid waste collection bill	0.65	Service not available	Service not available

Source: Household survey data

In Dhaka, door to door solid waste (domestic waste) collection facility is available, the charge for which is less than one dollar per month. Door to door collection is entirely done by the private sector. The collected waste by the private operators is then collected by the City Corporation trucks to dump in a particular place of the city to landfill. In Khulna and Faridpur, this service is not available.

Latrine technology and usage practices: In Dhaka and Khulna, high percentage of households has septic tanks connected to their latrines. These septic tanks and pits are not connected to any drainage systems. In Faridpur, the distribution is quite equalised. In Khulna, less number of households uses pits that are not ventilated. In Khulna, the percentage of septic tanks is much higher compared to the other two cities. This is because in Khulna most are buildings for which construction of septic tank is mandatory.

Table 5: Toilet types

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	30.36	25.20	31.73
Total	**100**	**100**	**100**

Source: Household survey data
Note: By Septic tank, it means multi-chamber tanks that have outflows connected to available drains.

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

Table 6: 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

Source: Household survey data
Note: By Septic tank, it means multi-chamber tanks that have outflows connected to available drains. If the tank was single chamber with or without an outflow it was recorded as a pit.

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 average 20 families. In Dhaka, number of slum settlements is much higher compared to the other two cities.

Table 7: 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

Source: Household survey data

Average number of households share a latrine is much higher in Dhaka compared to the other two cities. Average 7.6 households share a latrine in Dhaka which 3.43 household per 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 Dhaka, a high percentage of this non-representative sample of households used manual emptying. As mentioned earlier, these households are picked from some pocket areas which require emptying. Because of pressure of the neighbours, the collected sludge cannot be dumped here and there. That's why people prefer mechanical emptying so that sludge could be transported away.

In the other two cities, this frequency is much higher. Particularly in Khulna, only 2% 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 to solid part manually but practice of this type is very low.

Table 8: 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 (pump out liquid part mechanically and solid part manually)	0.5	1.7	1

Source: Household survey data

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 user 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 in Dhaka.

Table 9: 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

Source: Household survey data

In choosing a particular emptying process, most people consider easiness of availing the service. For others', the choice depend on a combination of factors, such as cost, flexibility of timing and easiness to avail the service. All these factors are in favour of manual emptying. Therefore it is likely that most people use manual emptying service.

Table 10: 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

Source: Household survey data
Note: multiple response

On the other hand, accessing mechanical emptying service from the municipality is quite a lengthy and bureaucratic process. If someone chose to avail 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 avail the service of the municipality. As a result, even though some people know about the availability of this service they just avoid it. On the other hand, in Dhaka city, most interviewed household who used manual emptying do not know the availability of mechanical emptying service provided by the NGOs. None the NGOs providing the service do any marketing about their service.

Emptying fees: Quite naturally, the cost of manual emptying is comparatively lower. 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 making motive. They try to recover their costs but the financial analysis presented in a later section suggests that both the

NGOs are running in loss. 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 11: 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

Source: Household survey data

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 – average monthly amount household could afford to pay is about US$ 1.

Table 12: 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

Source: Household survey data

Transportation and dumping: It is a great environmental concern that in most cases, collected sludge is not managed in an environmentally safe way. They are either put here and there or dumped into open drains or waterbodies which contaminate surface water. In 18.2% cases in Faridpur, 30.6% cases in Dhaka and 24.5% cases in Khulna, collected sludge is dumped in a particular place which is undesignated site usually used to dump solid waste. But in no cases they prevent sludge to contaminate surface water.

Table 13: 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 well 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

Source: Household survey data

Although collected sludge often goes to open, most people consider that they are aware of its negative consequences. In Dhaka, more than 60% respondents expressed

their concern that putting sludge here and there contaminate water, affect human health and have negative consequences on environment in general. In other two cities, although this percentage is lower compared to Dhaka, there is certain level of awareness among people of negative consequences of this act.

Table 14: 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

Source: Household survey data

4.6 FSM emptying practices and technologies

As mentioned in earlier sections, FS emptying in all three cities are overwhelmingly done by the manual sweepers. Faridpur and Khulna Municipalities and two NGOs in Dhaka also provide this service through vacu tug machine. However, their service is constrained by a number of factors (see SWOT analysis below). Some manual sweepers also started to use a kind of intermediate technology to pump out liquid part and then empty solid part manually.

The manual emptying is most hazardous as they usually do not use anything other than some buckets and plastic drum to transport. These manual sweepers even do not use any 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 save 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 system available in the Khulna and Faridpur cities are not efficient enough and not a popular option in the cities although they have considering

the market size (described in a later section), they have huge potentiality. In an absence of a proper dumping site for FS and functional treatment facility, emptying and transportation done through this system has only limited benefits. In the end, collected sludge through this system dumped into open drains, canal and waterbodies.

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 ends up in the treatment plan. 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.

The machine itself has some limitations such as it has no positive pressure to pump the extracted sludge into the treatment plant. This is one of the main reasons the treatment plant constructed few years ago has not been tested and commissioned yet.

SWOT analysis of mechanical emptying services

Strength	**Weakness**
• Less stinky • Harmless for extraction workers • Less time for extraction • No possibility of spreading the FS during extraction and transportation	• Low efficiency • Time intensive (transportation) • Cannot climb more more than 3% steeper slope • Difficult to move through narrow roads • Costly compared to manual service • Difficult to access (high bureaucracy) • Short pipe length • Maintenance difficulty
Opportunities	**Threat**
• Increasing demand • No competition • Creation of entrepreneurship	• High investment cost • Threat for manual sweepers • Inaccessible for low income people • Low acceptance

4.7 Overview of all WWTP, FSTP or dumping sites

Waste Water Treatment Plant (WWTP): the cities except Dhaka have no waste water treatment plant until now and there is no plan at the municipality level to establish one in their next five year plan.

Faecal Sludge Treatment Plant (FSTP): In Faridpur, the only faecal sludge treatment plant was constructed in 2009 which has not been tested or commissioned yet. As a result, some of its features 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 $feet^3$ which can treat 15.31m^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 (volume of sludge generation in the city is presented in a subsequent section). The city has no sewage treatment plant.

In Dhaka, a FS treatment plant was constructed by Dhaka WASA 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 upto 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[21] in the city. In Khulna, there is no treatment plant available but there is a plan to set up one which will take few years to become operational.

Dumping site: 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 a designated site but waste disposal is allowed to fill the land) is also used to dump FS. Although it was not possible to collect the percentage of FS dumped into this site but observation suggests that less than 5% FS is dumped into this site. 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 the open waterbody which is frequently used by the people for bathing and washing purposes.

4.8 FS end re-use in the three cities

A significant percentage of the respondents in all 3 cities thought that FS can be reused. Those who thinks the opposite feels that sludge is too harmful to be reused. Those who have thought that FS can be reused, most of them think that sludge could be reused as manure in agriculture. Others were not quite sure but had a feeling that sludge could be used to generate bio-gas and produce fish feed.

Table 15: Can FS be reused?

Can FS be reused?	City		
	Dhaka %	Faridpur %	Khulna %
Yes	56.1	59.5	60.3
No	17.6	24.6	6.7
Don't know	26.3	15.9	33
Total	100	100	100

Source: Household survey data

4.9 Market analysis per city

4.9.1 Production of faecal sludge

A comparative statement of market size of 3 cities is shown in the table below:

Table 16: Market size in 3 cities

[21] Rahman, M. M., Sanitation Sector Status and Gap Analysis: Bangladesh, Global Sanitation Fund, WSSCC, September 2009

Description	Unit	Dhaka	Khulna	Faridpur
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
Average users per pit/septic tank	Number	31.47	14.85	7.24
Total production of FS (theoretical)*	m^3/Year	2,740,893	315,499	26,767
Coverage under OSS (empirical)	m^3	564,689	892,051	90,149
Coverage under OSS (theoretical)	m^3	541,585	815,276	25,434

*0.5 ltr (average of 0.7 ltr. & 0.3 ltr.) per person per day including grey water

4.9.2 Mix of service offerings

Manual emptying: In Bangladesh, emptying business is predominantly run by the manual emptiers. Manual emptiers are being utilized by almost all levels of customer (HH and others) irrespective of their income or location.

Mechanized emptying **(Utility Department):** Municipalities or water & sewerage authorities are mainly responsible for sanitation and sewerage services. Khulna and Faridpur municipal authorities have trucks and/or vacu tug for emptying facilities, and designated operators to provide the services.

Mechanized emptying **(NGO)**: Two NGOs in Dhaka city alone have been involved in this business. Again, the focussed customers are slum communities covered under direct/ indirect projects run by the NGOs themselves or other NGOs. Some commercial organizations like industry, institute, shopping mall, etc have recently used the services of these 2 NGOs. But, compared to manual emptying business, the volume of business is negligible. They have been offering the services with limited promotional back up as well as awareness rising among the city dwellers and emptier community must be expanded further.

4.10 *Service delivery models review*

4.10.1 Overview of existing models

Manual emptying: Manual emptying is widely practiced in all the urban (and rural) areas of Bangladesh. Although there is lots of hazards and health problem associated with this service; yet, in a country with plenty of labour force with lack of alternative employment opportunities, traditional emptiers are easily available for hiring. As the emptiers community belongs to extreme poor group in the society, they do not have proper awareness on the risks associated with manual bare-hand emptying.

Mechanised emptying by utility department: Municipal authorities of the two cities have mechanical devises (vacu tug, tractors, etc) to provide the service. A fixed rate per emptying is charged, which is supposed to be deposited in advance, if someone wants to avail the service. Since the objective of the municipalities is to provide service instead of making profits out of the service, they hardly make a business plan and strive for profit. On the other hand, the long process, paper work, etc of availing their service keep away people from availing the service.

Mechanized emptying by NGO: The mechanized emptying by the NGO is a recent phenomenon which is run by 2 NGOs in Dhaka city. DSK (since 2001) and PSTC (since 2009) have been doing vacu tug based emptying business with the financial support from Water Aid Bangladesh. Each of the NGO has a vacu tug (2000 ltr capacity) which is toed with a refurbished pick up.

As the volume of business is quite small, they maintain 1-2 full time employees (driver and/or operator) and a part time supervisor (unit in-charge) to run the activities. Usually they hire emptier and additional hand on task basis depending on the volume and complexity of any particular emptying activity.

Both the NGOs have collaborative arrangements with the Dhaka WASA for dumping the faecal sludge in designated lifting points of the sewerage system. In the absence of a sizable volume of market for emptying FS and low price (due to competition with the manual emptiers), they have been running the business almost at breakeven level and striving hard to further expand their business.

Sewerage service: Partial sewerage network only exists in Dhaka city. It covers an estimated 20% of the sewage produced in the city and linked to the only STP of the country. The network STP are run and maintained by Dhaka WASA. DWASA charges the households for sewerage service, which is equal to the cost of water consumed by the HH.

4.10.2 Comparison with solid waste management service models

Door to door collection of solid waste has become an emerging business, particularly in the Dhaka city and few other major cities in the country. In Dhaka and in other major cities (mainly the divisional towns which are called City Corporations) the responsibility of solid waste management falls under the jurisdiction of the City Corporations. However, due to an absence of capacity of the Corporations or due to their lack of initiatives, private sector has come up to provide door to door collection service for a nominal fee. Initially this service was confined in some small areas but gradually in Dhaka alone it has covered almost entire city, providing the service to over 85% of the households in the city. Area based private service providers usually use locally made 3 wheeler rickshaw vans operated by a driver and a collector to collect domestic waste from door to door and take it to a particular place for the trucks of the Corporation to

come, collect and transport them to the particular dumping sites outside the city. This private-public model of collection and transportation of solid waste is working pretty well in Dhaka city. Profitability of these small initiatives has never been studied which was also beyond the purview of this study. However, a rough estimate suggests that these private and informal initiatives are highly profitable.

5. FINANCIAL AND BUSINESS MODEL ANALYSIS

5.1 Financial and Business Model analysis

5.1.1 Current scenario in 3 cities

Faecal sludge management is a demand responsive service that customers request their facility to be emptied. The usual practice is to utilize the services of manual emptier. Although vacu tug/truck based mechanized services have been introduced in 3 cities, many inhabitants are still not aware of this service.

No significant awareness program has been taken for the customers in the city by the service providers. Emptiers working under the municipality are not always using vacu tug for emptying purpose and sometimes they perform the tasks manually. So, the efficiency of vacu tug is under-utilized significantly in case of Faridpur Municipality. On the other hand, NGOs in Dhaka cities have not been getting wider response from the potential households. Linking of latrines directly with the open and/or covered drainage system (storm sewerage) is another critical factor for missing a huge number of customers by the NGOs operating in Dhaka city.

5.1.2 Demand - supply situation

Demand analysis: In the absence of any sewerage network or drainage systems, Khulna and Faridpur have relatively larger market in comparison to Dhaka. Dhaka has a sewerage network covering 20% of the total swage generated and storm sewerage (through covered and surface drainage system) occupies a huge share (70%). As such, effective demand for on-site sanitation is quite low compared to the sludge generation. The calculation made this adjustment to calculate coverage for OSS. Detial of the calculation is provided in the annex excel sheets. A comparative statement on the sanitation coverage of the 3 cities is shown in the table below:

Table 17: 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
Joint/community use of pit/ST	%	77.1	38.0	16.0
Utilization ratio- Joint Pit/ST: HH	Times	7.60	5.74	3.43
Production of Faecal Sludge				

Total production of FS (theoretical)*	m^3	2,740,893	315,499	26,767
Coverage under sewerage system	%	20.00	0.00	0.00
Coverage under storm sewerage (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 (empirical)	m^3	564,689	892,051	90,149
Coverage under OSS (theoretical)	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

Note: i) Average sludge generation rate (including gray water) for pit and septic tank is considered 0.3 ltr and 0.7 ltr per person per day respectively. ii) Number and size of pits and septic tanks are considered to measure the volume of empirical volume of sludge generation.

5.2 Projected demand for next 5 years

A projection of the volume of sludge that needs to be emptied through OSS in the 3 cities is done for 2012 – 2015 in the table below. The projection does not consider the change in proportion of coverage by sewerage or other types of sanitation. The empirical data is considered for demand projection in this case.

Table 18: Projected demand for on-site sanitation (in m^3)*

Year	Dhaka (growth rate: 2.53%)	Khulna (growth rate: 2.78%)	Faridpur (growth rate: 3.93%)
2011	564,689	892,051	90,149
2012	578,976	916,850	93,692
2013	593,624	942,338	97,374
2014	608,642	968,535	101,201
2015	624,041	995,461	105,178

* Based on empirical data and growth rate of OSS is assumed to be as same as population growth rate in each city.

5.3 Supply situation

On the basis of derived data for 2011, on-site sanitation coverage in the 3 cities is shown below. The market share of each category of service providers is assessed for 3 cities.

Table 19: Present coverage by different categories of service providers

Description	Dhaka		Khulna		Faridpur	
	m^3	%	m^3	%	m^3	%
Coverage by informal	562,829	99.67	883,384	99.03	90,005	99.84

providers (manual)						
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

Source: Household survey data

5.4 Demand – supply gap

As seen from the analyses, manual emptiers almost fully control the market of on-site sanitation in Dhaka, Khulna and Faridpur cities. Since the market size is big if service could be provided as an affordable rate, mechanized emptying business has huge potentials to penetrate in all the 3 cities with multiple numbers of trucks and other equipment since .

5.5 Mapping of official treatment/ dumping sites and routing results

Dhaka: A treatment plant was constructed by Dhaka WASA at Pagla, Narayangonj on 300 acres of land in 1980. The plant was upgraded in 1992 with support from JICA. It has a treatment capacity up to 1.25 million m^3 of sewage and 4 sludge lagoons. The sewerage network in the city has 22 lifting stations. It serves the need of around 20% of faecal sludge generated in the city. The rest 80% of faecal sludge generated in the city is linked with storm sewerage (70%) and a very small portion (10%) have effective pit/septic tanks being cleaned, which again thrown away to open water bodies or storm sewerage lines. The pits/septic tanks emptied by the mechanized vacu tug of the 2 NGOs are poured in to the sewerage network of Dhaka WASA (in the lifting points) with due permission from the authority.

Khulna city: There is no FS treatment plant in Khulna city. The sludge collected from pits and septic tanks are being dumped in the nearby open drains or water bodies by the manual emptiers. Khulna City Corporation (KCC) has an open dumping site (10 km away from the city) for solid waste dumping. The trucks of the city corporation drop the faecal sludge in the same dumping area, which is quite harmful for nearby housing areas. There is a network of covered drains in one housing area (Khlishpur) of the city. It has built in reservoir tanks in every 200 – 300 meter and finally linked with a large river. The network covers around 2000 households and 7-10 industries located in the area.

Faridpur city: A small treatment plant was constructed by Faridpur Municipality (5 km away from the city centre) in 2009 with the technical and financial support from WaterAid and Practical Action. But, it cannot be commissioned due to some technical difficulties and lying idle since its construction. An open dumping site for all sorts of waste is located 2.0 km away from the city centre. A small portion (approximately 5%) of total faecal sludge extracted is being dumped there. But, in most cases sludge

extracted by either vacu tug or by manual operation is dumped in the ditches, drains or nearby water bodies.

5.6 Company level financial analysis

5.6.1 Comparative analysis of income statements

The comparison is done on the basis of income statement exercise done for manual emptying and mechanized operation of utility departments and NGOs. The performance of the business model proposed is also shown in the last column to compare with the existing practices.

Table 20: Comparison of profitability per year (in US$)

Particulars	A Manual emptier	Mechanised services – DSK	Mechanised Services - Faridpur	Mechanised Services - Khulna	Mechanised Services - Proposed model
No. of trips per year	120	744	144	960	2,112
Revenue	**1,889**	**10,629**	**1,029**	**13,714**	**30,171**
Personnel costs	0	7,909	1,543	2,743	12,240
Operation & dumping costs	686	3,686	134	3,737	6,754
Capital costs	3	1,007	1,121	7,664	8,557
Total costs	**689**	**12,602**	**2,798**	**14,144**	**27,551**
Profit/(Loss) per year	**1,197**	**(1,973)**	**(1,769)**	**(430)**	**2,620**

Other than the NGOs, no private actors are in the emptying business. Therefore, break-even, calculation of IRR, NPV or sensitivity analysis is not done for the existing business. The proposed model described in the later sections covered these aspects of financial analysis in details.

5.6.2 Access to finance

Unless proper regulatory and awareness measures are taken to stop manual emptying and subsidized services by municipality, emptying will not be a commercially viable business. If the scenario changes towards viable business, banks and financial institutions as well as private entrepreneurs may come forward for investment in the FS emptying business. Eventually, the services from financial institutions can be obtained like any other business ventures.

As proposed in a later section, FS emptying business does not require big investment. However, the income potentials are constraints by the factors which could be addressed through regulatory enforcement. It is therefore important to provide capital funding from donor sources so that the demand could be created.

5.6.3 Role of public sector in business sustainability

Considering the present capacity gap of the service delivery agencies, it is not likely that they could be able to handle this huge task of FS management alone. On the other

hand, it is also not likely that pushing everything to the private sector is a viable option. A private-public model is therefore an imperative to manage this huge task of FS management in Bangladesh. Instead of trying to do everything (example of Khulna and Faridpur) and end of doing nothing, the public sector agencies should let the private sector doing the bulk of the work of emptying, collection and transportation as a business-like activity for profit and take the responsibility of providing dumping site, establishing and running the treatment part.

On the other hand, strict implementation of two laws is another important imperative to promote business as well as improve the situation. In Dhaka and other cities in the country which has drainage systems, people are linking their septic tanks with the drainage to let the sludge drain out which violates the environmental law and to some extent also violates the building code. On the other hand, the public sector service providers as well as all the manual sweepers currently enjoy the liberty of dumping their collected FS here and there. Proper enforcement of the environmental law and the building code will inevitably create the demand of mechanical emptying and proper transportation, thus will contribute to create opportunities for the business sector to enter and run as a viable enterprise.

5.6.4 Business analysis of Treatment Plants in the cities

The only treatment plant under operation in the country is located in Dhaka city being operated by Dhaka WASA (Water and Sewerage Authority) as a non-commercial activity. Faecal sludge collected from sewerage system (covering a portion of whole city area) is treated at the plant. The treatment plant constructed at Faridpur town is yet to commence its operation. Once set for operation, possible business opportunities may be harnessed for the plant. No treatment plant has so far been built at Khulna city by the authority. Steps should be taken without delay for such a large city in the country.

The scope for earning revenue may be: a) dumping fees; b) production of bio-fertilizer; c) sale of sludge cake to fish farms and others, d) charging an operation fees from the government. Bangladesh may learn from best practices in other parts of the globe in this connection.

6. CONCLUSION

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. In absence of proper emptying, transportation, dumping and treatment facilities, almost all sludge generated are diverting into surface water which shatter the gains achieved through increased sanitation coverage. Without a comprehensive system, mere introduction of a business model comprising one or two components by private sector agent may not be a standalone solution to address this huge problem. It is therefore important to work at different levels and pilot different approaches so that the successful working model could be scaled up.

The country context as well as the regulatory framework demands the municipalities to take the responsibility of FS management. However, there are serious lack of awareness; and huge resource and capacity gaps amongst the municipalities to manage FS. Awareness raising as well as advocacy and lobbying at the national level based on demonstrated business model of comprehensive FS management in municipalities by the NGOs in partnership with municipalities could be a potential way forward.

Government-NGO collaboration model could be limited in piloting service delivery models for emptying and transportation by the NGOs while Municipalities to allocate space for dumping and installation and running of treatment plant yielding bio-gas and compost (under experimentation by WaterAid). Different modalities should be experimented in different types of municipalities (Large, medium and small). Successful demonstration of pilot schemes would be advocated for nationwide scaling up through public-private partnership. A 3-4 year piloting phase could be designed and funded to address this.

7 RECOMMENDATIONS OF A SUSTAINABLE BUSINESS MODEL

7.1 Proposed service delivery model

Prevailing FSM scenario in the 3 studies cities led the research team to come up with a realistic business model which can be implemented by private sector or NGO initiatives. It will be a step forward from the prevailing practice.

7.2 Situation analysis

Unlike many other countries in the region, Bangladesh could not progress significantly in mechanized emptying practice. As described in the previous sections, FS emptying activities are mostly done manually in all the cities. A few municipal authorities have the required equipments but they do little to enforce or encourage the households and other types of customers to avail of the mechanized services. On the other hand, despite the presence of a big market, the initiatives by the NGOs also suffer and they do not get enough customers mainly because lack of regulatory enforcement allows people to connect their septic tanks with the drainage system. Nonetheless, analysis shows that both the units of the 2 NGOs have been running loss. In addition, since safe disposal is not mandatory, manual sweepers continue to keep their dominance over the market as they have the liberty to dispose the extracted sludge anywhere near to the place of extraction.

Compared to total sludge generation in Dhaka, market for emptying is quite small. It could be much higher if regulatory measures are enforced by the Department of Environment against disposal of raw sewage in the storm drainage system which is a major cause of surface water pollution around Dhaka city. This will ensure proper operation of existing pit latrines and septic tanks and creation of demand for emptying sludge deposited in those systems. In the other two cities, market is also quite large.

7.3 Alternative approach

In an absence of sufficient demand from the customer end for mechanized services, the volume of business cannot be expanded by the NGOs involved in the business. On the other hand, one of the possible ways of demand generation is proper enforcement of rules and regulations that septic tanks and pits have to be emptied and sludge has to be transported to a particular location, dumped and treated to prevent any public health effect. To strengthen enforcement, awareness raising as well as advocacy and lobbying at the national level based on demonstrated business model of comprehensive FS management in municipalities by the NGOs in partnership with municipalities could be a potential way forward.

It is also important that future models importantly consider the on-going learning that are achieved through the NGO managed programmes. Thus, experiments being done by the NGOs in Dhaka city can be adopted to replicate in other cities by including some additional features. Strategic inclusion of the emptier community in the programme, provide them training and other supports to encourage them adopt technological options. Current practices by the NGOs are weak in tapping more customers for their mechanized services. Inclusion of the emptier community who currently dominates the market and transforming them into mechanised small company like entities could be a potential way forward.

Depending on the market size in each city, 2-4 groups of manual emptiers can be created as business entities which will initially hire or rent vacu tug or truck from the selected NGO in the city. The group will be usually consisting of around 10 emptiers, who will be provided with administrative support by the NGO. NGO itself will not go for direct procurement of any business rather they will do a) awareness training on health and hygiene, b) entrepreneurship training to run small businesses, c) promotion of mechanized services, d) rental of truck and equipment to emptier groups.

Once the business is individually feasible for each of the group (may be after 3-4 years), they can be converted into small business company and the NGOs facilitate them in obtaining financial support for purchasing their own equipment. Thus, the role of NGOs will not be perpetually be involved in the business, rather they will play the role of demonstrator for the emptier community and uplift their emptying practice from manual to mechanized business with acceptable health and hygiene practice.

7.4 Technology options & operational features

Trucks and Equipment: Currently both the NGOs in Dhaka have been using vacu-tug (toes with refurbished pick up) of 2 m^3 capacity. Although the transportation has been speeded up from Mark – I to Mark – II but total length of the two parts (pick up + vacu tug) is quite long which is sometimes difficult for entering into narrow lanes. The cost of both vacu tug and pickup is quite high. The cost of a reconditioned pick up is around

BDT 2,500,000 (US$ 35,715) and a vacu tug is BDT 800,000 (US$ 11,430), which is too high a investment for a small business. The technological options that may be considered for the model is compared below:

Table 21: Comparative performance of vacu tug/truck

	Options	Capacity	Speed	Accessibility	Cost BDT	Cost US$
1	Vacu tug: MK I	0.6 m^3	5 km	Easy	900,000	12,857
2	Vacu tug: MK II + Pick-up	2.0 m^3	40 km	Moderate	3,500,000	50,000
3	Tank toed with tractor	2 – 3 m^3	30 km	Difficult	3,000,000	42,857
4	Tank lorry (with pump)	2 – 3 m^3	40 km	Difficult	3,500,000	50,000
5	Tank + pump mounted on pick-up	1 –1.5 m^3	40 km	Easy	1,400,000	20,000

The 5th option in the above table is considered in the proposed model. A 1m^3 container will be erected with pump machine on a Chinese/Indian built pick-up, which will cost around BDT 1,400,000 (US$ 20,000). It will occupy less space and no additional chassis or wheels will be needed for holding the tank. It will have a slim body and good speed to go into narrow lanes and quicker disposal. Fixing of pump machine and other adjustments can be done from local automobile workshops easily. Suction pipe, gloves and other accessories will be there as well.

Manpower: one operator and one driver will be employed from the NGO. Helpers and other support hand will be hired on case-to-case basis, if required.

Emptying & dumping procedure: upon receiving a work-order, the team will move on the site to complete the emptying tasks. After consultation and approval from the utility department in each city, the collected sludge will be disposed in a designated place. The 2 NGOs in Dhaka city has such arrangement with the Water and Sewerage Authority and they dispose the collected sludge to the designated lifting stations under the sewerage network. This reduces the cost of transportation significantly. Current way of no charge system should be continued to discharge the collected sludge in the sewerage lines.

Emptying fees: presently, the fee for emptying depends on a number of factors, such as size of pit/tank, volume of sludge, accessibility, distance of disposal point, etc. The proposed model will keep the rate competitive to the rates offered by the manual emptiers. A uniform rate of BDT 500 per cubic meter can be applied in all the 3 cities for mechanized emptying under the proposed model.

7.5 Projected income and coverage

An NGO unit is estimated to perform as per the parameter described in the table below. The volume of business and successful penetration by the business units will largely depend on operation efficiency, promotional measures, appropriate strategic

response to customer needs, etc. With two trucks and related investments, the proposed model will cover the following market share of on-site sanitation in the 3 selected cities.

Table 22: Projected market share of proposed business in 3 cities

City	Demand for OSS per year (m^3)	Projected volume to be emptied per year	
		m^3	%
Dhaka	564,689	2,112	0.37
Khulna	892,051	2,112	0.24
Faridpur	90,149	2,112	2.34

The situation may vary in different cities depending on the performance of local partner NGOs.

Table 23: Parameters for financial analysis

Sl #	Particulars	Unit	Amount/Quantity
1	Quantity of sludge emptied per month	m^3	352
2	Fees charged per m^3	BDT	500 ($ 7.14)
3	Household customers	%	70
4	Other (institute, industry, mall, etc.)	%	30
5	Number of trucks	Number	2
6	Capacity of trucks	m^3	1
7	Average trips per day per truck	Number	8
8	Average working days per month	Number	22
9	Average distance per return trip	Km	10
10	Distance covered per month	Km	20
11	Fuel consumption per return trip	Liter	2
12	Fuel cost (diesel) per liter	BDT	50 ($0.72)
13	Repair & maintenance cost per month	BDT	10,000 ($142.86)
14	Insurance, tax, fitness and other recurring cost per truck per year	BDT	20,000 ($285.72)
15	Cost of hand gloves and spares per yr.	BDT	12,000 ($171.43)
16	Promotional costs per month	BDT	3,000 ($42.86)
17	Depreciation rate of truck (strgt. line)	%	20%
18	Rate of inflation/year	%	11
19	Increase in operation efficiency/year	%	5

The performance summary of the proposed model is shown below. Detailed income statement is provided in the annex.

Table 24: Projected income of the proposed model for the next 5 years

Particulars	Year 1		Year 2		Year 3		Year 4		Year 5	
	'000' BDT	US$	'000' BDT	US$	'000' BDT	US$	'000' BDT	US$	'000' BDT	US$
No. of trips	2,112		2,218		2,328		2,445		2,567	
Revenue	**2,112**	**30,171**	**2,462**	**35,165**	**2,869**	**40,985**	**3,344**	**47,768**	**3,897**	**55,763**
Op. cost – fixed	934	13,346	1,089	15,554	1,269	18,129	1,479	21,129	1,724	24,626
Op. cost- variable	434	6,206	506	7,233	590	8,430	688	9,825	802	11,451
Total op. Costs	**1,369**	**19,551**	**1,595**	**22,787**	**1,859**	**26,558**	**2,167**	**30,954**	**2,525**	**36,077**
Depreciation	560	8,000	560	8,000	560	8,000	560	8,000	560	8,000
Profit/(Loss)	**183**	**2,620**	**306**	**4,378**	**450**	**6,426**	**617**	**8,814**	**812**	**11,596**

7.6 Other performance indicators of the proposed business model

Other financial indicators have also been calculated for the model. The analysis indicates that the model would be a viable proposition under the chosen parameters.

Table 25: Key financial performance indicators

Indicator	Value
Breakeven point (BEP)	79%
Internal rate of return (IRR)	46%
Net present value (NPV) at 15% disc. Rate	BDT 1,238,092
Return on Equity (ROE)	8%

7.7 Sensitivity analysis

A sensitivity test is carried out for the proposed model to check the tolerance of the project under different changing circumstances. The summary may be viewed as under:

Table 26: Sensitivity analysis of the proposed model

Status		BEP	IRR	NPV@ 15% disc.	ROI
Original situation		79%	46%	1,238,092	8%
Emptying fees	10% increase	81%	69%	1,989,549	12%
	10% decrease	77%	28%	579,241	4%
Operating cost	10% increase	79%	33%	781,145	5%
	10% decrease	79%	60%	1,695,040	10%
Efficiency level	10% increase	79%	46%	1,262,163	8%
	10% decrease	79%	45%	1,214,252	8%

7.8 Risk analysis

The following issues needs to be addressed properly by the responsible facilitating NGO to make the business a success.

a) Appropriate promotional measures targeting to all possible customers in the operational cities.
b) Permission from the municipality and other utility departments on the unhindered operation of emptying.
c) Threats from the manual emptiers by keeping attractive rental or other supports for them.
d) Appropriate monitoring and record keeping mechanism.
e) Pressure on government agencies for enforcing the households and others to construct appropriate septic tanks and safe disposal.

ANNEX-1

Income statement

Vacu-tug Program, DSK

1 truck (2 m3 capacity), 62 trips per month, USD 7.14/m3

Item	Annual Amount		Monthly	Per trip	Percentage
	USD	BDT	BDT	BDT	%
Personnel Costs					
Wages paid: *Unit Manager*	2,100	147,000	12,250	197.58	
1 Driver	1,960	137,208	11,434	184.42	
2 Operators	2,169	151,800	12,650	204.03	
Social Contribution to permanent staff	1,046	73,200	6,100	98.39	
Medical expenses	206	14,400	1,200	19.35	
Overtime	429	30,000	2,500	40.32	
Subtotal	7,909	**553,608**	**46,134**	**744.10**	**62.76**
Operating and dumping costs					
Registration fees of company	-	-	-	-	
Licensing fees for truck *(incl. fitness, insurance, etc)*	171	12,000	1,000	16.13	
Office building rent *(for garage)*	514	36,000	3,000	48.39	
Telephone	103	7,200	600	9.68	
Electricity	-	-	-	-	
Water	-	-	-	-	
Offices supplies, computer	17	1,200	100	1.61	
Trucks Maintenance and repair	1,526	106,800	8,900	143.55	
Safety Equipment *(hand tools and spares)*	69	4,800	400	6.45	
Fuel *(pumping & transport)*	1,286	90,000	7,500	120.97	
Sludge dumping/tipping Fees	-	-	-	-	
If sold for re-use: Transportation costs to buyer	-	-	-	-	

Others (specify)	-	-	-	-	
Subtotal	**3,686**	**258,000**	**21,500**	**346.77**	**29.25**
Equipment Capital costs					
Loan Interest paid to Bank	-	-	-	-	
Insurance costs for trucks, vehicles	-	-	-	-	
If used, costs to refurbish truck (one time- upfront)	-	-	-	-	
Truck Depreciation Cost *(10% per year)*	357	25,000	2,083	33.60	
Tyres annual depreciation Cost *(50% per year)*	57	4,000	333	5.38	
Suction pipes depreciation Cost *(50% per year)*	21	1,500	125	2.02	
Vacu tug depreciation costs *(10% per year)*	571	40,000	3,333	53.76	
Vehical rental cost	-	-	-	-	
Subtotal	**1,007**	**70,500**	**5,875**	**94.76**	**7.99**
Total recurring cost	**12,602**	**882,108**	**73,509**	**1,186**	**100.00**
Revenue Sources					
Emptying (Households only) - *70%*	7,440	520,800	43,400	700.00	**70.00**
Emptying (Other*) Specify each - *30%*	3,189	223,200	18,600	300.00	**30.00**
Other uses** of the trucks (specify each)	-	-	-	-	
If sold for re-use: Income from sale to buyer	-	-	-	-	
Total revenue	**10,629**	**744,000**	**62,000**	**1,000.00**	**100.00**
Profit /Loss					
Profit before Tax	**(1,973)**	**(138,108)**	**(11,509)**	**(185.63)**	
Tax	**-**	**-**	**-**	**-**	
Profit (loss) after Tax	**(1,973)**	**(138,108)**	**(11,509)**	**(185.63)**	**-15.66**

* Include any revenues from emptying contracts with utility or private companies or industrial sites

** Garbage collection, construction use etc

*** The speed of vacu tugs are not much to drive fast. Therefore, in Dhaka vacu tugs are put into a pick-up type of vehicle to move faster.

Note: An officer (partialtime) will replace unit manager and s/he will be given a project allowance Tk. 2000 per month.

Parameters

Particulars		Unit	Amt/Qnty
Average trips per day		Number	4
Average trips per month		Number	62
Average distance per trip *(return trip)*		Km	20
Working days per month		Number	15
Number of truck		Number	1
Fuel consumption per trip		Liter	4
Fuel cost per liter *(Diesel)*		Taka	46
Capacity of truck/vacu tug		Cubic Meter	2
Quantity of sludge emptied per month		Cubic Meter	124
Distance covered per month		Km	1,240
Fees charged per CuM in BDT		Taka	500
Cost of used truck (including refurbishment)		Taka	250,000
Cost of vacu tug		Taka	400,000

Income statement

Vacu-Tug Operation, PSTC

1 truck (2 m3 capacity), 16 trips per month, USD 7.14/m3

Item	Annual Amount		Monthly	Per trip	Percentage
	USD	BDT	BDT	BDT	%
Personnel Costs					
Wages paid: *Supervisor (partial)*	685.71	48,000	4,000	247.42	
Driver (On call Basis)	277.14	19,400	1,617	100.00	
1 Operator + I Cleaner (On call basis)	554.29	38,800	3,233	200.00	
Social Contribution to permanent staff	-	-	-	-	
Medical expenses	-	-	-	-	
Subtotal	**1,517.14**	**106,200**	**8,850**	**547**	**30.49**
Operating and dumping costs					
Registration fees of company	-	-	-	-	
Licensing fees for truck *(incl. fitness, insurance)*	171.43	12,000	1,000	61.86	
Office building rent***	-	-	-	-	
Telephone	51.43	3,600	300	18.56	
Electricity	-	-	-	-	
Water	-	-	-	-	
Offices supplies, computer	34.29	2,400	200	12.37	
Trucks Maintenance and repair + vacu tug	685.71	48,000	4,000	247.42	
Safety Equipment *(gloves, masks, soap, etc)*	51.43	3,600	300	18.56	
Fuel *(pumping & transport)*	270.86	18,960	1,580	97.73	
Sludge dumping/tipping Fees	-	-	-	-	
If sold for re-use: Transportation costs to buyer	-	-	-	-	
Others (specify)***	-	-	-	-	
Subtotal	**1,265.14**	**88,560**	**7,380**	**456.49**	**25.43**

Equipment Capital costs					
Loan Interest paid to Bank	-	-	-	-	
Insurance costs for trucks, vehicles	-	-	-	-	
If used, costs to refurbish truck (one time- upfront)	-	-	-	-	
Truck Depreciation Cost *(10% per year)*	785.71	55,000	4,583	283.51	
Tyres annual depreciation Cost *(50% per year)*	85.71	6,000	500	30.93	
Suction pipes depreciation Cost *(25% per year)*	178.57	12,500	1,042	64.43	
Vacu tug depreciation costs *(10% per year)*	1,142.86	80,000	6,667	412.37	
Vehical rental cost	-	-	-	-	
Subtotal	**2,192.86**	**153,500**	**12,792**	**791.24**	**44.08**
Total recurring cost	**4,975.14**	**348,260**	**29,022**	**1,795.15**	**100.00**
Revenue Sources					
Emptying (Households only)	1,524.29	106,700	8,892	550.00	**55.00**
Emptying (Other*) Specify each	1,247.14	87,300	7,275	450.00	**45.00**
Other uses** of the trucks (specify each)	-	-	-	-	
If sold for re-use: Income from sale to buyer	-	-	-	-	
Total revenue	**2,771.43**	**194,000**	**16,167**	**1,000.00**	**100.00**
Profit /Loss					
Profit before Tax	**(2,203.71)**	**(154,260)**	**(12,855)**	**(795.15)**	
Tax	**-**	**-**	**-**	**-**	
Profit (loss) after Tax	**(2,203.71)**	**(154,260)**	**(12,855)**	**(795.15)**	**-79.52**

* Include any revenues from emptying contracts with utility or private companies or industrial sites

** Garbage collection, construction use etc

*** Garage rental and indirect overcost cost are borne by PSTC central account, but not included in vacutug account.

Parameters

Particulars		Unit	Amt/Qnty
Average trips per day		Number	3.23
Average trips per month		Number	16
Average distance per trip (return trip)		Km	10
Working days per month		Number	5
Number of truck (wih vacu tug)		Number	1
Fuel consumption per trip		Liter	2
Fuel cost per liter		Taka	79
Capacity of truck/vacu tug		Cubic Meter	2
Quantity of sludge emptied per month		Cubic Meter	32
Distance covered per month		Km	162
Fees charged per CuM in BDT		Taka	500
Cost of used truck (including refurbishment)		Taka	550,000
Cost of vacu tug		Taka	800,000
Remuneration for driver per trip		Taka	100
Remuneration for operator and cleaner per trip		Taka	200

Income statement

Emptying Services, Faridpur Municipality

1 vacu tug (0.6 m3 capacity), 20 trips per month, USD 7.14/m3

Item	Annual Amount		Monthly	Per trip	Percentage
	USD	BDT	BDT	BDT	%
Personnel Costs					
Wages paid:	-	-	-	-	
1 Operator	1,028.57	72,000	6,000	300.00	
1 Cleaner	514.29	36,000	3,000	150.00	
Social Contribution to permanent staff	-	-	-	-	
Medical expenses	-	-	-	-	
Subtotal	**1,542.86**	**108,000**	**9,000**	**450**	**55.14**
Operating and dumping costs					
Registration fees of company	-	-	-	-	
Licensing fees for truck *(incl. fitness, insurance)*	-	-	-	-	
Office building rent	-	-	-	-	
Telephone	51.43	3,600	300	15.00	
Electricity	-	-	-	-	
Water	-	-	-	-	
Offices supplies, computer	34.29	2,400	200	10.00	
Trucks Maintenance and repair + vacu tug	34.29	2,400	200	10.00	
Safety Equipment *(gloves, masks, soap, etc)*	-	-	-	-	
Fuel *(pumping & transport)*	13.54	948	79	3.95	
Sludge dumping/tipping Fees	-	-	-	-	
If sold for re-use: Transportation costs to buyer	-	-	-	-	
Others (specify)***	-	-	-	-	
Subtotal	**133.54**	**9,348**	**779**	**38.95**	**4.77**

Equipment Capital costs					
Loan Interest paid to Bank	-	-	-	-	
Insurance costs for trucks, vehicles	-	-	-	-	
If used, costs to refurbish truck (one time- upfront)	-	-	-	-	
Truck Depreciation Cost *(10% per year)*	-	-	-	-	
Tyres annual depreciation Cost *(50% per year)*	85.71	6,000	500	25.00	
Suction pipes depreciation Cost *(25% per year)*	178.57	12,500	1,042	52.08	
Vacu tug depreciation costs *(20% per year)*	857.14	60,000	5,000	250.00	
Vehical rental cost	-	-	-	-	
Subtotal	**1,121.43**	**78,500**	**6,542**	**327.08**	**40.08**
Total recurring cost	**2,797.83**	**195,848**	**16,321**	**816.03**	**100.00**
Revenue Sources					
Emptying (Households only)	720.00	50,400	4,200	210.00	**70.00**
Emptying (Other*) Specify each	308.57	21,600	1,800	90.00	**30.00**
Other uses** of the trucks (specify each)	-	-	-	-	
If sold for re-use: Income from sale to buyer	-	-	-	-	
Total revenue	**1,028.57**	**72,000**	**6,000**	**300.00**	**100.00**
Profit /Loss					
Profit before Tax	**(1,769.26)**	**(123,848)**	**(10,321)**	**(516.03)**	
Tax	**-**	**-**	**-**	**-**	
Profit (loss) after Tax	**(1,769.26)**	**(123,848)**	**(10,321)**	**(516.03)**	**-172.01**

*Garage rental and indirect overcost cost are borne by PSTC central account, but not included in vacutug account.

Parameters

Particulars		Unit	Amt/Qnty
Average trips per day		Number	5.00
Average trips per month		Number	20
Average distance per trip (return trip)		Km	1
Working days per month		Number	4
Number of vacu tug		Number	1
Fuel consumption per trip		Liter	1
Fuel cost per liter		Taka	79
Capacity of truck/vacu tug		Cubic Meter	0.6
Quantity of sludge emptied per month		Cubic Meter	12
Distance covered per month		Km	20
Fees charged per CuM		Taka	500
Cost of used truck (including refurbishment)		Taka	-
Cost of vacu tug		Taka	300,000

Income statement

Emptying Services, Khulna Municipality

1 truck (2 m3 capacity), 40 trips per month, USD 14.28/m3

Item	Annual Amount		Monthly	Per trip	Percentage
	USD	BDT	BDT	BDT	%
Personnel Costs					
Wages paid:	-	-	-	-	
1 Operator-cum-driver	1,371.43	96,000	8,000	200.00	
1 Cleaner	1,028.57	72,000	6,000	150.00	
Social Contribution to permanent staff (20%)	274.29	19,200	1,600	40.00	
Medical expenses (5%)	68.57	4,800	400	10.00	
Subtotal	**2,742.86**	**192,000**	**16,000**	**400**	**19.39**
Operating and dumping costs					
Registration fees of company	-	-	-	-	
Licensing fees for truck *(incl. fitness, insurance)*	257.14	18,000	1,500	37.50	
Office building rent	-	-	-	-	
Telephone	68.57	4,800	400	10.00	
Electricity	-	-	-	-	
Water	-	-	-	-	
Offices supplies, computer	68.57	4,800	400	10.00	
Trucks Maintenance and repair + vacu tug	428.57	30,000	2,500	62.50	
Safety Equipment *(gloves, masks, soap, etc)*	-	-	-	-	
Fuel *(pumping & transport)*	857.14	60,000	5,000	125.00	
Sludge dumping/tipping Fees	-	-	-	-	
If sold for re-use: Transportation costs to buyer	-	-	-	-	
Others (hired cleaners)	2,057.14	144,000	12,000.00	300.00	
Subtotal	**3,737.14**	**261,600**	**21,800**	**545.00**	**26.42**

Equipment Capital costs					
Loan Interest paid to Bank	-	-	-	-	
Insurance costs for trucks, vehicles	171.43	12,000	1,000	25.00	
If used, costs to refurbish truck (one time- upfront)	-	-	-	-	
Truck Depreciation Cost *(10% per year)*	-	-	-	-	
Tyres replacement cost	171.43	12,000	1,000	25.00	
Suction pipes replacement cost	178.57	12,500	1,042	26.04	
Truck's depreciation costs *(20% per year)*	7,142.86	500,000	41,667	1,041.67	
Vehical rental cost	-	-	-	-	
Subtotal	**7,664.29**	**536,500**	**44,708**	**1,117.71**	**54.19**
Total recurring cost	**14,144.29**	**990,100**	**82,508**	**2,062.71**	**100.00**
Revenue Sources					
Emptying (Households only)	4,114.29	288,000	24,000	600.00	**30.00**
Emptying (Other - govt. and autonomous offices)	9,600.00	672,000	56,000	1,400.00	**70.00**
Other uses** of the trucks (specify each)	-	-	-	-	
If sold for re-use: Income from sale to buyer	-	-	-	-	
Total revenue	**13,714.29**	**960,000**	**80,000**	**2,000.00**	**100.00**
Profit /Loss					
Profit before Tax	**(430.00)**	**(30,100)**	**(2,508)**	**(62.71)**	
Tax	**-**	**-**	**-**	**-**	
Profit (loss) after Tax	**(430.00)**	**(30,100)**	**(2,508)**	**(62.71)**	**-3.14**

Parameters

Particulars		Unit	Amt/Qnty
Average trips per day		Number	2.00
Average trips per month		Number	40
Average distance per trip (return trip)		Km	20
Working days per month		Number	20
Number of truck (in operation)		Number	1
Fuel consumption per trip		Liter	5
Fuel cost per liter		Taka	50
Capacity of truck/vacu tug		Cubic Meter	2.0
Quantity of sludge emptied per month		Cubic Meter	80
Distance covered per month		Km	800
Fees charged per CuM		Taka	1,000
Cost of used truck (including refurbishment)		Taka	-
Cost of truck		Taka	2,500,000

Income statement (Manual emptying)

Ave. number of emptying per month: 10 latrines

Item	Annual amount		Monthly amount	per emptying
	USD	BDT	BDT	BDT
Capital Costs				
Wages for all employees	-	-	-	-
Small equipment (wheelbarrows, shovels, buckets, etc.).	2.86	200.00	16.67	1.67
Safety equipment (gloves, boots, etc.).	-	-	-	-
Others (specify)	-	-	-	-
Subtotal	**2.86**	**200.00**	**16.67**	**1.67**
Operating Costs				
Fees paid for emptying support	342.86	24,000.00	2,000.00	200.00
Transport support fees paid (sometimes sludge are transported to a distance place	171.43	12,000.00	1,000.00	100.00
Disinfectants	-	-	-	-
Medicine used	-	-	-	-
Material renting (few cases, they rent pump machine to pump out liquid)	171.43	12,000.00	1,000.00	100.00
"baksheesh" for Harassment	-	-	-	-
If sold for re-use: Transportation costs to buyer	-	-	-	-
Subtotal	**685.71**	**48,000.00**	**4,000.00**	**400.00**
Total Cost	**688.57**	**48,200.00**	**4,016.67**	**401.67**
Revenue				
Emptying (HH)	1,714.29	120,000.00	10,000.00	1,000.00
If sold for re-use: Income from sale to buyer	-	-	-	-
* Other uses of the equipment (specify)	171.43	12,000.00	1,000.00	100.00
Total Revenue	**1,885.71**	**132,000.00**	**11,000.00**	**1,100.00**
Profit/ Loss				
Profit / Loss	**1,197.14**	**83,800.00**	**6,983.33**	**698.33**

* Example: garbage collection, construction labour etc.

Assumptions:

a. No regular employees

b. Bucket is the only equipment owned (life: 12 months)

c. Wheelbarrows, shovels and other equipments are rented and/or provided by households

d. Support laborers are hired on per emptying basis.

e. Average revenue per emptying (2 m3) is BDT 1000.

f. Average monthly emptying is 10 latrines

g. 1 USD = 70 BDT

Income statement

Mechanized Emptying NGO (Proposed model)

2 trucks (1 m3/truck capacity), 352 trips per month, USD 7.14/m3

Item	Annual Amount		Monthly	Per trip	Percentage
	USD	BDT	BDT	BDT	%
Personnel Costs					
Wages paid: *1 Unit Manager*	2,571	180,000	15,000	85.23	
2 Drivers	3,429	240,000	20,000	113.64	
2 Operators	2,743	192,000	16,000	90.91	
Social Contribution to permanent staff *(10%)*	874	61,200	5,100	28.98	
Medical expenses *(10%)*	874	61,200	5,100	28.98	
Overtime	1,749	122,400	10,200	57.95	
Subtotal	**12,240**	**856,800**	**71,400**	**405.68**	**43.97**
Operating and dumping costs					
Registration fees of company	171	12,000	1,000	5.68	
Licensing fees for truck *(incl. fitness, etc)*	171	12,000	1,000	5.68	
Office building rent *(for office (partial) & garrage))*	1,371	96,000	8,000	45.45	
Telephone	171	12,000	1,000	5.68	
Electricity	34	2,400	200	1.14	
Water	17	1,200	100	0.57	
Offices supplies, computer	17	1,200	100	0.57	
Trucks Maintenance and repair	1,714	120,000	10,000	56.82	
Safety Equipment *(hand tools and spares)*	171	12,000	1,000	5.68	
Fuel *(pumping & transport)*	2,743	192,000	16,000	90.91	
Sludge dumping/tipping Fees	-	-	-	-	

If sold for re-use: Transportation costs to buyer	-	-	-	-	
Others (specify)	171	12,000	1,000	5.68	
Subtotal	**6,754**	**472,800**	**39,400**	**223.86**	**24.26**
Equipment Capital costs					
Loan Interest paid to Bank	-	-	-	-	
Insurance costs for trucks, vehicles	57	4,000	2,000	11.36	
If used, costs to refurbish truck (one time- upfront)	-	-	-	-	
Truck Depreciation Cost *(20% per year)*	8,000	560,000	46,667	265.15	
Tyres annual replacement Cost	286	20,000	1,667	9.47	
Suction pipes replacement Cost	214	15,000	1,250	7.10	
Vehical rental cost	-	-	-	-	
Subtotal	**8,557**	**599,000**	**51,583**	**293.09**	**31.77**
Total recurring cost	**27,551**	**1,928,600**	**162,383**	**923**	**100.00**
Revenue Sources					
Emptying fee (Households only) - *70%*	21,120	1,478,400	123,200	700.00	**70.00**
Emptying fee (Other*) Specify each - *30%*	9,051	633,600	52,800	300.00	**30.00**
Other uses** of the trucks (specify each)	-	-	-	-	
If sold for re-use: Income from sale to buyer	-	-	-	-	
Total revenue	**30,171**	**2,112,000**	**176,000**	**1,000.00**	**100.00**
Profit /Loss					
Profit before Tax	**2,620**	**183,400**	**13,617**	**77.37**	
Tax	**-**	**-**	**-**	**-**	
Profit (loss) after Tax	**2,620**	**183,400**	**13,617**	**77.37**	**8.39**

Parameters

Particulars		**Unit**	**Amt/Qnty**
Average trips per day per truck		Number	8

Average trips per month per truck		Number	176
Average distance per trip *(return trip)*		Km	10
Working days per month		Number	22
Number of truck		Number	2
Fuel consumption per trip		Liter	2
Fuel cost per liter *(Diesel)*		Taka	50
Capacity of truck/vacu tug		Cubic Meter	1
Quantity of sludge emptied per month		Cubic Meter	352
Distance covered per month		Km	1,760
Fees charged per CuM in BDT		Taka	500
Cost of new truck		Taka	1,400,000

ANNEX-2

FS Production : Dhaka city, Bangladesh

Calculations		
Number of households inthe city =	HH	3,337,470
% of the city HH with On-site sanitation=	OSS%	10.00%
Number of the city HH with On-site sanitation =	OSS% x HH= OSS	333,747
Number of the adjusted city HH with On-site sanitation =	Adj OSS	110,576
% of the HH with OSS having pits in the city (from your HH survey) =	PIT%	68.40%
% of the HH with OSS having septic tanks in the city (from your HH survey) =	ST%	31.60%
% of the HH with OSS having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) =	CES%	0%
Number of the HH with OSS having pits in the city (from your HH survey) =	PITS% x Adj OSS = PITS	75,634
Number of the HH with OSS having septic tanks in the city (from your HH survey) =	ST% x Adj OSS = ST	34,942
Typical volume of the septic tank =	SV m^3	14.41
Typical volume of the pits =	PV m^3	3.17
Typical volume of the Cesspool/Holding tanks =	CV m^3	0

Survey Data	Emptying Frequency Pits	# pits to be Emptied/yr	Emptying Frequency Septic Tanks	# Septic tanks to be Emptied/yr	Emptying Frequency cesspools	# Fequency cesspools to be Emptied/yr
2-3 times/yr	37.7%	71,285	9.8%	8,561	0.0%	-
Once/yr	6.7%	5,067	2.3%	804	0.0%	-
Once/2 yrs	29.4%	11,118	29.3%	5,119	0.0%	-
Once/3yrs	11.1%	2,770	21.8%	2,514	0.0%	-
Once/4 yrs	4.8%	908	9.8%	856	0.0%	-
Once/5-10 yrs	9.5%	862	19.5%	818	0.0%	
Once/ over 10 yrs	0.8%	61	7.5%	262	0.0%	-
Others	0.0%	-	0.0%	-	0.0%	-
	A. TOTAL Pits TO BE emptied per year =	**92,071**	**B. TOTAL Septic tanks To BE emptied/ year =**	**18,933**	**TOTAL cesspools To BE emptied/ year =**	-

P1	**Market Size =**	**Total VOLUME (in m3) of sludge TO BE emptied / year**	**(A x PV) + (B x SV) +(C x**	**564,689**	This is the FS produced in the city **based on ACTUAL survey data**

P2	**Theoretical Market Size =**	**Total VOLUME of sludge TO BE emptied / year**	**(PITS x No of users x 0.3 ltr. X 365 days) + (ST x no of users x (0.7 ltr. X 365 days)**	**541,585**	This is the **THEORETICAL FS** produced in the city

Assume that theoretically, dry pits get 0.3 liters per day per person and multi chamber septic tanks get upto 1.0 liters per day per person; but numbers vary somewhat depending on the wetness of the containment, so please show assumptions you use to pick a number

C	**Current FS COLLECTED =**	**507,885**	**[(No of trucks x m^3 capacity of trucks x no of trips per year) + (no of pits emptied manually per year x PV) + (no of septic tanks emptied manually per year SV)]**

Assume that 90% of the FS produced in actually collected each emptying event

So theoretical market size is P2 and your actual survey data shows the emperical market size is P1

The gap between P1-C (or P2 - C), is the gap in what is produced vs what is collected.

Observations and Assumptions:

a. The analysis is adjusted by considering the use of pit/septic tank by multiple households.
d. 38% HH share pit/ST on joint or community basis (with an average of 7.60 HH per Pit/ST).
e. It is assumed that joint use of both Pit/ST is on same proportion basis.
f. Average number of users, number of HH using Pit/ST is divided by average HH size (4.50).
g. In calculating theoritical market size, it is assumed that pit and ST are being filled in @ 0.3 ltr per person per day and 0.7 ltr per person per day respectively.

FS Production : Khulna city, Bangladesh

Calculations		
Number of households inthe city =	HH	384,169
% of the city HH with On-site sanitation=	OSS%	99.23%
Number of the city HH with On-site sanitation =	OSS% x HH= OSS	381,211
Number of the adjusted city HH with On-site sanitation =	Adj OSS	261,588
% of the HH with OSS having pits in the city (from your HH survey) =	PIT%	31.25%
% of the HH with OSS having septic tanks in the city (from your HH survey) =	ST%	68.75%
% of the HH with OSS having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) =	CES%	0%
Number of the HH with OSS having pits in the city (from your HH survey) =	PITS% x Adj OSS = PITS	81,746
Number of the HH with OSS having septic tanks in the city (from your HH survey) =	ST% x Adj OSS = ST	179,842
Typical volume of the septic tank =	SV m^3	14.41
Typical volume of the pits =	PV m^3	3.17
Typical volume of the Cesspool/Holding tanks =	CV m^3	0

Survey Data	Emptying Frequency Pits	# pits to be Emptied/yr	Emptying Frequency Septic Tanks	# Septic tanks to be Emptied/yr	Emptying Frequency cesspools	# Fequency cesspools to be Emptied/yr
2-3 times/yr	10.8%	22,071	4.7%	21,131	0.0%	-
Once/yr	0.0%	-	0.0%	-	0.0%	-
Once/2 yrs	26.5%	10,831	11.5%	10,341	0.0%	-
Once/3yrs	19.6%	5,287	7.8%	4,629	0.0%	-
Once/4 yrs	15.7%	3,209	9.4%	4,226	0.0%	-
Once/5 - 10 yrs	19.6%	1,602	43.2%	7,769	0.0%	-
Once/over 10 yrs	7.8%	638	23.4%	4,208	0.0%	
Others	0.0%	-	0.0%	-	0.0%	-
	A. TOTAL Pits TO BE emptied per year =	**43,639**	**B. TOTAL Septic tanks To BE emptied/ year =**	**52,305**	**TOTAL cesspools To BE emptied/ year =**	-

P1	**Market Size =**	**Total VOLUME (in m3) of sludge TO BE emptied / year**	**(A x PV) + (B x SV) +(C x CV)**	**892,051**	This is the FS produced in the city **based on ACTUAL survey data**

P2	**Theoretical Market Size =**	**Total VOLUME of sludge TO BE emptied / year**	**(PITS x No of users x (0.3 ltr. X 365 days) + (ST x no of users x (0.7 ltr. X 365 days)**	**815,276**	This is the **THEORETICAL FS** produced in the city

Assume that theoretically, dry pits get 0.3 liters per day per person and multi chamber septic tanks get upto 1.0 liters per day per person; but numbers vary somewhat depending on the wetness of the containment, so please show assumptions you use to pick a number

C	**Current FS COLLECTED =**	**802,511**	**[(No of trucks x m^3 capacity of trucks x no of trips per year) + (no of pits emptied manually per year x PV) + (no of septic tanks emptied manually per year SV)]**

Assume that 90% of the FS produced in actually collected each emptying event

So theoretical market size is P2 and your actual survey data shows the emperical market size is P1

The gap between P1-C (or P2 - C), is the gap in what is produced vs what is collected.

Observations and Assumptions:

a. The analysis is adjusted by considering the use of pit/septic tank by multiple households.

d. 38% HH share Pit/ST on joint or community basis (with an average of 5.74 HH per Pit/ST).

e. It is assumed that joint use of both Pit/ST is on same proportion basis.

f. Average number of users of Pit/ST is 14.85.

g. In calculating theoritical market size, it is assumed that pit and ST are being filled in @ 0.3 ltr per person per day and 0.7 ltr per person per day respectively.

FS Production : Faridpur city, Bangladesh

Calculations		
Number of households inthe city =	**HH**	**25,342**
% of the city HH with On-site sanitation=	OSS%	98.02%
Number of the city HH with On-site sanitation =	OSS% x HH= OSS	24,840
Number of the adjusted city HH with On-site sanitation =	Adj OSS	22,025
% of the HH with OSS having pits in the city (from your HH survey) =	PIT%	65.75%
% of the HH with OSS having septic tanks in the city (from your HH survey) =	ST%	34.25%
% of the HH with OSS having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) =	CES%	0%
Number of the HH with OSS having pits in the city (from your HH survey) =	PITS% x Adj OSS = **PITS**	14,481
Number of the HH with OSS having septic tanks in the city (from your HH survey) =	ST% x Adj OSS = **ST**	7,543
Typical volume of the septic tank =	**SV** m^3	19.82
Typical volume of the pits =	**PV** m^3	3.21
Typical volume of the Cesspool/Holding tanks =	**CV** m^3	0

Survey Data	Emptying Frequency Pits	# pits to be Emptied/yr	Emptying Frequency Septic Tanks	# Septic tanks to be Emptied/yr	Emptying Frequency cesspools	# Fequency cesspools to be Emptied/yr
2-3 times/yr	15.6%	5,648	7.8%	1,471	0.0%	-
Once/yr	3.8%	550	0.0%	-	0.0%	-
Once/2 yrs	26.9%	1,948	16.7%	630	0.0%	-
Once/3yrs	11.3%	540	7.8%	194	0.0%	-
Once/4 yrs	14.6%	529	10.0%	189	0.0%	-
Once/5-10 yrs	19.8%	344	41.1%	372	0.0%	
Once/over 10 yrs	8.0%	116	16.7%	126	0.0%	
Others	0.0%	-	0.0%	-	0.0%	-
	A. TOTAL Pits TO BE emptied per year =	**9,674**	**B. TOTAL Septic tanks To BE emptied/ year =**	**2,982**	**TOTAL cesspools To BE emptied/ year =**	-

Market Size =	**Total VOLUME (m3) of sludge TO BE emptied / year**	**(A x PV) + (B x SV) +(C x CV)**	**90,149**	This is the FS produced in the city **based on ACTUAL survey data**

Theoretical Market Size =	**Total VOLUME of sludge TO BE emptied / year**	**(PITS x No of users x (0.3 ltr. X 365 days) + (ST x no of users x (0.7 ltr. X 365 days)**	**25,434**	This is the **THEORETICAL FS** produced in the city

Assume that theoretically, dry pits get 0.3 liters per day per person and multi chamber septic tanks get upto 1.0 liters per day per person; but numbers vary somewhat depending on the wetness of the containment, so please show assumptions you use to pick a number

Current FS COLLECTED =	**79,248**	**[(No of trucks x m^3 capacity of trucks x no of trips per year) + (no of pits emptied manually per year x PV) + (no of ST emptied manually per year SV)]**

Assume that 90% of the FS produced in actually collected each emptying event

So theoretical market size is P2 and your actual survey data shows the emperical market size is P1
The gap between P1-C (or P2 - C), is the gap in what is produced vs what is collected.

Observations and Assumptions:

a. The analysis is adjusted by considering the use of pit/septic tank by multiple households.
d. 16% HH share Pit/ST on joint or community basis (with an average of 3.43 HH per Pit/ST).
e. It is assumed that joint use of both Pit/ST is on same proportion basis.
f. Average users of Pit/ST is 7.24
g. In calculating theoritical market size, it is assumed that pit and ST are being filled in @ 0.3 ltr per person per day and 0.7 ltr per person per day respectively.

ANNEX-3

FINANCIAL PROJECTION OF THE PROPOSED MODEL

	Unit	Year 1	Year 2	Year 3	Year 4	Year 5
Inflation index	11%	1	1.11	1.23	1.37	1.52
Increase in annual efficiency level	5%	1	1.05	1.10	1.16	1.22
Number of trucks	2					
Revenue						
Emptying services (trips per year)	2,112	2,112,000	2,461,536	2,868,920	3,343,727	3,897,113
Tarriff per trip	500					
Other revenue sources						
TOTAL ANNUAL REVENUE		**2,112,000**	**2,461,536**	**2,868,920**	**3,343,727**	**3,897,113**

Operating costs - Fixed						
Fixed annual salary costs		- 734,400	- 855,943	- 997,602	- 1,162,705	- 1,355,133
Registration fees of company		- 12,000	- 13,986	- 16,301	- 18,998	- 22,143
Licensing fees for truck (incl. fitness, etc)		- 12,000	- 13,986	- 16,301	- 18,998	- 22,143
Office building rent (for office & garrage)		- 96,000	- 111,888	- 130,405	- 151,988	- 177,142
Telephone		- 12,000	- 13,986	- 16,301	- 18,998	- 22,143
Electricity		- 2,400	- 2,797	- 3,260	- 3,800	- 4,429
Water		- 1,200	- 1,399	- 1,630	- 1,900	- 2,214
Offices supplies, computer		- 1,200	- 1,399	- 1,630	- 1,900	- 2,214
Safety Equipment *(hand tools and spares)*		- 12,000	- 13,986	- 16,301	- 18,998	- 22,143
Loan interest paid to bank		-	-	-	-	-
Insurance cost for vehicle		- 4,000	- 4,662	- 5,434	- 6,333	- 7,381
Tyre replacement cost		- 20,000	- 23,310	- 27,168	- 31,664	- 36,904
Suction pipe replacement cost		- 15,000	- 17,483	- 20,376	- 23,748	- 27,678
Misc other costs		- 12,000	- 13,986	- 16,301	- 18,998	- 22,143
TOTAL FIXED OPEX		- 934,200	- 1,088,810	- 1,269,008	- 1,479,029	- 1,723,808

Operating costs - Variable						
Fuel		- 192,000	- 223,776	- 260,811	- 303,975	- 354,283
Trucks' Maintenance and repair		- 120,000	- 139,860	- 163,007	- 189,984	- 221,427
Variable wages		- 122,400	- 142,657	- 166,267	- 193,784	- 225,855
TOTAL VARIABLE OPEX		- 434,400	- 506,293	- 590,085	- 687,744	- 801,565
TOTAL ANNUAL OPEX		**- 1,368,600**	**- 1,595,103**	**- 1,859,093**	**- 2,166,773**	**- 2,525,374**
Net operating cash flow		**743,400**	**866,433**	**1,009,827**	**1,176,954**	**1,371,740**
Investment Cash flow						
Cost of the vehicle		- 2,800,000				
Sale of salvage						1,400,000
Net investment cash flow		- 2,800,000	-	-	-	1,400,000
Net project cash flow before tax		**- 2,056,600**	**866,433**	**1,009,827**	**1,176,954**	**2,771,740**

Line items to calculate taxation						
Depreciation		560,000	560,000	560,000	560,000	560,000
Net profit		183,400	306,433	449,827	616,954	811,740
Taxation	35%	- 64,190	- 107,251	- 157,440	- 215,934	- 284,109
EAITDA		**119,210**	**199,181**	**292,388**	**401,020**	**527,631**
Net cash after taxes (FCF)		**- 2,120,790**	**759,181**	**852,388**	**961,020**	**2,487,631**
Net monthly cash		*- 176,733*	*63,265*	*71,032*	*80,085*	*207,303*
		2,620	*4,378*	*6,426*	*8,814*	*11,596*

5 year analysis

NPV @15% discount rate	**1,238,092**
After Tax IRR - 5 years	**36%**
Pre-tax IRR - 5 years	**46%**
Avg 5 yr monthly cash to operator	**48,990**
BEP (3rd year)	**79%**

CASH A/C						
Opening balance		-	- 2,120,790	- 1,361,609	- 509,221	451,799
Cash increase (decrease) for the year		- 2,120,790	759,181	852,388	961,020	2,487,631
Closing balance		- 2,120,790	- 1,361,609	- 509,221	451,799	2,939,430

Income Statement						
Revenue		2,112,000	2,461,536	2,868,920	3,343,727	3,897,113
Less operating expenses		- 1,368,600	- 1,595,103	- 1,859,093	- 2,166,773	- 2,525,374
EBITDA		743,400	866,433	1,009,827	1,176,954	1,371,740
Less depreciation		- 560,000	- 560,000	- 560,000	- 560,000	- 560,000
EBIT		183,400	306,433	449,827	616,954	811,740
Total tax payable		- 64,190	- 107,251	- 157,440	- 215,934	- 284,109
EAITDA		119,210	199,181	292,388	401,020	527,631

Balance Sheet - year end						
Assets						
Vehicles		2,240,000	1,680,000	1,120,000	560,000	-
Closing cash		679,210	1,438,391	2,290,779	3,251,799	5,739,430
Total assets		2,919,210	3,118,391	3,410,779	3,811,799	5,739,430

Liabilities

Owner's equity						
Opening equity		*2,800,000*	*2,919,210*	*3,118,391*	*3,410,779*	*5,211,799*
Add annual net EAITDA		*119,210*	*199,181*	*292,388*	*401,020*	*527,631*
Net owner's equity		2,919,210	3,118,391	3,410,779	3,811,799	5,739,430
Total liabilities and owner's equity		2,919,210	3,118,391	3,410,779	3,811,799	5,739,430
Return on Equity (ROE)		**4%**	**6%**	**9%**	**11%**	**9%**
Average annual 5 year ROE			*8%*			

Sensitivity analysis

Status		BEP	IRR	NPV	ROE
Original situation		79%	46%	1,238,092	8%
Emptying fees	10% up	81%	69%	1,989,549	12%
	10% down	77%	28%	579,241	4%
Operating cost	10% up	79%	33%	781,145	5%
	10% down	79%	60%	1,695,040	10%
Efficiency level	10% up	79%	46%	1,262,163	8%
	10% down	79%	45%	1,214,252	8%