Safely Managed On-Site Sanitation (SMOSS)

June 2022 | Bangladesh Report

Bangladesh SMOSS Project Steering Committee Members:

Md. Saifur Rahman, Chief Engineer, Department of Public Health Engineering (DPHE)
Dara Johnston/Zaid Jurji, Chief of WASH, UNICEF Bangladesh
Professor Dr. Md. Mujibur Rahman, BUET (Rtd.) Unicef
Professor Dr. Tanvir Ahmed (ITN-BUET)
Md. Kamrul Hasan, Dhaka WASA
Alamgir Hossen, Bangladesh Bureau of Statistics (BBS)
Shamsul Gafur Mahmud (WHO)
Hasin Jahan (WaterAid)
S.M.A. Rashid (NGO Forum)
Shawkat A. Begum (Practical Action)
Md Akramul Islam (BRAC)
Eheteshamul Russel Khan (DPHE)
Syed Adnan Ibna Hakim (UNICEF, Bangladesh)

Bangladesh SMOSS Project Technical Committee Members:

Tushar Mohon Shadhu Khan, Addl. Chief Engineer -Planning, DPHE
Professor Dr. Md. Mujibur Rahman, BUET (Rtd.) Unicef
Mohammad Saifur Rahman (DPHE)
Syed Adnan Ibna Hakim (UNICEF)
Alauddin Ahmed (ITN-BUET)
Dr Abdullah Al Muyeed (CWIS-FSM Cell, DPHE)
Mr. Uttam Kumar Saha (Practical Action)
Md. Zillur Rahman (BRAC)
Mr Habibur Rahman (WSUP)
Shahidul Islam (SNV)
Engr. Md. Toriqul Islam (NGO-F)
Dr. Amal Kumar (UNICEF)

Technical Reviewer:

Joint Monitoring Program (JMP) Team member:
Tom Slaymaker (UNICEF),
Richard Paul Johnston (WHO) and
Freya Mills

Proof Reader:

Suzanne Reiff (Water, sanitation & hygiene promotion consultant)
Nicole Klaesener-Metzner, WASH Specialist, ROSA, UNICEF

Project Management Team:

Tushar Mohon Shadhu Khan, Addl. Chief Engineer -Planning, DPHE;
Professor Dr. Md. Mujibur Rahman, BUET (Rtd.) Unicef
Dr. Amal Halder (Data Management and Statistical Consultant, UNICEF)
Syed Adnan Ibna Hakim (WASH Officer, UNICEF, Bangladesh)

Design & Concept:

Md. Rakibul Ahsan Limon

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PREFACE

It is estimated that one-third of the world's population is served by on-site sanitation, and only 10% of urban dwellers in low-income countries have access to sanitation options that are Connected to sewers. Hence, the issue of dealing with safely managed sanitation service chain is unavoidable and finding appropriate, cost-effective and environmentally friendly safely managed sanitation service chain management options are crucial. The situation in Bangladesh with respect to Safely Manage Sanitation is complex; its population has tripled from 45 million in 1950 to a massive 175 million people today with a third of these living in urban centers, and although access to sanitation options has increased and the country has made remarkable progress in eliminating open defecation, the safe management of fecal matter has become a major and urgent challenge. This report presents an overview of the current safely managed on-site sanitation situation in the country and attempts to provide suitable options to upgrade on-site sanitation service and recommendations to work towards pro-poor how gradually, accountable, safe and sustainable safely managed on-site sanitation services, to contribute to the improved living environment, health and well-being of the people of Bangladesh.

The Bangladesh Department of Public Health Engineering (DPHE) wishes to express sincere gratitude to the various institutions and individuals who were highly committed and worked tirelessly to make the study a success. The study was made possible through financial and technical support received from Bill and Melinda Gates Foundation (BMGF), UNICEF-WHO Joint Monitoring Program (JMP) and United Nations Children's Fund (UNICEF) Bangladesh. In addition, the expertise contributed by various consultants (global and regional) in the areas of sampling, training, fieldwork, data processing and report writing, timely coverage from the media, and input from various stakeholders who participated in SMOSS workshops cannot be overemphasized. This study was made possible through the dedication of the SMOSS Study National Steering Committee and Technical Committee.

DPHE and UNICEF are grateful to the respondents who welcomed field teams into their homes and enthusiastically answered the many questions as well as allowed their sanitation facilities observed and measured. DPHE and UNICEF would like to acknowledge the following institutions who were members of the SMOSS Steering and Technical Committees for their invaluable contributions towards the accomplishment of the study: Local Government Division and Policy Support Branch, Ministry of Local Government, Rural Development & Cooperatives, Dhaka, Chittagong and Khulna Water and Sewerage Authority, The World Bank, Asian Development Bank, Practical Action, Water Aid, SNV,WSUP, BRAC, NGO-Forum, UNICEF Youth Volunteer Network.

Md. Saifur Rahman
Chief Engineer
Department of Public Health Engineering (DPHE)
Ministry of Local Government,
Rural Development & Cooperatives (MoLGRD&C)
People's Republic of Bangladesh.

Zaid Jurji
Chief, Water, Sanitation & Hygiene WASH Programme
UNICEF Bangladesh Country Office
UNICEF House, Plot # 30,
Syed Mahbub Morshed Avenue,
Sher-E-Bangla Nagar, Dhaka 1207

ABBREVIATIONS

SMOSS	Safely Managed On-Site Sanitation
FSTP	Fecal Sludge Treatment Plant
FGD	Focus Group Discussion
KII	Key Informant Interview
BBS	Bangladesh Bureau of Statistics
DPHE	Department of Public Health Engineering
GoB	Government of Bangladesh
JMP	Joint Monitoring Programme
MDG	Millennium Development Goals
MICS	Multiple Indicator Cluster Survey
NGO	Non-Governmental Organization
SDGs	Sustainable Development Goals
UNICEF	United Nations Children's Fund
WASH	Water, sanitation and hygiene
WHO	World Health Organization

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PART ONE:
SUMMARY REPORT

1. Introduction

Safe management of on-site sanitation includes ensuring that on-site storage containments effectively separate excreta from the environment, and that fecal sludge in these containments is safely emptied, transported and treated (Fecal Sludge Management, FSM) remains a critical issue in Bangladesh . The fecal sludge deposited in septic tanks and pits is not always safely managed and is often simply discharged into the nearby residential environment, posing a massive threat to the environment and to public health.

To explore the status of the different stages of safely managed on-site sanitation (SMOSS) systems across Bangladesh regarding safe fecal containments, emptying, transportation, treatment and reuse/disposal, a study was launched in late 2020 to assess the situation and provide recommendations for routine monitoring of SMOSS progress in the future. The study revealed that whilst 50% of the population had access to safe latrines with appropriate fecal sludge containment facilities, only 10% of households (for both safe and unsafe latrines) practiced safe emptying, transport and disposal of fecal sludge. The situation in Low Income Communities (LICs) was observed to be even worse, with 59% of toilets having no containment facility at all but instead, they were directly connected to the drains. Manual emptying of pits is still very common as the availability of mechanical emptying systems are rare, and fecal sludge treatment facilities are equally scarce.

The study provides recommendations on how to improve and mainstream monitoring of SMOSS, as well as how to improve safe management of on-site sanitation management. The role of local Government institutions (LGI's) will need to evolve in this sector, to monitor and enforce safe emptying and disposal of fecal sludge, this will also enhance the demand for more Fecal Sludge Treatment Plants (FSTP). To support this, it is recommended LGI's assess potential PPP models for establishing sanitation chain of services including collection, transportation, treatment, disposal and/or re-use of treated fecal sludge. Planning for future expansion of services (procuring lands for disposal/treatment sites and purchasing FSM equipment) should be taken into account, including increased demand for FSM as communities continue to grow and latrines continue to improve. To achieve this, it will be crucial to ensure that the capacities of LGIs are strengthened in terms of manpower, resources and training, which in turn will facilitate the capacity building of stakeholders that are directly or indirectly related to SMOSS services development. Also, regular monitoring of the progress made in fecal sludge containment and related services will be critical, and, in order to carry this out, it will be essential to identify the relevant monitoring indicators and mechanisms for local implementation. The monitoring data can then be analyzed and assessed locally, for updating and fine-tuning the SMOSS programming.

1.1 Background

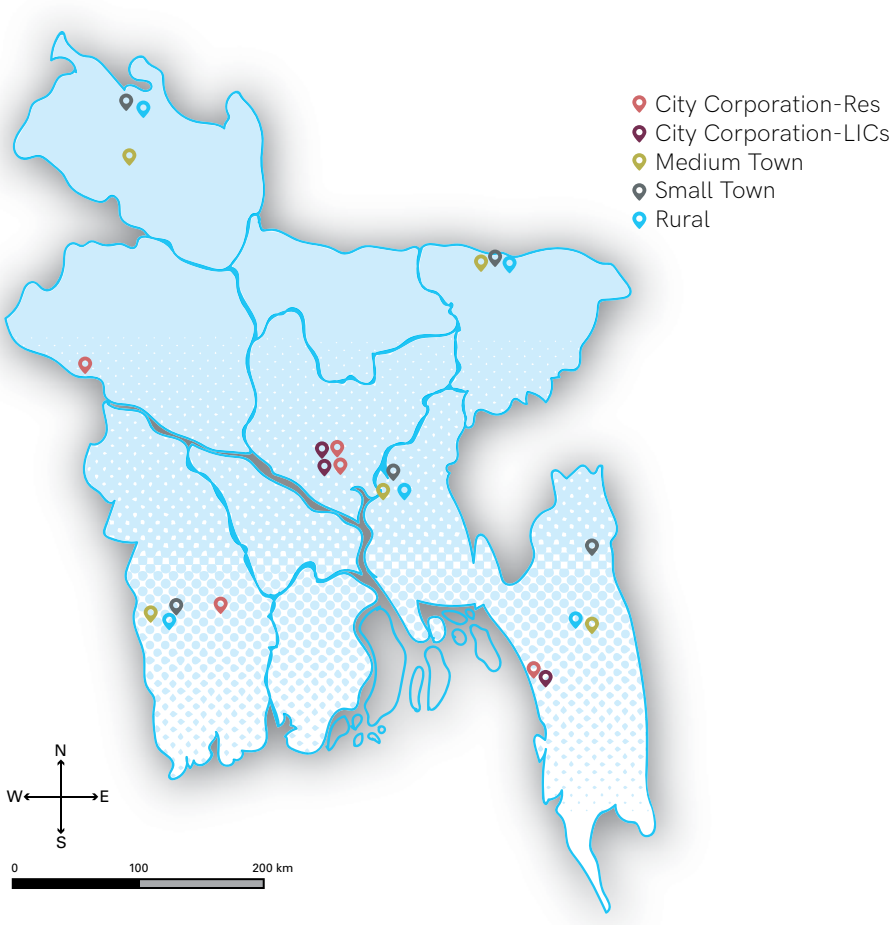
On-site sanitation is prevalent throughout Bangladesh, both in urban and rural areas, and the huge quantity of fecal sludge generated in septic tanks and pits (of pit/pour-flush latrines) is not safely managed. Fecal sludge from these facilities is discharged into the nearby residential environment, drainage systems or water bodies. This is causing severe pollution of the environment and affecting the water bodies, particularly within and around cities and towns where population concentrations are high.
In the urban communities of Bangladesh, management of on-site sanitation systems represents a massive environmental hazard, though small scale fecal sludge management (FSM) systems are found in some areas (for example in Khulna City Corporation area, Faridpur Municipality, Kustia Municipality, Jhenaida Municipality, and small areas of Chattogram City Corporation, and Rangpur City Corporation etc.) which include emptying and transportation services, and treatment of fecal sludge.

1.2
Objective

Nationwide data on safely managed sanitation systems in Bangladesh, however, is yet to be collected. Furthermore, collecting data on safe management of excreta from on-site sanitation systems is challenged by the unavailability of an agreed and validated list of indicators, as well as valid data collection methods and instruments. The JMP 2017 report showed that the single biggest global gap in data availability for national and global monitoring of progress was for the safe management of excreta from on-site sanitation systems (WHO/UNICEF JMP 2017).The primary objective of this study is to explore the status of the different stages of safely managed on-site sanitation (SMOSS) systems across the country with respect to safe fecal containments, emptying, transportation, treatment and reuse/disposal and to make recommendations for routine monitoring of SMOSS progress in future.

1.3
Methodologies

The study was a two-stage mixed methods study design. The study covered five major geographical areas of the country with varying hydro-geologic zones: dense urban areas (City Corporation areas – Dhaka South and Dhaka North), remote and difficult to reach areas (Sunamganj district in Sylhet region); water scarce areas (Rajshahi region); climate vulnerable coastal areas (Khulna region), and the Chattogram Hill track (CHT) areas. The CHT areas are a number of diverse locations, with communities representing different religious beliefs and cultures. The mixed method study design adopted both quantitative and qualitative techniques.



MAP PIN 1- SMOSS survey data collection points, Bangladesh

To be considered nationally representative, data collection activities included the four administrative categories - 1) City Corporations (CC) representing large cities, 2) Medium Towns (MT), 3) Small Towns (ST) and 4) Rural areas (MAP PIN 1). All administrative areas were considered across all five previously defined hydro-geologic zones. Further to note, the CC households had two separate representative groups: CC Resident communities and CC Low Income Communities (LICs). The four different categories of administrative areas were based on population density and population size of the country. As such, City Corporations are based on a population size of >300,000 (Ref. 6. Bangladesh Housing Census, 2011, BBS), Medium towns were based on a population size of 100,000 – 300,000, and Small Towns were based on a population size <100,000, and is under municipality corporations.

Field-level data collection activities were implemented from October to December 2020. A team of 65 enumerators/UNICEF Volunteers were recruited as well as 9 supervisors to carry out the quantitative data collection activities. Qualitative data was collected by a separate set of qualitative research specialists (Details at page-17).

The study team used the random cluster sampling (RCS) technique for the quantitative household survey. The sampling was based on the design effect (def.) 2.2, Intraclass correlation coefficient (ICC[1]) 0.05 and error level 0.05. It was calculated that across all five data collection areas (CC-Residents, CC-LICs, Medium Towns, Small Towns, and Rural), a minimum of 23 clusters (25 households per cluster) would be enough to represent each of the five areas. The team estimated that data was to be collected from 137 clusters with a total of 3425 households. Field teams were able to conduct interview in 3149 households out of 3425. Inspections were conducted for sanitation facilities for a total of 2518 households out of 3149, where latrines containment facilities were available.

For the qualitative research, the study conducted 13 Focus Group Discussion (FGD) with service providing agencies, departments, companies and frontline groups using a formative tool/guideline. For key informant interviews with key staff of the policy and decision-making government departments and agencies in regard to SMOSS, the team conducted 10 Key informant discussion using virtual platform.

In the analysis section, rural and urban weighted national data are presented as well as a descriptive analysis based on calculated proportions and means. Also, a comparative data set will be presented according to rural, urban, city corporation-residence, city corporation-LICs, municipalities (medium towns) and small towns areas.

2. FINDINGS

2.1 Safely managed sanitation service chain assesment

Nationally representative data and rural versus urban data in Figure-1 are based on the total of 3,147 Households that were reached during the SMOSS study.Nationally, while 50% of the population used safe sanitation facilities (improved and adequately contained), 23% required emptying their latrine pits and septic tanks, yet only 19% emptied. Only 3.9% did mechanical emptying using either manual pump (non-motorized), motorized pump, or vacuum tanker, whereas 15% emptied manually using local equipment such as Shovel, spade, bucket, rope, etc. Of the 3.9% Households that emptied mechanically, 3.3% transported the emptied fecal sludge using motorized vehicles (motorized transportation of fecal sludge were mostly from Households using mechanical emptying). Overall, 2.2% of emptied fecal sludge was disposed of at a designated disposal/ treatment site and a majority of these House holds used mechanical emptying. However, some Households used manual emptying and transported emptied fecal sludge using vans or push carts and disposed of sludge at designated disposal sites. A significant number of House holds (8%) emptied their pits and septic tanks and buried the fecal sludge within or near to the premises. Thus, in 10% of households emptied fecal sludge was disposed either locally or at a designated disposal site; in the remaining 9% of households where sanitation facilities were emptied, wastes were unsafely discharged to the environment.

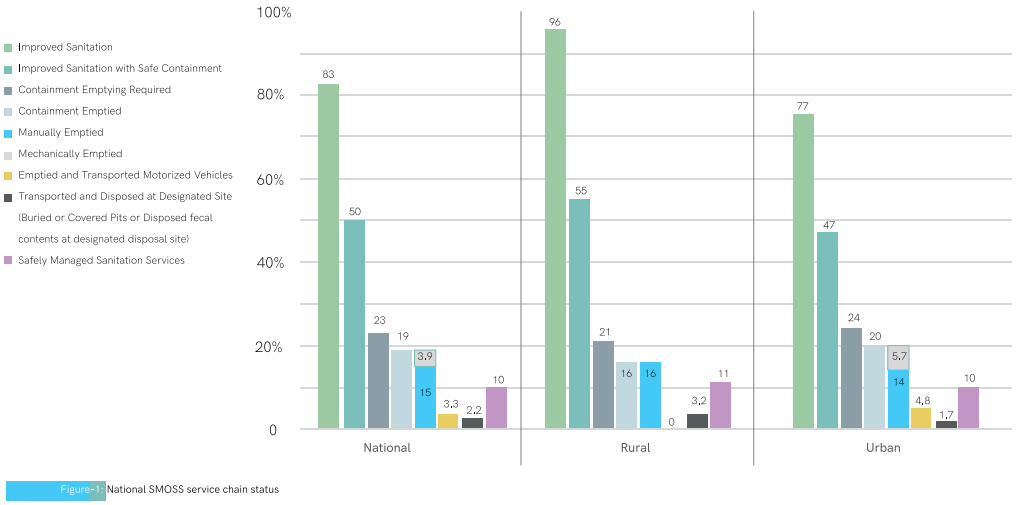


Figure-1: National SMOSS service chain status

In urban areas (Figure-2), significantly higher number of HHs had access to improved latrines in small towns (96%) and medium towns (95%). It also showed relatively better status of functional elements of SMOSS in terms of emptying, motorized transportation, and safe disposal, compared to large city corporations. The worst-case scenario was in the LICs of large cities, having only 8% improved with safe containment latrine facilities and SMOSS services virtually absent of the fecal sludge in an 'appearently' safe manner; either by burial into covered pits or by transporting the sludge to designated disposal sites.

The different types of safe sanitation facilities that are in use in Bangladesh include flush or pour flush toilets connected to piped sewer systems, septic tanks or different types of pit latrines, ventilated safe pit latrines, pit latrines with slabs and composting toilets. The SMOSS study results show that 50while 83% of households use improved sanitation facilities, only 50% of these have adequate containment and are potentially safely managed. This is very comparable to the MICS 2019 which found 85% of the population using improved sanitation facilities, but did not include any assessment of containment (BBS/UNICEF, 2019).

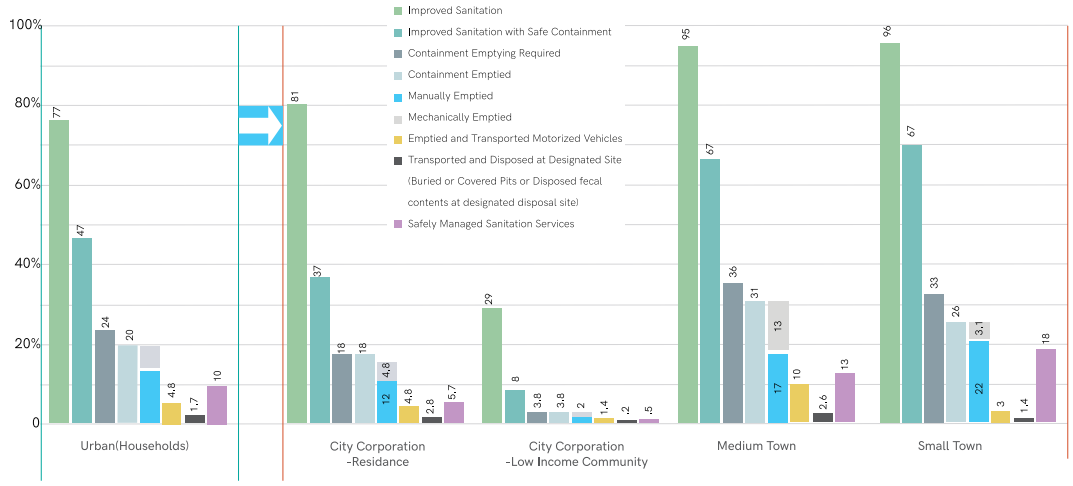


Figure- 7: SMOSS service chain - Urban

2.2
Access to improved sanitation facilities with adequate containment

Access to improved sanitation facilities with adequate containment in both rural and urban areas are lower (55% in rural and 47% in urban) in the SMOSS study compared to 82% in rural and 61% in urban areas a year ago in the MICS (2019) survey. SMOSS result is very much comparable to the MICS 2019, but the variation shows because of MICS 2019 did not include any assessment of containment (e.g. SMOSS study excluded 29.5% sewerage coverage in urban areas that appears to be confused with storm drainage networks).

The lower access to improved sanitation with adequate containment (50%) in the SMOSS study could be attributed to the fact that septic tanks (13%) that are directly connected to drains, ditches or other open water bodies without going through soak wells are considered improved sanitation with inadequate containment system. Moreover, another 14% of latrines/toilets that do not have any containment (pit or septic tank) at all and are directly discharging into drains or ditches, are considered unimproved sanitation facilities in the SMOSS study.

HOUSEHOLDS

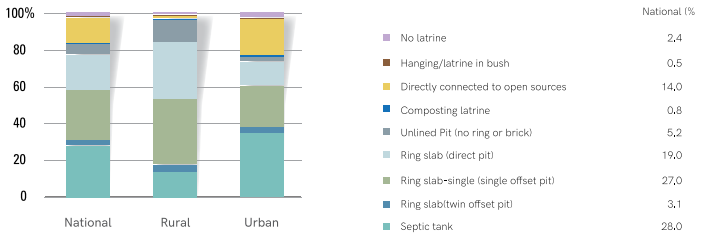


Figure- 3: Sanitation coverage by facilitie types

It should be noted here, that to ensure SMOSS service, containment of fecal sludge in pits or septic tanks is extremely important for safe and sustainable management of subsequent functions in the sanitation service chain. Further, access to pit latrines with adequate containment during the SMOSS survey was found to be lower (37%) compared to the MICS 2019 survey (53%). The SMOSS survey found that 20% of pit latrines were either of inadequate capacity and hence overflowing or some pits were discharging to ditches/open water bodies.

The use of septic tank systems in urban areas, as revealed by the present SMOSS survey, is of particular importance. The survey found that 34% of Households in urban areas were using septic tanks but close to half of them (16%) were not considered contained as their outlets are connected directly to drains, ditches or open water bodies. The MICS (2019) survey also found 32.9% of Households using septic tanks but did not differentiate between contained or not contained septic tanks.

A further striking result of this study is the use of septic tanks with inadequiate containment in large city corporations. While 69% of Households in large city corporation areas use septic tanks, a staggering 41% of households with septic tanks were discharging directly into storm water drains, canals, or backyard ditches and because of this direct discharge into the open environment, the emptying of septic tanks was also less frequent as sludge the tank outlets and into the environment. This appears to be the main reason for very low demand for emptying and transportation services in large cities. Equally, in medium-towns, 41% of Households use septic tanks of which13% are unsafe in small-towns the situation was not as bad; with only 2% of Households using septic tanks unsafely of the 13% of Households using a septic tank system.

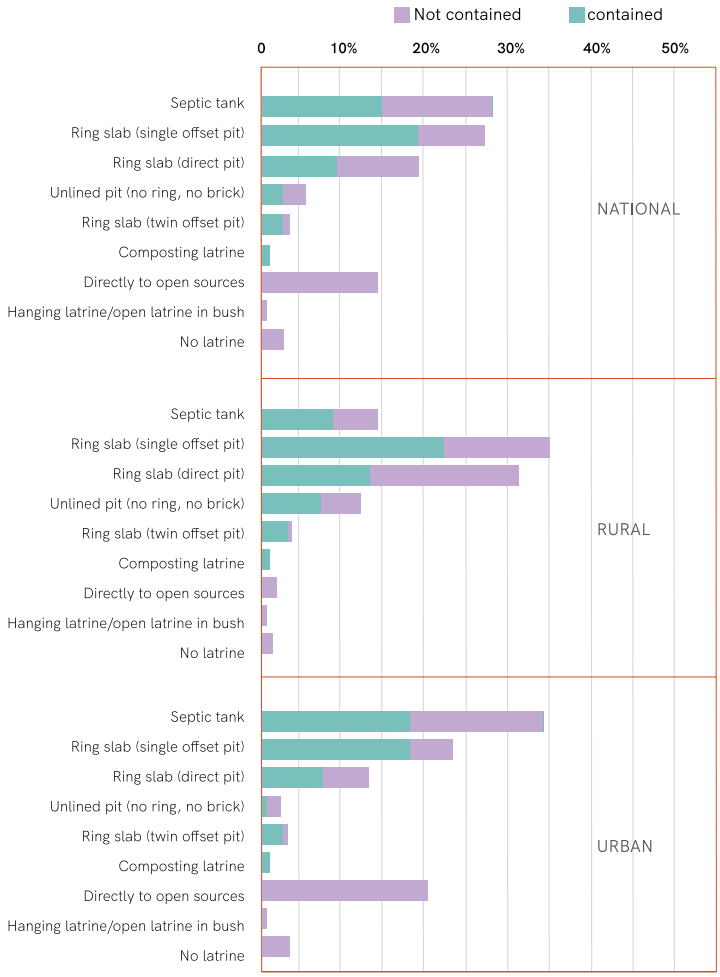


Figure- 3a: Sanitation coverage by facilitie types

HOUSEHOLDS

It is worth mentioning here that if these not contained septic tanks could be transformed into contained ones, which should be possible relatively easily; a significant portion of urban Households would come under safe latrine coverage. This would also leverage the development of sustainable FSM with more urban population enjoying safely managed sanitation services.

2.3
Emptying fecal sludge from pits and septic tanks

The study found that 1513 households (of 3147) had improved latrines with adequate containment and 2518 households (of 3147) had latrines with either a pit or septic tank inadequate containment (Figure-4).

The MICS (2019) survey also reported that exactly 56% of Households never emptied their pits and septic tanks. There could be several reasons for this; firstly, a major portion of the pits and septic tanks didn't reach the stage of emptying at the time when the survey was conducted, for instance 57% of the sanitary inspections and 63% of the sludge management surveyed (data are in Table 3.3 in the detailed report) were found half or more than half empty. Secondly, a significant number of Households are perhaps reluctant to empty their latrine pits/septic tanks, unless it becomes absolutely essential, e.g., when overflowing, primarily because of the cost of emptying. Thirdly, some containment storage (9%) are located inside the dwellings, e.g., inside the kitchen, and also 14% pits are directly under the latrine superstructure so they are not easily accessible and as stated previously, given many on-site facilities are connected to drains or waterways, it is possible that sludge sludge overflows reducing accumulation in the containment.

Figure- 4: Fecal sludge emptying practices.

Among households that had contained latrines, only 38% of those households ever emptied their latrine pits or septic tanks and continued using them. This in comparison was lower (33%) among households of any type of containment facilities. Inspections during the survey found that 43% of pits and 37% of septic tanks were almost full or two-third portion full (detailed at page 31) indicating that a significant proportion of containment storages were filled up and required emptying but emptying of pits/septic tanks was relatively low. This situation is particularly critical for septic tank performance. Due to sludge build-up, there will be much less liquid volume left for sedimentation of solids within the septic tank, resulting in a solids/sludge overrun through the outlet device to the soak well leading to blockage of the soak well and prohibiting infiltration of effluent into the soil and ultimately leaving a failed, overflowing soak well. Generally, septic tanks should be emptied when sludge build-up reaches between one-third to less than half the volume so that the septic tanks can function adequately and can retain most of the solids and restrict solids overflow with the effluent into the soak wells. It is therefore, extremely important to generate demand for emptying services of septic tanks and pits for the continued proper functioning of these onsite options.

2.4
Transportation of fecal sludge

Among the households with contained latrine facilities (1,513 Households), 21% carried out mechanical emptying using methods such as non-motorized pumps, small motorized pumps and vacuum tankers (Figure-5). However, almost all mechanical emptying was only practiced in URBAN areas.

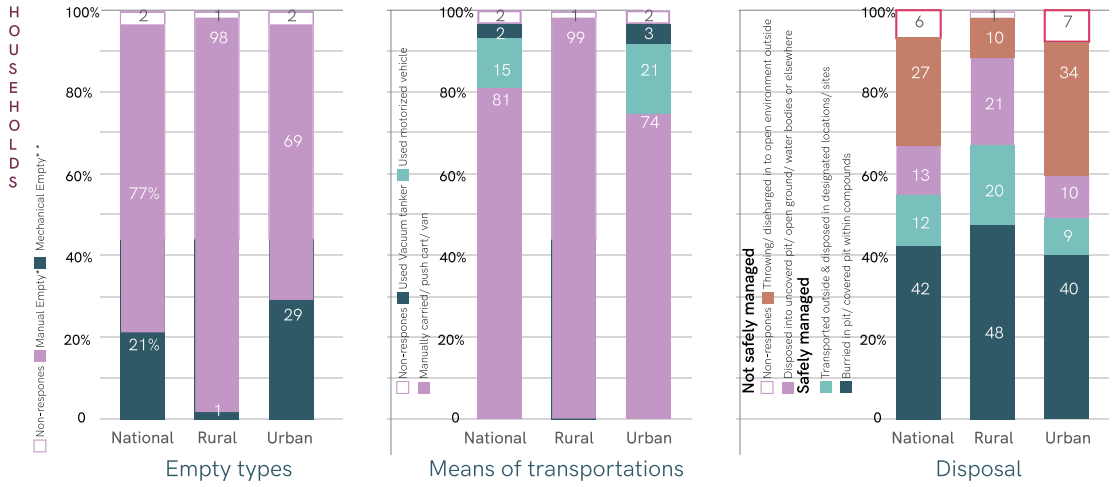


Figure- 5: Emptying, transportation and disposal of fecal sludge from HHs improved on-site facilities with adequate containment

Transportation of 81% of emptied fecal sludge from households with contained facilities was done manually using push carts or vans and was commonly associated with manual emptying. Only 17% of emptied fecal sludge was transported using motorized vehicles (15%) and vacuum tankers (2.3%) mostly in large cities including some LICs and medium towns as shown in Figure-5. The entire rural population (99%) resorted to manual emptying using local tools and techniques and manual transportation of fecal sludge is the only option as mechanical emptying services and motorized vehicle/ vacuum tankers for transportation of fecal sludge is only available in urban areas.

Regarding disposal of emptied sludge from Households with contained facilities, as indicated in Figure-5, 54% of disposal was assessed as safe, including 42% buried in pits on the property and 12% disposed in a designated disposal site. 40% of the disposal was done unsafely in an open environment, such as discharging into storm-water drains, uncovered pits, open ground and open water bodies. Triangulation of the quantitative data, group discussions with frontline workers and informant interviews revealed that the unsafe disposal of fecal sludge is due to lack of awareness, lack of regulatory actions by law enforcement departments, lack of monitoring capacity of local authorities, and absence of designated disposal sites or treatment facilities.

*Manual empty: Used shovel, spade, bucket, rope, etc.

**Mechanical empty: non-motorized pumps, small motorized pumps, Vacutags, etc.

2.5
Disposal and Treatment

Households level engagement in the treatment and re-use of fecal sludge is uncommon in Bangladesh. However, the SMOSS survey found that 21% of the households could mention the purposes of transporting the emptied fecal sludge, and as expected, this was the case more so in urban areas (25%) than in rural areas (Table 3.6 in the detailed report). However, only in a few cases was there the mention of the safe disposal and re-use of fecal sludge.

Focus group discussion and key informant interview revealed that there are fecal sludge management projects initiated by NGOs and some by commercial service providers partly across different cities in Khulna, Chattogram, Rangpur, Jhenidah, Kushtia, Jashore, Gazipur, Dhaka, and Mymensingh. The FGD respondents reported that they disposed of fecal sludge at the designated locations allocated by the authorities. However, in the five municipalities and in the big city corporation areas, the individual frontline workers reported that (participated in the FGD) they do not have the capacity to dispose of fecal contents at designated locations because of its cost and that it is too time consuming. It is estimated that in the areas where service providers support groups are available, over half in those locations disposed fecal contents safely.

2.6
Protective measures for emptying operations

Though nearly one-third (33%) of the survey's Households using on-site sanitation facilities, irrespective of containment latrines, and 38% of Households with safely contained facilities, have ever emptied their latrines; use of protective equipment for the services were considered low. The common protective equipment used by the emptiers were face mask, gloves, boots, and very few individuals used body cover. 53% of the cleaning workers used masks, 39% used gloves, 27% used boots and 15% used body covers. In urban areas, the use of gloves, boots and body covers is slightly higher compared to rural areas, whilst mask use in rural areas is higher. In 15% of cases use of chemicals like kerosene, phenol, bleaching powder, quick lime, ash, are reported. These chemicals were used mainly in order to get rid of bad smells of fecal contents. It may be noted here that the above percentages of using different safety equipment, particularly the use of masks, may not be a true representation of pre-COVID period.

3. RECOMMENDATION

The extensive data in this study clearly revealed that although half of the population has access to safe, safe latrine facilities, knowledge and practice levels of safe emptying, transportation, treatment, disposal and/or safe reuse of treated products, taking protective measures, and use of mechanical systems are still unacceptably low. For urban areas, the scenarios are comparatively better in small and medium towns, whilst the situation in large city corporations is poor and even worse in the LICs of large cities.

SMOSS services in urban areas will not be effective unless the very critical situation in the LICs of large cities is immediately addressed. With only 8% access to safe sanitation facilities in LICs, 59% of toilets have no containment facility at all and are directly connected to drains/ ditches/open water bodies. 12% of Households still do not have any latrine facility at all. At present, in urban areas nearly 80% of emptying is done manually, while in rural areas emptying is done almost entirely manually. During emptying, emptiers often do not use of safety gears/ equipment.Treatment of fecal sludge is very limited in Bangladesh; only a handful of small to medium Fecal Sludge Treatment Plants have been developed and are being operated by a small number of City Corporations and Paurashavas (municipality), mostly in partnership with I/NGOs.

According to the Local Government Act (2009), the overall responsibility of on-site sanitation management lies with the local government institutions (LGIs) e.g., City Corporations, Municipalities for urban areas, and Upazila (Sub-district) Councils, Union Councils for rural areas as mentioned in IRF-FSM (2017). However, these institutions have limited manpower, resources and capacity for planning, development, and management of sanitation services.

Enforcement of sanitation related laws and regulations may be very challenging unless all concerned people; including local public representatives, government officials, civil society, and most importantly the users are sensitized to the benefits of safe on-site sanitation facilities and the complete chain of safely managed sanitation services. Proper sensitization will also help stop illegal/unauthorized connections of pits/septic tanks to open drains, ditches or water bodies as well as restricting unauthorized disposal of collected sludge into the open environment.

3.1 Improving On-site Containment Systems

As half of the population is using improved but not contained sanitation systems, the immediate focus should be on transforming them into safe systems, ensuring the adequate containment of fecal sludge, and preparing them to adopt sustainable fecal sludge management (FSM), thus ensuring SMOSS. It shouldn't be too difficult to change the unsafe septic tanks into safe septic tanks in urban areas, except in a few densely populated areas of Dhaka and Chattogram cities where soak wells may not be successful primarily because of the low infiltration capacity of the soil.

Upgrading septic tanks (13%) with inadequite containment systems could immediately convert saptic tanks with adequite containment systems to increase safely managed sanitation coverage to 63%. Another 14% of Households that do not have any containment facility at all and discharge directly to drains and open water bodies, could be upgraded by enforcing installations of adequate containment facility, to increase safely managed sanitation coverage to 77%. Private sector organizations may be encouraged to produce and promote pre-constructed septic tanks of durable materials e.g., PVC, GRP etc. for varying number of users and following appropriate design. Such an initiative would accelerate improved and adequite on-site containment system.

Both safe, contained and not contained tanks have to be checked for adequacy in design considering the number of users e.g., checking tank dimensions, having generally 2-chamber tanks with a length to width ratio of 3:1; properly positioned with appropriate inlet and outlet devices; and adequately designed soak wells with an appropriate filter media. This checking is extremely important to make sure that the system functions truly as septic tanks (and not simply as holding tanks or pits) whereby most solids are retained through sedimentation, anaerobic decomposition takes place, and the generated sludge is contained. Depending on the design, the accumulated sludge must be emptied regularly. The desludging operation of septic tanks must be monitored by the local authorities (LGIs) following a "scheduled desludging plan" to be prepared as a means to implement SMOSS. Strict enforcement of such a plan will increase demand for emptying and transportation of fecal sludge which subsequently will enhance demand for building more FSTPs, thereby completing the chain of SMOSS services in an area.

Unsafe pit latrines should be relatively easier to convert into safe ones. Undersized/Overflowing pits can be addressed either by increasing volume based on user numbers or convert them into twin off-set pits for alternate use whichever may be appropriate in a given context. However, for alternate twin off-set pits to be considered as a safely managed on-site option, two important criteria need to be fulfilled: firstly, each pit should be designed for adequate volume, capable of accumulating fecal sludge continuously for 18 to 24 months, so that during the alternate resting period the content is fully sanitized; and secondly, the Y-junction/diversion pit must be properly designed, built and operated for smooth transfer of fecal sludge from one pit to the other.

3.2
Special Attention to Sanitation Services for the LICs

SMOSS services in urban areas will not be effective unless the very critical situation in the LICs of large cities, as revealed by this study, is immediately addressed. With only 8% access to contained sanitation facilities, 59% of toilets with no containment facility at all and that are directly connected to drains/ ditches/ open water bodies, 15% are connected to septic tanks with inadequate containment systems and those outlets are connected to the open environment and 12% still do not have access to any kind of sanitation facility at all. The situation is very alarming and concerned authorities must pay immediate attention to improve the sanitation conditions in the LICs thereby ensuring safely managed, inclusive sanitation services for the city dwellers.

Individual or clustered latrines may be connected, perhaps through small sewer networks, to community septic tanks or multiple pits system wherefrom the fecal sludge could be emptied and transported to designated disposal/treatment sites. In LICs with very high population density, frequent desludging of the community septic tanks or small low volume pits would be needed to avoid latrines without containment and eliminate open defecation. Concerned authorities should also invest in arranging small motorized vehicles fitted with vacuum pumps, so that these can navigate through narrow roads in slums and LICs. It is also important that the concerned authorities consider giving financial support to the poor Households in terms of lowering the emptying and transportation charges and waiving sanitation tax where appropriate with the objective of rapidly enhancing the SMOSS services in LICs.

3.3
Ensuring Safe Emptying and Transportation of Fecal Sludge

Initiate shifting from manual emptying to mechanical emptying and targeting to gradually achieve 100% of mechanical emptying of fecal sludge containments is the goal. While at present nearly 80% (almost entirely in rural areas) of emptying is done manually, immediate focus should be on ensuring the use of safety equipment by the emptiers and also the use of small motorized pumps or at least manually driven pumps in order to strictly avoid emptiers/cleaners entering into pits or septic tanks.

This will require adequate orientation and training of emptiers/sanitation workers/cleaners and an adequate supply of safety equipment. The process must be facilitated by the local government institutions in both urban and rural areas with support from government technical agencies e.g., DPHE, LGED, WASA, and possibly with support from I/NGOs, and local CBOs. Local level, strong monitoring systems should be developed by the LGIs and must be in place to ensure safe emptying operations.

Fecal sludge emptied must be transported safely to designated disposal and/or treatment locations and motorized transport facilities must be enhanced, manual transportation using push carts or vans should gradually be phased-out. Transport operators must also follow the safety rules and use proper safety equipment during fecal sludge transportation.

The issue of unauthorized disposal at different locations in the open environment must be seriously addressed and such disposal must be strictly prohibited. To stop the situation of unauthorized disposal, it is important that the concerned LGIs ensures designated disposal and/or treatment sites at appropriate locations considering areas to be served, estimated fecal sludge volume, travel distance and availability of land.

Following the recently developed Institutional and Regulatory Framework (IRF) for FSM (2017), a strong policy environment may be developed locally by the LGIs with support from relevant government and non-government organizations.

3.4
Treatment, Disposal and/or End use of fecal sludge

As revealed by the present SMOSS study, treatment of fecal sludge is very limited in Bangladesh; only a handful of small to medium FSTPs have been developed and are being operated by a few City Corporations and Paurashavas (municipality), mostly in partnership with I/NGOs. FSTPs in Chattogram, Khulna, Rangpur city corporations, and in Faridpur, Jhenidah, Kustia, Shakhipur, and Lakhsmipur municipalities are a few examples of fecal sludge treatment areas. Construction of some more FSTPs in different municipalities are in the pipeline through government and external funded projects.

However, hundreds more FSTPs are needed in urban and rural areas to accommodate the increased amount of fecal sludge that will be generated at the onsite sanitation points. This will be particularly important as the unsafe/unsafe onsite facilities are safe and containment facilities are adequately established and demand for emptying and transportation increases.

It is therefore, important that the LGIs, with technical and financial support from the central government and central government organizations, e.g., DPHE, WASAs, I/NGOs and development partners, immediately embark upon building FSTPs alongside improvement/ enhancement of other upstream functions such as emptying and transportation of fecal sludge. This will require procuring lands and equipment e.g., vacuum tankers of varying sizes, to be planned and designed with provisions for future expansion, for specific urban or rural communities. Apart from land intensive drying bed options, other alternative/innovation treatment approaches should also be considered.

It is to be emphasized that the involvement of the private sector in the construction, operation and maintenance of FSTPs would expedite the whole process of fecal sludge treatment. LGIs could also consider various PPP models for establishing the entire sanitation chain of services including collection, transportation, treatment, disposal and/or reuse of treated products. This could lead to rapid development of safely managed, sustainable, inclusive sanitation services.

However, as an interim measure, transported fecal sludge can be safely disposed of at designated locations in trenches and covered with appropriate material and left undisturbed for 18 to 24 months. This will be particularly useful for rural areas where developing FSTPs may not be immediately feasible. It is also important that people understand the reuse value of treated products. Popularizing safe use of treated end products, e.g., fertilizers, bio-energy, will also increase demand for SMOSS.

3.5
Enhancing Capacity of Institutions for Service Delivery

While the government has recognized the need for developing safe sanitation services for both urban and rural areas, it is extremely important that the capacities of LGIs are strengthened in terms of manpower, resources, training and orientation which can then facilitate the capacity building of stakeholders that are directly or indirectly related to SMOSS services development. LGIs must rapidly undertake the elaboration of their own capacity development and resources management plans with support from the Local Government Ministry, CWIS-FSM Support Cell of DPHE, and the Capacity Development program of ITN-BUET that are already in place for this purpose. Apart from the concerned LGI officials and staff, fecal sludge emptiers, collection and transportation operators, FSTP operators are all important stakeholders needing skills development through orientation and training.

3.6
Awareness Raising for SMOSS Services

Enforcement of sanitation related laws and regulations may be very challenging unless all concerned people including local public representatives, government officials, civil society, and most importantly the users are sensitized to the benefits of safe on-site sanitation facilities and the complete chain of safely managed sanitation services. Proper sensitization will also help stop illegal/unauthorized connections of pits/septic tanks to open drains, ditches or water bodies as well as restricting unauthorized disposal of collected sludge into the open environment.

A major challenge in establishing the 'safely managed sanitation system' is the lack of understanding of its meaning by the general people across the different level of sanitation services: access to safe sanitation, emptying, collection, transportation, treatment and disposal / re-use of fecal sludge. It is therefore critically important that concerned stakeholders, including government agencies and I/NGOs, take initiatives to translate the concept and definition of safely managed sanitation systems into the local context. Until this is done across all stakeholders, and general people are sensitized and required support systems are made available, it will be extremely difficult to achieve the desired goal.

3.7
Monitoring Progress of SMOSS Services

The findings of this SMOSS Bangladesh study have revealed that immediate actions are needed in every aspect of the complete sanitation chain, starting with the containment of fecal sludge, followed by emptying, transportation, treatment and disposal and/or reuse of the treated products. The study further suggests that, since all the system elements in the sanitation chain are interlinked, if fecal sludge can be adequately contained (the first element in the chain) simply by improving the onsite sanitation options at household level e.g., septic tanks and various forms of pit latrines; improvement of the subsequent functional elements of the sanitation chain would be accelerated.

It will be crucially important therefore, to monitor fecal sludge safe containment on a regular basis and also monitor all other activities along the chain, to ensure the progress of safely managed sanitation services. For effective monitoring, it is important that relevant monitoring indicators are identified and mechanisms devised that can be adopted locally. The monitoring data would then be analyzed and evaluated locally and reported to an assigned national body for review.

Considering the data obtained from the present SMOSS baseline study, and based on the results and discussions presented in this report, specific recommendations related to monitoring indicators/ criteria and approaches for all the functional elements along the sanitation chain are suggested below.

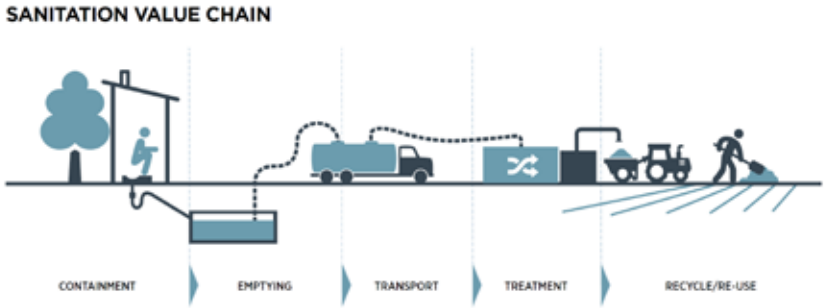
Fig: treatment of fecal sludge and reuse potentials of the treated by product

Safe and adequate containment of fecal sludge

Septic Tank	Pit Latrines		
	Twin Pit Offset	Single Offset	Direct Pit
☐ A fully watertight, adequately designed/ dimensioned tank exists ☐ The tank is equipped with properly positioned inlet and outlet devices ☐ The tank outlet is connected to an adequately designed 'Soak Pit' or a sub-surface drain-field ☐ The tank bottom sludge accumulation depth does not exceed 40-45% of the total tank depth, beyond which sludge emptying would be essential ☐ The septic tank must have a clear freeboard of 0.3 meter above the top surface of scum layer ☐ The septage must not overflow at any time ☐ The septic tank outlet is not connected to storm water drainage/ ditch/ low lands/ open water body.	☐ Two lined or stable, unlined pits, separated by a distance equivalent to effective pit-depth, exist ☐ Both pits must have cover slabs with appropriate opening for sludge emptying ☐ Toilets/cubicles have commodes/pans fitted with proper water-seals and are connected to the offset pits through a Junction/ diversion pit ☐ Neither of the pits overflow at any time ☐ Y-junction / diversion pit is properly designed, built, and operated for smooth transfer of fecal sludge from one pit to the other pit ☐ Have 0.3-meter clear space between pit slab and top surface of fecal sludge of the pit which is operational while surveyed/ inspected ☐ Neither of the two pits is connected to storm drains/ water body/open space.	☐ Single lined or stable, unlined pit exists ☐ The pit must have a cover slab with appropriate opening for sludge emptying ☐ Pit does not overflow at any time ☐ Toilets/cubicles have commodes/pans fitted with proper water-seals and are connected to the offset pit ☐ The pit has 0.3-meter clear space between cover and top surface of fecal sludge ☐ Pit not connected to storm drains/ water body/ open space.	☐ Single lined or stable, unlined pit exists underneath latrine superstructure ☐ Latrine pan fitted with proper water seal exist ☐ The pit does not overflow or leak ☐ The pit has 0.3-meter clear space between cover and top surface of fecal sludge ☐ Pit not connected to storm drains/ water body/ open space.

Safe emptying of fecal sludge

Mechanical Emptying	Manual Emptying (To be phased out gradually)
☐ Pit emptier/sanitation workers use personal protective equipment (mask, gloves, gumboots, etc.) ☐ Motorized pump/vacuum pumps are used for septic tank/pit emptying ☐ Emptying equipment is to be as per ISO standards and approved by local authority (no leakage in emptying pipe/tank etc.) ☐ Under no circumstances should pit emptiers/ sanitation workers enter pits or septic tanks ☐ Pit emptiers/ sanitation workers do not take any food during emptying operation.	☐ Pit emptiers/sanitation workers use personal protective equipment (mask, gloves, gumboots, etc.) ☐ Under no circumstance should, pit emptiers/ sanitation workers enter pits or septic tanks ☐ Buckets, rope used as needed; emptied fecal sludge stored in drums/containers of appropriate sizes, covered and readied for transportation by vans/ push carts ☐ Spades are not used ☐ Pit emptiers/ sanitation workers do not take any food during emptying operation.



Safe transportation

Motorized Transportation and Discharge	Non-motorized Transportation and Discharge
☐ Fecal sludge transport operators and related staff use PPE (mask, gloves, gumboots, etc.) ☐ Use motorized vehicles fitted with sludge emptying pump/ vacuum tanker as per ISO standard and approved by local authority ☐ No spillage of fecal sludge during emptying, collection and transportation ☐ Fences and warning signs at critical locations along the route and around disposal point for accident prevention ☐ Collected fecal sludge disposed of at approved designated sites (trenches/ burying pits with adequate cover materials or FSTPs) and NOT into storm drains/sanitary sewage pump/ lift stations/ open water body/ low lands	☐ Pit emptier/ transport operators and related staff use PPE (mask, gloves, gumboots, etc.) ☐ Covered drums/containers filled with fecal sludge have adequate freeboard and placed on the push carts/ manual vans/ tricycle vans in such a way that there is no spillage on the road ☐ Proper conduits/pipes used for transport to the burying pit ☐ No spillage of fecal sludge during emptying, collection and transportation ☐ Collected fecal sludge disposed of at approved designated sites (trenches/ pits with adequate cover materials or FSTPs) and NOT into storm drains/sanitary sewage pump/ lift stations/ open water body/ low lands

Complete treatment of fecal sludge and reuse potentials of the treated by product

Treatment of fecal sludge/ dewatering/ drying/	Treatment of separated liquid and disposal	Storage/ processing of dried fecal sludge/ reuse/ disposal
☐ Treatment plant operators and staffs use safety equipment (Mask, gloves, gumboots, etc.) ☐ The treatment plant is adequately fenced ☐ The treatment plant is operational ☐ Treatment option employed is unplanted drying bed/ planted drying bed/ mechanical dewatering/others ☐ Dried sludge stored in a properly built shed/ left in the open ☐ Dried sludge transferred to other locations for further processing ☐ Separated liquid conveyed to specific units for further treatment ☐ In absence of a FSTP, transported fecal sludge is safely disposed of at designated location through trenching and covering with cover materials ☐ Disposed fecal sludge is left undisturbed for 18 to 24 months ☐ Odor, dust and leachate are under control.	☐ Treatment plant operators and staffs use safety equipment (Mask, gloves, gumboots, etc.) ☐ Site is adequately fenced ☐ Separated liquid treatment option e.g., ABR/ constructed wetlands/ anaerobic filter/ stabilization ponds ☐ The treatment plant is in operation ☐ Regular effluent quality testing protocols exists ☐ Test results of concerned parameters e.g., BOD, SS, FC, E. Coli, etc. are reviewed regularly and are found to satisfy the guideline values as per the Bangladesh Environment Conservation Rules (ECR) 1997, for either reuse in agriculture, fish ponds or for disposal into the aquatic environment.	☐ Plant operators and staffs use safety equipment (Mask, gloves, gumboots, etc.) ☐ Dried sludge storage shed exist ☐ Dried sludge tested for moisture content, calorific value, Helminth eggs, other pathogens and nutrient contents ☐ Dried sludge taken for further processing for reuse as fuel and/or compost or for safe disposal at designated locations ☐ Odor, dust and leachate are under control. ☐ Test results fulfill the standards/ guideline values set by the competent authority e.g., the Department of Agricultural Extension, Bangladesh for the compost derived from dried sludge to be applied in agriculture.

3.8 Institutionalizing SMOSS Monitoring:

1) A high level 'National Coordination Committee (NCC)' is being instituted at the Ministry of Local Government, Rural Development and Cooperatives. The sanitation secretariat in DPHE is expected to act as the 'Secretariat' of the NCC. Alongside other roles and responsibilities assigned by the NCC, Policy Support Branch (PSB) can develop national and local level SMOSS monitoring protocols and is best positioned to monitor and track progress of National SMOSS situation.

(2) Policy Support Branch with support of sanitaion secretariat to develop household and institutional level safely managed containment inspection and monitoring protocols and orient DPHE and DG-Health frontline staffs and the WATSAN Committees to conduct the field inspection and monitoring.

(3) CWIS-FSM Support Cell is to develop safely managed emptying and transportation inspection and monitoring protocols and orient City Corporations, Municipalities, Upazilas and Union Parishads to undertake field monitoring, preferably by engaging private sector organizations with LGI officials overseeing the whole process.

(4) The NCC shall approve all relevant rules, regulations, monitoring protocols and approaches/ mechanisms and may form different sub-committees/ taskforce to steer monitoring and inspection activities for urban and rural SMOSS progress.

PART TWO:
DETAIL REPORT

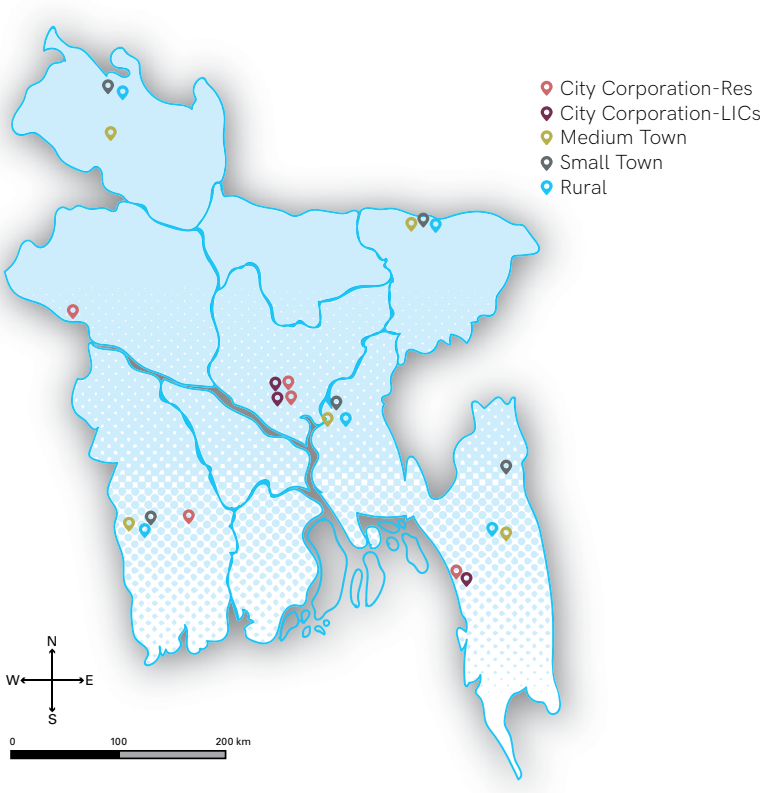
1.
Study design versus geographical area coverage

While the majority of people have access to safe sanitation facilities in Bangladesh (use septic tanks or pit latrines), the study hypothesis was, much of the fecal matter collected in these on-site facilities is not safely managed.

The study was a two-stage mixed method study design. The study covered major five geographical areas of the country under varying hydro-geologic zones - densest urban areas (City Corporation areas – Dhaka South and Dhaka North), remote haor and difficult to reach areas (Sunamganj district in Sylhet region); water scarcity areas (Rajshahi region); climate vulnerable coastal areas (Khulna region), and Chattogram hill tract areas. The Chattogram hill tracts are areas are diverse locations, and the people are based on different religious beliefs and culture. The mixed method study design adopted both quantitative and qualitative techniques. The sample size of the design was nationally representative.

Considering the nationally representativeness, data collection activities included the representations in four categories of administrative areas - 1) Resident communities and LICS in City Corporations (CC) representing large cities, 2) Medium Towns (MT), 3) Small Towns (ST) and 4) Rural areas (Figure 1). All administrative areas were considered across all four previously defined hydro-geologic zones. Further to note, the CC households had separately two representative groups- CC Resident communities and CC Low Income Communities (LICs). The four different categories of administrative areas were based on population density and population size of the country. For example, City Corporations are based on population size of >300,000 (Ref. 6. Bangladesh Housing Census, 2011, BBS), Medium towns were based on population size of 100,000 – 300,000, Small Towns were based on population size <100,000 and is under municipality corporations.

The quantitative technique included interviews with household members and inspection/ observation of the design, operation and maintenance, and present condition of on-site facilities.



MAP PIN 1- SMOSS survey data collection points, Bangladesh

The quantitative technique involved data obtained from household surveys using random cluster sampling (RCS). Qualitative technique included focused group discussions (FGD), key informant interviews (Key informant interview), inspections (household sanitation facilities) and spot checks (designated location for treatment and disposal of waste). In qualitative sampling, the study team decided to conduct at least two Focus group discussion with the frontline activists, departments, and groups at each of five hydro-geologic zones. This represented the zone population. The Key informant interview participants were the people/actors those were engaged in key-decision making process at country level. Detailed about the participants and sample size is discussed in the respected sections below.

Across the report, we used key terminologies – safe containment, safe emptying and transportation, safe disposal, and safe treatment. These terminologies are defined as per WHO (World Health Organization (WHO), 2018). We also used the terminology of low-income communities (LICs) in city corporation areas and the terminology is used here as per the definition of UNDP (UNDP, 2019). Details of the terminologies are summarized herewith in Figure1.

Figure – Normative definitions

Safe latrine coverage	This literature used safe latrine category based on JMP definitions. Besides this, the study mostly used safe latrine coverage data. Definition of safe latrine coverage differs from JMP definition. In the literature of JMP, if a latrine has a standard superstructure (proper door and fencing which can maintain the privacy of the latrine users) and has a septic tank or has a pit which has no leakage. If the pit is occasionally flooded during the rainy season, yet it falls in the safe latrine category. However, we called a latrine is safe to use if septic tank is not connected with any open source environment, or if the pit of a latrine has no leakage or the latrine has base at higher level so that in rainy season the fecal contents in pit does not connect with open source environment.
Safe containment of fecal sludge	"Fecal sludge should be contained in a septic tank or in a wet-pit that leach directly into the subsoil. In either case, sludge should not enter the environment where it could directly expose users and the local community to fecal pathogens. Liquid effluent from septic tanks or wet-pit container should discharge to a sewer or subsoil structures via a soak pit or leach field or should be fully contained for later conveyance. It should not be discharged to an open drain or water body where, through contact or consumption, it could result in exposure of the local community and/or wider community to fecal pathogens".
Safe emptying & transportation	"Both manual and motorized technologies require workers (service providers, emptiers, and exhausters) to handle tools and equipment that have contact with fecal sludge (including the liquid supernatant or effluent if any). Workers entering pits should be avoided due to the risk of injury or death from pits collapsing or inhalation of toxic gases. The key principle for safe emptying and transport is therefore limiting the exposure of these groups to the hazardous fecal sludge. From a public health perspective, manual emptying carries a greater risk than motorized emptying, as there is greater likelihood of workers having contact with the fecal sludge. Therefore, wherever possible motorized emptying and transport should be prioritized over manual emptying and transport.
Safe disposal: Transfer stations and sewer discharge stations	Discharge stations need to be properly designed and/or operated, especially if retro-fitted to an existing wastewater system. If thick fecal sludge is discharged into a sewer that is not designed to receive such sludge, it may cause a blockage and result in the sewer overflowing or, if the associated treatment works is not designed to receive concentrated fecal sludge, it may cause a failure of the treatment process. Both problems can be expensive to rectify. Designated disposal site meant the respective local authorities allocated locations to dispose the fecal contents. The designated disposal locations could be municipality allocated disposal sites.
Safe treatment	A treatment plant with a good pathogen removal performance will also have a good physical and chemical removal performance. Many issues to consider in selection of a treatment process including- • the predicted inflow and characteristics of the influent or fecal sludge; • available land; • available energy sources; • available human resource capacity; • location of population centers; • topoFigurey; • soil characteristics; • water table; • local climate and prevailing winds; • seasonal and climatic variations; • overall capital cost; and • likely operation and maintenance costs.
Unsafe pit latrines or septic tanks	Unsafe pits defined as those had some level of leakage or break so that the fecal contents can contaminate the surrounding environment. Unsafe septic tanks defined as those septic tanks were connected to open sources in order to avoid the filling of septic tanks. The open sources meant connected to drainage facilities, to water bodies, or to open fields.
Low Income Communities (LICs) Ref: UNDP	Low-income communities are struggling to find affordable urban housing in Bangladesh's cities. Millions are heading to cities to tap into economic opportunities, causing booming urban growth. But many of them are facing skyrocketing property prices, a dysfunctional rental market, and limited public housing. Local authorities are falling behind on delivering affordable housing schemes. The outcome is low-income communities pay exorbitant rents to live in slums with poor services and no tenure security.

1.2
Study Components, tools, guidelines

The study adopted both quantitative and qualitative components and used multiple methods and techniques for data generation. Details of the tools are attached separately. Methods and techniques are briefly described here.

1.2.1
Desk review

The study team conducted desk review based on available secondary sources of data. Such secondary sources would include available database, reports, and documents from different government institutions, and I/NGOs. During the desk review, the team attempted to review datasets of MICS, BDHS, National Hygiene Survey, and data of ongoing 61 Towns' project by DPHE/ITN-BUET.

After reviewing tools, we noticed that those data sets collected primary data, only up to sanitation coverage level whose percentage figures are available in their published reports. However, the ongoing 61 Towns' Project may have some level of in-depth data in line with the SMOSS study, however, the authority might not be ready yet to share the data set due to incompleteness of the study.

1.2.2
Household survey using smartphones

For the primary sources of quantitative data in regard to SMOSS related information, face to face household interviews were conducted and in addition, the field team conducted inspections of household sanitation facilities, sanitation conditions, and faecal containment status. These data were directly inputted to the smartphone.

Details of the tools are attached separately (Appendix A).
The household questionnaire was designed in to an electronic software, tested the software questionnaire and oriented the questionnaire for the enumerators. Data those were captured, were sent to the server by the enumerators daily basis. The software had the flexibility of checking the accuracy level of the survey centrally once the questionnaire was sent from the field.

The software was independently designed by a consultancy firm, named the software 'sitepad'. The software had was powered to include conditional field entry, conditional checking options, autosaving options, and frequent editing options. Further once the data was sent to the online server, yet in case further correction was needed, once this corrected version resubmitted, it was replaced by the previous submission copy.

Pilot testing – immediately after conducting in-house training for both questionnaire and methodology, and smartphone program, the team did dummy practices, follow by day long field test. Later on, a day-long discussion was arranged to address the feedback from the dummy practices and field testing.

Minimized Error level – after submission to the server, the SMOSS technical team conducted logical checks for
all submitted data and provided immediate feedback to the data collectors for correcting the data. Another advantage of using this software was, there was very limited chance of data loss. This was because, the field team collected data using offsite data collection options, once the enumerator finished data collection for the day, immediately, s/he connected the smartphone to internet and send off the raw data to the server. Later on, while the enumerator was at home, he double checked data and corrected the errors, and then s/he re-submitted the corrected data.

The lessons from the electronic software designing, training, pilot testing and data cleaning were – 1) bring the programmer, coordination staff, and technical specialists was a bit difficult because of administrative arrangement and this delayed the program to finalize for the field, 2) Flexibility of frequent editing options in the smartphone look plenty of times providing specific feedback to respective staff and basically it needs full time dedicated staff which was lacking and this delayed the survey as well, 3) since there was limited scope to do onsite supervision by technical staff, which as not possible because of movement restriction during the COVID-19, therefore, the supervision of data collection activities had to depend on local level UNIFEF admin team.

1.2.3

Focus Group Discussions (FGD) with service providers

This was a primary source of qualitative data. The study team conducted qualitative Focus group discussion with different categories of services providers including private/commercial agencies, NGOs, sweepers, cleaner groups and other frontline workers, transport and treatment plant operators. This tool covered equipment and services related to emptying and transportation of faecal sludge as well as data on services related to treatment, recycling and reuse. The tool also included some spot checks at designated locations for treatment and disposal of FS in case the FGD is conducted on spots. Details of the tools are attached separately (Appendix B).

1.2.4

Spot checks/Virtual Tour of designated sites for faecal sludge treatment and disposal

The virtual tour added to the primary sources of spot checks data. In case the study team failed to conduct spot checks at FGD points such as storage, treatment and disposal/reuse sites, primarily due to prevailing COVID-19 situation, the team conducted virtual tours.

During data collection, each of the field team members regularly uploaded enormous number of spot check photoFigures and videos in the Facebook group, provided feedback and comments on the photoFigures/videos. During data analysis, we have used those for triangulation of the data. All 10 online Key informant interview interviews were recoded too during the data collection and used those interview document for the compilation of Key informant interview data.

These data were very useful in preparation of the detailed technical report, but the only challenge was, compiling those data findings needed plenty of time.

1.2.5

Kll (Key informant interview) with local stakeholders

Objective of Key Informant Interviews were to know the understanding level of SMOSS components by the key actors, policy and decision makers, the current status of the country in regards policy making and implementation, and also to know the capacity and strength. Primary qualitative sources of information were also collected from different categories of policy/ decision making informants including DPHE, LGD, DG-HEALTH, WASAs, City Corporations, Paurashavas (Municipalities), Upazila, Union Parishads, Research Organizations/ Universities, and I/NGOs.

Initially we had listed a series of departments and agencies from which collection of information was planned covering multiple areas including level of strategic plan for fecal sludge management, budget allocations, capital management, financial schemes for FSM, capacity of institutions, availability and capacity of private sector operators, operations monitoring and sustainability.

Details of the guideline tool is attached separately (Appendix C).

1.3 Sampling

1.3.1 Quantitative household survey and inspections of sanitation facilities

he study team used random cluster sampling (RCS) technique for the quantitative household survey (van Breukelen & Candel, 2012). The sampling team calculated the design effect (deff) 2.2 based on ICC 0.05 and error level 0.05. It was calculated that across all five data collection areas (CC-Residents, CC-LICs, Medium Towns, Small Towns, and Rural), a minimum of 23 clusters (25 households per cluster) would be enough to represent each of five areas. The team estimated that data to be collected from 137 clusters, and a total of 3425 households will be covered (Table 2.1). However, the field teams were able to conduct interview in 3149 households out of 3425. Inspections were conducted for sanitation facilities for a total of 2518 households out of 3149, in which visible sanitation facilities were available.
Sanitation inspections were done in those same sampled household latrines. The inspections were done based on several indicators including types of sanitation facilities, leakage or break of pit/septic tank, locations of the facilities, depth of the pit or the septic tanks, and filling status of the pit/tank.

Measurement of depth and filling status of latrine pits/septic tanks and sample size:

During sanitation facilities inspections, depth of pits or septic tanks, and filling status of the pit/tank usually not possible across all. The study teams estimated that the inspection of minimum 10% pits/septic tanks among the sampled households would give a sample of 343 pits/septic tanks, which would have enough power to analyse for these two fresh indicators to represent nationally. It was assessed that at least 80% household latrines will have pits or septic tanks to collect data for these two fresh indicators. Based on Cochran's formula, the standard sample size becomes 246 . The data collection was restricted to the latrines those had visible pits/septic tanks to inspect. In collecting data, the field team measured the length, breadth and height of the latrine pit based on local techniques. Later on, the team noted height of the filling points of those latrine pits/septic tanks.
[1)]

Finally, the field team was able to take measurement of length, breadth and height of 732 pit and 255 septic tanks (total 987 out of 3149, 31%). Filling by fecal content status was inspected and measured for 647 pits/septic tanks (20%).
The cluster and sample size calculation detailed are given in Appendix D.

Table 2.1: Household Sample Distribution

Category of pop	Rural	Small Town	Medium Town	City Corporation		Total Cluster	HH per cluster	Total HH
GEO. Region				Resident	LIC			
1. Rajshahi	5	6	6	5		22	25	550
2. Khulna	5	6	6	5		22	25	550
3. Sunamganj	5	6	6			17	25	425
4. Chittagong	5	5	5	5	10	30	25	750
5. CHT	8	7	7			22	25	550
6. Dhaka CC				10	14	24	25	600
TOTAL Cluster	28	30	30	25	24	137		
HH per cluster	25	25	25	25	25			
TOTAL HH	700	750	750	625	600			3425

The Cochran formula is: $n=\frac{z^2pq}{e^2}$ where e=0.05, Z=1.96, p=0..8

1.3.2
Cluster definition and household selection process

The study clusters are chosen using random cluster sampling technique (cluster randomization technique is given in sampling section). In this study, clusters were random wards from the sampled unions (union is the lowest administrative boundary) for rural, and random ward from the sampled Small Towns, Medium Towns and CCs for urban too. For rural clusters, once a ward number was chosen, the field team listed all the villages, and a random (drawn using simple random sampling technique) village was considered as cluster. For urban locations, once a ward number was sampled, the field team listed all mahallas (in urban Bangladesh, in wards there are several mahallas like the boundaries in rural villages) and a random mahalla was considered as a cluster. Finally, for each cluster, with the help of local people, the field team assessed the center point of the villages/mahallas, and the household closest to the center location of a sampled village or mahalla was the first sampled household. The enumerators selected the main respondents, introduced himself/herself, and took the consent. Once the respondents consented for the interview, the enumerators completed the survey electronically using smartphones. Once, survey for the first household was done, the enumerators skipped five closest households and then chose the second. This process continued till survey for the required number of households (cluster size was 25 households, please refer to the sampling technique section) was completed. This was a sampling with replacement of households i.e. if the respondents of a household did not agree for the consent, the team replace it by the next nearest households.

1.3.3
Qualitative FGD

In order to gain insights into people's motivations and social practices in regard to fecal sludge management by frontline workers or individuals, implementation groups, NGOs, and departments, also to know how they view or perceive their experiences in communities, societies and other aspects of life, the study team designed to conduct maximum of 20 Focus group discussion with service providing agencies, departments, companies, frontline groups using a formative tool/guideline (Table 2.2).

Though the plan was for 20, since COVID-19 crisis situation was getting worse, therefore the FGD team conducted minimum required 13 FGD interviews in which 6 was with govt level municipal authorities, 2 commercial service providers, 2 individual groups, 3 treatment plant workers supported by NGOs. The team realized other 7 interviewers nature was similar to those participants from whom data were already captured, the team decided to end up the Focus group discussion.

Sources of contacting the FGD participants were - during household interviews there was a question in this regard to mention by the household respondents for all the list of service providing individuals in the respective areas, and secondly CC and municipalities have the data of all the serviced providing individuals and groups.

Table 2.2: Summary of FGD Sample Size

Private/Commercial Agencies	5
Sweepers/Cleaners Group/Manual emptier	5
NGOs	5
Other frontline workers related to Transportation/Disposal	5
Total	20

1.3.4
Qualitative Key informant interview

The study designing team estimated to conduct maximum of 20 Key informant discussion with the policy/decision making authorities/ agencies/ department personnel. The list of 20 interviewing candidates across different departments and agencies are provided in the Appendix-E. The expert team of Key informant discussion conducted 10 Key informant discussion using virtual platforms. Though these interviews accomplished the objective, conducting more interviews were hampered by unavailability time and individuals.

1.4
Data collection team

We collected quantitative data recruiting a field level team of enumerators and supervisors. We recruited a team of 65 enumerators/UNICEF Volunteers and 9 supervisors and finished quantitative data collection activities in 10 data collection days (Table 2.3). UNICEF Volunteers are team of pools, though most of them are freshers by all of them possess post-graduation level degree, well conversant of English and Bengali, comfortably could translate English questionnaires into local level Bengali form, they are well trained and well-conversant of smartphone based data collection techniques. The volunteers were higher across all five zones and also allocated them in their respective zones for data collection.

Qualitative Focus group discussion and Key informant discussion are conducted by the study team directly. However, there were some special cases where enumerators were sent directly on spot for conducting Focus group discussion and spot checks.

Table 2.3: Quantitative data collection team

	Locations	Number of total HH	Number of days	# of survey/ day/person	# of enumerators	Supervisor
1	Nilphamari District	425	10	5	8	1
2	Khulna City Corporation	125	10	5	2	0
3	Satkhira District	425	10	5	8	1
4	Sunamganj District	425	10	5	8	1
5	Chattogram City Corporation	375	10	5	7	1
6	Cumilla	375	10	5	7	1
7	Rangamati	550	10	5	11	2
8	Dhaka North and South City Corporations	600	10	5	12	2
9	Rajshahi City Corporation	125	**10**	**5**	**2**	**0**
	Total	3425	10	5	65	9

1.5
Quality Assurance

In order to maintain uniform understanding and strength, we employed a skilled set (UNICEF Volunteers) of data collection teams. The teams were given a comprehensive orientation training in regard to theoretical orientation on SMOSS systems, study methodology, study questionnaire and smartphone programming. The in-house training was conducted centrally at Dhaka-base and the same set of facilitators facilitated training sessions across all training batches. The in-house trainings were followed by dummy practices, field practices and open discussion sessions.

During data collection, the technical team remained in touch with the enumerators all times, provided cellphone based guidance and support. The local UNICEF team and CC/Municipality engineers and technical staff supervised the team too and cross checked the household survey questionnaire by repeat interviews of minimum 5% households. The volunteer enumerators everyday uploaded spot check pictures and videos from household surveys in the Facebook group and provided feedback and comments. The technical team also arranged conference meeting every day in the evening time to address the difficulties and challenges.

In order to minimized data loss, the field team members collected offline data and instantly after finishing the field day, uploaded the raw dataset to the service by connecting smartphones to internet. Later on, when the team was at home, they rechecked and edited the datasets and resubmitted the data, which was automatic replaced by the previously submitted raw data. Later on, the central level expert team downloaded dataset and conducted logical checking and provided feedback person by person once any sort of error was found. Qualitative data collection through interviews with the policy making stakeholders were conducted carefully in presence of study core team members. To clarify any uncertainty interviewers were asked to revisit the households. Key informant interview data were collected by arranging virtual meetings and the audio version interview was recorded for double checking of compiled data.

1.6 Data analysis

We analyzed quantitative data in stata (stata corp.@, USA). Like urban data, though rural data are nationally representative too, the study designed to collect significantly higher proportion of urban data than rural. This was mainly, the urban populations were categorized into four self-representative sub-categories (CC-Resident, CC-LICs, Municipality/middle towns, and small towns). Since the study considered significantly higher proportion of urban samples than rural, we presented Rural and Urban weighted national data. The weight factor was calculated based on 2017 rural and urban estimated population (WHO/UNICEF/JMP, 2019). We did descriptive analysis and calculated proportions, and means, and presented comparative data by rural, urban, city corporation-residence, city corporation-LICs, municipalities (medium towns) and small towns. Thus, we conducted tests of significance between rural versus urban and calculated p-values. In calculating such, we used generalized estimated equations (GEE) model, because our data are in the form of random cluster sampling. The benefit of GEE is the production of reasonably accurate standard errors, hence confidence intervals with the correct coverage rates. The model accounts for cluster adjustment, and uses estimated correlation structure matrix to re-estimate the regression parameters and to calculate standard errors(Hanley et al., 2003).

Qualitative FGD data were analyzed to clarify and validate the quantitative figures. For examples, use of safety equipment, who were engaged in emptying of fecal contents, what are the equipment used in emptying, etc. data were available in both quantitative household survey and FGD. The FGD data also complemented the quantitative data gap. For example, household respondents were not able to response beyond emptying services such as, in regard to the behavioral practices during transportation systems, disposal locations, treatment actions and reuse related questions. These data were complemented by the qualitative findings. During analysis, we found few conflicting data as well, for example, the FGD data revealed that the proportion of emptying using emptiers were higher in Khulna CC compared to quantitative proportions. However, we found clarified reasons with the qualitative detailed inquires.

Since the Key informant interview data were collected from the country level key decision makers, policy makers, administrative supervisors and policy guiding personnel, the compiled Key informant interview data assisted mainly in writing discussion sections and recommendations. The Key informant interview data also assisted triangulating the causes of some of the gaps as found during the quantitative and FGD data analysis.

Qualitative data analysis was done using simple excel sheets.

1.7
Methodological limitation

The field team could not collect data from 8% of the sampled households, mainly because, the sampled clusters in Dhaka South City Corporation are mostly under the coverage of off-site sanitation systems, and there remained a few incomplete data for some clusters as well mostly due to incomplete interviews. Besides, there was restrictions from central level onsite supervision due to COVID-19; however, the UNICEF regional team member and municipality level engineers and other technical staff supervised and so could minimize this limitation.

Emptying and transportation related qualitative FGD data collection in rural set up was not done because in rural set up, the emptying and transportation groups usually are not available. Emptying and transportation service providers were available only in urban set up. Therefore, in case someone needed the services for their pit/septic tank, one has to communicate the commercial groups available at nearby urban set up.

1.8
Ethical Considerations

Participants in this study faced minimal risk of physical, psychological, social, or legal injury. Under the present COVID-19 pandemic situation, special attention was given in conducting the entire survey to ensure maximum protection of the enumerators, householders, interviewees and interviewers so that the risk of infection transmission is minimum throughout the study program.

Factors related to cultural sensitivities and risks of breach of confidentiality were handled carefully. Community members could see study staff entering other houses of their neighbors (usually all family members within a house) and may overhear interviews. However, every effort was given to ensure that household surveys and interviews were conducted in privacy.

There are instances when household members, service providing individual/authorities, and key informants felt uncomfortable sharing information. However, to minimize risk, code numbers were used instead of names. In addition, some interviewees felt uncomfortable discussing their works in front of household members, peers, or co-workers. Interviewers initially called the subjects to describe the purpose and process of the interview and to set up a time when the subject can talk on the phone in a private place.

Study Results: Household Survey

2.1
Sampling coverage

The field team collected quantitative data from 3149 households (out of the targeted 3425, 92%); 689 were from rural Bangladesh (green dots in figure 1) and rest 2460 household data belonged to urban areas that represented across all different categories- city corporation residence (red dots), city corporation low-income communities (Dhaka City North and South Corporation areas) and Chattogram city corporation), medium towns (blue dots) and small towns (black dots). Detailed of the sample sizes are shown in the Table 3.1.

Table 3.1: Summary of sample size

Sampling type	Number	Percent (%)
Rural	689	22
Urban-Total	2460	78
City Corporation (CC) – Residence	542	17.2
City Corporation (CC) – LICs	577	18.3
Medium town (MT)	641	20.4
Small town (ST)	700	22.2

Qualitative sample

The team conducted 11 Focus group discussion with emptying, transportation and treatment service providing staff/workers across Bangladesh.

(Emptying and transportation staff/workers:
1. Cumilla City Corporation, 2. Rangamati Municipality, 3. Sunamganj Municipality, 4. Daudkandi municipality, 5. Dhaka-1 DSK Vacutak Mirpur, 6. Dhaka-2 Lily's Family Mirpur, 7. Mymensingh Harijon polli, 8. Khulna Harijon polli;

Treatment service workers/staff:
9. Dhaka – Pagla sewage treatment plant, 10. Sathkhira Municipality, 11. Khulna Hogladanga FSTP)

92 participants participated the Focus group discussion (4 female) at an average of 11 persons. The FGD participants were the people directly engaged in emptying and transportation services such as sweepers/cleaners, workers, supervisors, helpers, and vacuum tanker operators.

The team conducted 10 key informant interviews (Key informant discussion) at the decision and policy level individuals from government departments, international agencies and I/NGOs in Bangladesh.

Fifteen percent (15%) of the survey households were female headed and the majority of the main respondents (54%) of the household survey were female. Considerably higher proportion of female respondents (56%) were

2.2 Socio-demographic characteristics

from urban communities compared to 45% rural female respondents. Mean household size of the SMOSS survey was 5.4 and over one-third (36%) of the households had under-five children. We divided the survey households into income quartile groups based on households' annual income and named the quartiles as – low-income economies, lower middle-income economies, upper-middle income economies and high-income economies. We found, lowest 9% of rural households, and the 7% of LICs households were in high-income economies; whereas the lowest 11% of CC-Resident households and 11% of medium town households were in low-income economies (Table 3.2). The inspections during the qualitative Focus group discussion confirmed that in Bangladesh, the nature of the soil categories are diverse across different geoFigureic zones (Appendix F). Fine sand in coastal areas, mixture of clay and fine sand in haor and flood prone areas, gravel or coarse sand in hill tract areas, clay and loamy soil in city corporation areas, and heavy clay loamy soil in water logging areas.

Table 3.2: Socio-demoFigureic characteristics

Indicators	National**	Rural	Urban	Statistical	CC- Resi.	CC-LICs	MT	ST
	N=3149	N=689	N=2460	Difference:	N=542	N=577	N=641	N=700
	% (n)	% (n)	% (n)	Ru. vs Ur.*	% (n)	% (n)	% (n)	% (n)
1. Household head - female	14 (411)	19 (131)	11 (280)	0.019	14 (77)	15 (86)	10 (66)	7 (51)
2. Respondents - female	53 (1,694)	50 (310)	56 (1,384)	0.007	48 (260)	56 (325)	64 (410)	56 (389)
3. Mean household size (Avg)	5.4	5.3	5.4	--	5.1	4.9	5.7	5.9
4. Households with under-five children	35 (1106)	37 (253)	35 (853)	0.599	24 (130)	38 (217)	29 (187)	46 (319)
5. Income group[1)]								
Low-income economies	29 (775)	51 (341)	18 (434)	0.000	11 (59)	24 (132)	11 (69)	26 (174)
Lower middle-income economies	26 (813)	23 (153)	28 (660)	0.116	19 (98)	44 (245)	18 (115)	30 (202)
Upper middle-income economies	25 (805)	17 (113)	29 (692)	0.000	29 (152)	26 (145)	32 (198)	29 (197)
High-income economies	20 (665)	9 (58)	25 (597)	0.000	41 (217)	7 (39)	39 (244)	15 (97)

*Cluster adjusted p-values are calculated using generalized estimated equation (GEE) model

** Weighted percent

2.3
Access to latrine and status of latrine containment

Overall, 50% of the households surveyed have access to safe, safe latrine coverage that includes 7% limited (shared facilities) coverage as presented in Table 3.3. Another 13% households having septic tanks, though considered 'safe on-site sanitation option' by definition, have not been considered safe in this study as these are not adequately containing fecal sludge rather discharging them into storm water drains or open water bodies. Of the remaining 50%, 2.6% do not have any latrine at all, i.e., these people are still practicing open defecation. Access to safe latrine coverage in rural areas (55%) is slightly higher compared to urban (47%), the difference though not statistically significant. We have adopted a strict definition of safe latrines as defined in the Box 1. The large city corporations have much lower safe latrine coverage (37%) compared to medium and small towns having safe latrine coverages of 67% and 70% respectively. There were six different categories of safe latrines found in use in SMOSS survey areas - 1) single direct pit ring slab latrines, 2) single offset pit ring slab latrines 3) twin offset pit ring slab latrines, 4) unlined direct pit latrines, 5) septic tank system, and 6) composting latrines.

In large cities, septic tank system is the major option (68%) used, followed by different types of pit latrines, while in both medium and small towns different types of pit latrines - single offset pits, twin offset pits and direct pits are the major options followed by septic tanks. Single offset pit option appears to be most widely used in medium towns (28%) and small towns (33%). Safe sanitation coverage in LICs of large cities is extremely low at only 8%, most of which is limited coverage (6%) as expected and of the remaining 92%, 80% use unsafe options and 12% practice open defecation. In rural areas, safe coverage is achieved mostly by using different types of pit latrines (44%), the single offset pit being the dominant type (24%) followed by direct pit type (13%) and septic tank (7%).

As mentioned earlier, a considerable percentage (13%) of septic tank systems (based on entire population), though considered safe but are not containing fecal sludge and hence unsafe, because those septic tanks' outlets were connected to open drainage system, open water bodies or low lands. This was more common in urban areas (16%) and particularly in large cities (41%) and in LICs (15%) of large cities. The SMOSS study also found that 14% safe latrine structures had no containment facilities at all but are directly discharging to surface drains, storm water piped drainage systems or to open water bodies, e.g., canals, lakes and rivers. This practice is much higher in urban areas (20%) compared to rural areas (2%), and again outrageously high (59%) in LICs of large cities. Unsafe latrine coverage (36%) in rural areas are mostly by the use of different kinds of unsafe pits, i.e., pits without slabs, frequently overflowing pits because of inadequate depth, or pits had broken or had leakages so that the fecal contents contaminated the surrounding environment. Open defecation in rural areas has been found to be less than 2%.

1 Household annual income economies by quartiles. Number of eligible households was 3048 out of 3149; 665 rural and 2383 urban.

Table 2.3: Latrine access and status of latrine pits/septic tanks

Indicators	National**	Rural	Urban	Statistical	CC- Resi.	CC-LICs	MT	ST
	N=3147	N=689	N=2458	Difference:	N=540	N=577	N=641	N=700
	% (n)	% (n)	% (n)	Ru. vs Ur.*	% (n)	% (n)	% (n)	% (n)
1. Latrine access								
Safe latrine	50 (1543)	55 (378)	47 (1165)	0.301	37 (198)	8 (49)	67 (428)	70 (490)
Not shared (Basic)	43 (1320)	48 (329)	40 (991)	0.305	31 (166)	3 (17)	60 (385)	60 (423)
Shared (Limited)	7 (223)	7 (49)	7 (174)	0.974	6 (32)	6 (32)	7 (43)	10 (67)
2. Latrine type:								
i. Septic tank with safe discharge[2)]	15 (507)	9 (61)	18 (446)	<0.0001	27 (149)	7 (40)	28 (181)	11 (76)
ii. Septic tank -unsafe discharge[3)]	13 (441)	6 (38)	16 (403)	<0.0001	41 (220)	15 (85)	13 (83)	2.1 (15)
iii. Ring slab (twin offset pit) -safe	3 (86)	3 (22)	3 (64)	0.695	2.6 (14)	-- (0)	5.3 (34)	2.3 (16)
iv. Ring slab (single offset pit & tank with un-sealed bottom)-safe	19 (590)	22 (152)	18 (438)	0.251	4 (20)	1 (6)	28 (179)	33 (233)
v. Ring slab (direct pit) -safe	10 (268)	13 (88)	7 (180)	0.114	2.4 (13)	0.5 (3)	4.4 (28)	19 (136)
vi. Unlined pit (no ring or brick)-safe	3 (62)	7 (50)	0.5 (12)	<0.0001	0.4 (2)	--(0)	--(0)	1.4 (10)
vii. Composting latrine -safe	1 (30)	1 (5)	1 (25)	0.697	-- (0)	-- (0)	0.9 (6)	2.7 (19)
viii. Pit latrine (any pit) - unsafe	20 (564)	36 (249)	13 (315)	<0.0001	4 (21)	6 (34)	15 (96)	23 (164)
ix. Directly connected safe latrine - unsafe discharge[4)]	14 (492)	2 (11)	19 (481)	<0.0001	18 (98)	59 (339)	5 (31)	2 (13)
x. Hanging/latrine in bush	0.6 (18)	0.6 (4)	0.6 (14)	ns	-- (0)	0.9 (5)	-- (0)	1.3 (9)
xi. No latrine	2.6 (89)	1.3 (9)	3.2 (80)	ns	0.6 (3)	11 (65)	0.5 (3)	1.3 (9)
3. Depth of pit/septic tank								
Irrespective of households with safe & un-safe latrines	(N=959)							
Pit:	(N1=704)							
<=2 meter	31 (225)	24 (50)	35 (175)	0.065	67 (36)	73 (8)	34 (69)	27 (62)
>2 meter and <=5 meter	56 (385)	63 (131)	51 (254)	0.131	31 (17)	18 (2)	56 (113)	54 (122)
>5 meter and <=7 meter	7 (56)	6 (12)	9 (44)	0.393	2 (1)	--	8 (16)	12 (27)
>7 meter	6 (38)	8 (16)	4 (22)	0.115	--	9 (1)	2 (5)	7 (16)
Septic tank:	(N2=255)							
<=2 meter	22 (56)	18 (5)	22 (51)	0.336	19 (18)	36 (12)	20 (14)	25 (7)
>2 meter and <=5 meter	65 (168)	61 (17)	67 (151)	0.970	75 (73)	52 (17)	62 (43)	64 (18)
>5 meter and <=7 meter	5 (14)	4 (1)	6 (13)	0.557	2 (2)	--	13 (9)	7 (2)
>7 meter	8 (17)	18 (5)	5 (12)	0.185	4 (4)	12 (4)	4 (3)	4 (1)
Among households with safe latrines only	(N=766)							
Pit:	(N1=568)							
<=2 meter	31 (182)	26 (40)	34 (142)	0.113	65 (24)	86 (6)	36 (62)	26 (50)
>2 meter and <=5 meter	57 (316)	64 (100)	52 (216)	0.057	32 (12)	14 (1)	55 (95)	56 (108)
>5 meter and <=7 meter	8 (47)	6 (9)	9 (38)	0.335	3 (1)	-- (0)	8 (14)	12 (23)
>7 meter	4 (23)	4 (7)	4 (16)	0.683	-- (0)	-- (0)	2 (3)	7 (13)
Septic tank:	(N2=198)							
<=2 meter	21 (41)	20 (5)	21 (36)	0.881	21 (16)	16 (3)	20 (10)	25 (7)
>2 meter and <=5 meter	65 (129)	60 (15)	66 (114)	0.624	72 (54)	63 (12)	59 (30)	64 (18)
>5 meter and <=7 meter	6 (13)	4 (1)	7 (12)	0.331	3 (2)	--(0)	16 (8)	7 (2)
>7 meter	8 (15)	16 (4)	6 (11)	0.135	4 (3)	21 (4)	6 (3)	4 (1)

2 Septic tanks not connected to any open sources
3 Septic tank outlets connected to open drainage system or open water bodies
4 No pit/septic tank; toilets directly connected to drain/ditch/open source

4. Filling status								
Irrespective of households with safe and un-safe latrines	(N=647)							
Pit:	(N1=441)							
Almost full	26 (114)	25 (24)	26 (90)	0.788	25 (8)	33 (4)	34 (44)	20 (34)
One-third portion empty	22 (90)	30 (29)	18 (61)	0.015	25 (8)	17 (2)	13 (17)	20 (34)
Half portion empty	22 (102)	19 (18)	24 (84)	0.337	16 (5)	25 (3)	16 (20)	32 (56)
More than half empty	30 (135)	26 (25)	32 (110)	0.182	34 (11)	25 (3)	37 (47)	28 (49)
Septic tank:	(N2=206)							
Almost full	16 (33)	23 (3)	16 (30)	0.548	11 (9)	28 (10)	19 (10)	5 (1)
One-third portion empty	22 (44)	46 (6)	20 (38)	0.035	14 (12)	29 (10)	11 (6)	48 (10)
Half portion empty	24 (50)	23 (3)	24 (47)	0.936	27 (23)	29 (10)	19 (10)	19 (4)
More than half empty	37 (79)	8 (1)	40 (78)	<0.0001	48 (40)	14 (5)	51 (27)	28 (6)
Among households with safe latrines only	(N=538)							
Pit:	(N1=369)							
Almost full	24 (90)	24 (17)	24 (73)	0.865	25 (6)	33 (3)	34 (39)	16 (25)
One-third portion empty	19 (69)	23 (16)	18 (53)	0.264	21 (5)	22 (2)	12 (14)	21 (32)
Half portion empty	24 (89)	21 (15)	25 (74)	0.889	21 (5)	22 (2)	17 (19)	32 (48)
More than half empty	33 (121)	31 (22)	33 (99)	0.599	33 (8)	22 (2)	37 (42)	31 (47)
Septic tank:	(N2=169)							
Almost full	16 (26)	23 (3)	15 (23)	0.955	7 (5)	35 (9)	19 (8)	5 (1)
One-third portion empty	22 (35)	46 (6)	19 (29)	0.021	13 (9)	23 (6)	10 (4)	48 (10)
Half portion empty	26 (45)	23 (3)	26 (42)	0.595	32 (22)	31 (8)	19 (8)	19 (4)
More than half empty	36 (63)	8 (1)	40 (62)	<0.0001	47 (32)	11 (3)	51 (21)	29 (6)
5. Location of containment store5)								
Irrespective of households with safe and un-safe latrines	(N=2518)							
Front side/ main entrance	17 (467)	6 (38)	23 (429)	<0.0001	41 (178)	18 (31)	17 (103)	18 (117)
Backyard	57 (1,358)	72 (477)	47 (881)	<0.0001	23 (101)	42 (70)	59 (357)	54 (353)
Inside the dwelling house	11 (315)	5 (30)	15 (285)	<0.0001	28 (125)	22 (37)	17 (105)	3 (18)
Below the latrine structure	14 (344)	17 (111)	13 (233)	0.293	5 (24)	14 (23)	5 (29)	24 (157)
Data not available	1 (34)	0.6 (4)	2 (30)	0.027	3 (11)	4 (7)	1 (7)	0.8 (5)
Among households with safe latrines only	(N=1513)							
Front side/ main entrance	15 (267)	4 (15)	22 (252)	<0.0001	40 (79)	29 (14)	17 (74)	18 (85)
Backyard	62 (906)	71 (266)	56 (640)	<0.0001	30 (60)	57 (28)	64 (269)	60 (283)
Inside the dwelling house	9 (141)	5 (18)	11 (123)	<0.0001	22 (44)	6 (3)	15 (62)	3 (14)
Below the latrine structure	14 (191)	19 (70)	11 (121)	0.288	7 (14)	8 (4)	4 (16)	18 (87)
Data not available	0.6 (8)	1 (4)	0.5 (4)	0.172	0.5 (1)	-- (0)	0.2 (1)	0.4 (2)
6. Access to pit/ septic tank by the emptier6)								
Irrespective of households with safe and un-safe latrines	(N=2518)							
Not accessible at all	4 (104)	1 (6)	5 (98)	<0.0001	8 (33)	15 (25)	1 (6)	5 (34)
Not easily accessible	28 (679)	34 (227)	24 (452)	0.080	26 (112)	12 (20)	24 (145)	27 (175)
Among households with safe latrines only	(N=1513)							
Not accessible at all	2 (32)	1.6 (6)	2.3 (26)	0.300	4 (7)	-- (0)	0.7 (3)	3 (16)
Not easily accessible	26 (372)	34 (127)	21 (245)	0.203	30 (59)	4 (2)	20 (84)	21 (100)

6
*Cluster adjuAs per the survey design, the field team conducted inspections of pits and septic tanks of the 959 household latrines out of 3149 (30%; 22% pit latrines and 8% septic tanks). Among 959 latrines, the majority of the pits (57%) and septic tanks (65%) have depths between 2.0 and 5.0 meters, while 31% of the pits and 21% of septic tanks have depth less than 2 meters. Though our field team could record the measurements of height, length and breadth of septic tanks, in this analysis we used data of heights only. We did this because of three reasons; Data are available for 2518 households in 8 types of latrine categories, i.e. N=2518

5 Data are available for 2518 households in 7 types of latrine categories, i.e. N=2518

size of pits and septic tanks were not uniform in shape, and secondly measurement of septic tanks varied across the country, thirdly it is difficult to compare the measurement between septic tanks and pits.

The field survey team could also inspect the depth of sludge in 647 latrines (20% of all sampled Households) during the data collection. Among the safe latrine facilities, 33% pits and 36% septic tanks were found more than half empty, while 24% pits and 16% of septic tanks were almost full by fecal sludge. The rest of the pits and septic tanks were one-third portion to half empty.

The team further inspected the locations of pits and septic tanks and assessed their accessibility by the emptier when needed. In this literature, we mentioned 'not accessible' meant to either the latrine pits/septic tanks were located under the housing structure's floor base, or the pits/septic tanks were at so remote locations (may be at a very narrow space behind the house, etc.) where enumerators could not reach at all. 'Not easily accessible' meant to somehow it was very difficult to reach the pits/septic tanks. Such data were available for 2518 latrines of different categories (Table 3.3, section 5,6). Most of the pits and septic tanks were located at the backyard of the houses and some were located inside the dwellings. Among the safe latrine facilities, 62% were located at the backyard, 15% at the front side, 14% directly under the latrine superstructure, and 9% latrine pits/septic tanks were installed inside the dwellings. 26% of the pits/septic tanks were not easily accessible to the emptiers while 2% latrine pits/septic tanks were not accessible at all for emptying.

2.4
Emptying of latrine pits and septic tanks

A total of 2,518 of 3,147 households (80%) surveyed have latrines, both adequate & inadequate containments across six categories (unlined pit, single direct pit, single offset pit, twin offset pit, and safe/unsafe septic tank) which could be emptied when needed. Remaining 629 sampled households (20%) are not included in this analysis because those were in the categories that do not have any containment facility at all. These Households have toilets directly connected to drains/open water bodies, some use hanging latrines and there are Households who practice open defecation (See Table 3.3).

As presented in Table 3.4, irrespective of Households having adequate & inadequate containment systems. 42.5% Households (1080 households) reported that their pits/septic tanks required emptying (meant to their latrine pits were filled by fecal contents and therefore, the latrine owing household members thought that the pits/septic tanks require emptying for reuse the pits/septic tanks) while only 33% emptied (856 households) and continued reusing their facilities, and 57.5% never required emptying (this meant to the latrine pits/septic tanks yet never filled somehow). For Households having toilet with adequate containment facilities, 44% required emptying yet only 38% actually emptied their latrine pits/septic tanks and continued using them. The rest arranged some alternative techniques such as closed the pits and dug new pits, switched to second pit, drained to water bodies by connecting pits/septic tanks with the water bodies, drained to open sources by connecting pits/septic tanks with the drainage facilities, or left it as it was. Among those who required emptying, and actual emptying to start reusing those pits/septic tanks, highest proportions were in the offset pit category, followed by septic tanks and unlined pits categories respectively (table 3.4). During the qualitative investigations, the FGD participants those who were directly engaged in emptying services in urban areas, reported that about 5-10% of the households in a community demanded emptying services following safe practices i.e., dumped the fecal contents into authorized dumping locations/sites. The remaining 90% mainly resort to unsafe practices, e.g., by connecting the pits/septic tanks into open spaces, drains, canals etc. (Details of FGD are given in the Appendix F). Of those latrines that were emptied, 92% of emptying services (795 of 2518 Households) was done by sweeper/sanitation workers and the rest done by self-initiatives. Cleaners/ sweepers had to enter inside the pit/septic tanks in about 11% cases of emptying, this is being practiced more frequently in urban areas (See Table 3.4). Among household with safe latrines, emptiers used face masks in 53% percent cases, hand gloves in 39% cases, boots in 27%, and 15% used body cover. 15% of the emptying workers used chemicals such as ash, kerosene, phenol, bleach or quicklime (see Table 3.4) primarily to get rid of bad odors. The group discussions with the service providing frontline workers acknowledged the limited use of these categories of protective equipment and chemicals.

In urban areas, only 28% Households used mechanical emptying services using non-motorized manual pump (7.4%), small motorized pump (18%), and vacuum pumps (3.2%), and 69% resorted to manual emptying using buckets, ropes, shovel and spade. Almost the entire (98%) emptying operations in rural areas is done manually. Use of vacuum pumps/tankers is primarily seen in large cities (11%) with some (2%) use in medium towns.

Table 2.4 Emptying of latrine pits and septic tanks

Indicators	National**	Rural	Urban	Statistical	CC- Resi.	CC-LICs	MT	ST
	% (n)	N=660	N=1858	Difference:	N=439	N=168	N=601	N=650
		% (n)	% (n)	Ru. vs Ur.*	% (n)	% (n)	% (n)	% (n)
1. Pit/septic tank								
Irrespective of households with safe and unsafe latrines[7]	N=2518							
Never required emptying	57.5 (1438)	60 (393)	56 (1045)	0.998	66 (288)	80 (134)	47 (284)	52 (339)
Required emptying	42.5 (1080)	40 (267)	44 (813)	0.998	34 (151)	20 (34)	53 (317)	48 (311)
Septic tanks	11 (316)	5 (34)	15 (282)	<0.0001	25 (109)	14 (23)	20 (118)	5 (32)
Offset pits	18 (467)	17 (109)	19 (358)	0.782	7 (32)	3 (6)	28 (170)	23 (150)
Unlined pits	13 (297)	19 (124)	9 (173)	0.014	2 (10)	3 (5)	5 (29)	20 (129)
Among households with safe latrines only	N=1513							
Never required emptying	54 (789)	61 (229)	50 (560)	0.009	50 (99)	55 (27)	46 (192)	53 (242)
Required emptying	44 (724)	39 (144)	51 (580)	0.009	50 (99)	45 (22)	54 (230)	47 (229)
Septic tanks	14 (226)	6 (24)	18 (202)	<0.0001	36 (72)	33 (16)	21 (88)	5 (26)
Offset pits	22 (346)	19 (71)	24 (275)	0.262	10 (19)	8 (4)	30 (125)	27 (127)
Unlined pits	10 (152)	13 (49)	9 (103)	0.309	4 (8)	4 (2)	4 (17)	16 (76)
2. Actions on requirement of emptying -								
Irrespective of households with safe and unsafe latrines	N=2518							
Left it as it is/nothing was done	2 (45)	1 (9)	2 (36)	0.698	0.6 (2)	--	2 (11)	4 (23)
Dug/opened new pit	6 (138)	6 (41)	5 (97)	0.523	--	--	1 (8)	14 (89)
Switched to second pit	2 (48)	2 (13)	2 (35)	0.896	0.2 (1)	--	3 (20)	2 (14)
Drained into water/open sources	2 (46)	2 (12)	2 (34)	0.949	2 (7)	--	4 (21)	1 (6)
Emptied and continued using	33 (856)	30 (195)	36 (661)	0.524	32 (141)	20 (34)	43 (258)	35 (228)
Septic tanks	10 (287)	5 (33)	14 (254)	<0.0001	23 (100)	14 (23)	17 (103)	4 (28)
Offset pits	14 (363)	12 (77)	15 (286)	0.518	7 (31)	3 (6)	22 (131)	18 (118)
Unlined pits	9 (206)	13 (85)	7 (121)	0.049	2 (10)	3 (5)	4 (24)	13 (82)
Among households with safe latrines only	N=1513							
Left it as it is/nothing was done	1.2 (20)	0.8 (3)	1.5 (17)	0.346	0.5 (1)	-- (0)	0.7 (3)	2.6 (13)
Dug/opened new pit	6 (89)	5 (20)	6 (69)	0.507	-- (0)	-- (0)	2 (8)	13 (61)
Switched to second pit	2.7 (42)	2.7 (10)	2.7 (32)	0.942	0.5 (1)	-- (0)	4.4 (19)	2.4 (12)
Drained into water/open sources	0.6 (8)	0.8 (3)	0.4 (5)	0.458	0.5 (1)	-- (0)	0.5 (2)	0.4 (2)
Emptied and continued using	38 (607)	29 (110)	44 (497)	0.004	48 (96)	45 (22)	47 (199)	38 (180)
Septic tanks	13 (219)	6 (23)	17 (196)	<0.0001	35 (70)	33 (16)	20 (85)	5 (25)
Offset pits	17 (267)	13 (48)	19 (219)	0.142	9 (18)	8 (4)	23 (98)	21 (99)
Unlined pits	8 (121)	10 (39)	7 (82)	0.359	4 (8)	4 (2)	4 (16)	12 (56)
3. Emptying were done by								
Irrespective of households with safe and unsafe latrines[8]	N=856							
Emptied by self-initiatives	7 (63)	6 (12)	8 (51)	0.337	5 (7)	6 (2)	5 (12)	13 (30)
Sweeper/sanitation workers emptied[9]	91 (775)	94 (183)	90 (592)	0.019	88 (124)	94 (32)	91 (234)	89 (202)
Others: WASH committee, UP, Ps, CC, pvt. company, NGO, etc.	3.5 (35)	-- (0)	5.3 (35)	<0.0001	11 (16)	3 (1)	7 (18)	-- (0)
Among households with safe latrines only	N=607							

7 We found 2518 households had latrine in the six categories: unlined pit, lined pit latrines - single direct pit/single offset pit/twin offset pit, and safe/unsafe septic tanks. Other three categories (629 household) of compost latrine, toilets directly connected to drain/open sources, and hanging latrines are not included in this analysis.

8 856 households emptied latrines and continued using.

9 Few of the households used self-initiatives and sweeper both.

Emptied by self-initiatives	6 (39)	3 (3)	7 (36)	0.047	5 (5)	5 (1)	4 (7)	13 (23)
Sweeper/sanitation workers emptied[10]	92 (553)	97 (107)	90 (446)	0.002	85 (82)	91 (20)	92 (184)	89 (160)
Others: WASH committee, UPs, CC, pvt. company, NGO, etc.	4.4 (30)	-- (0)	6 (30)	<0.001	6 (15)	5 (1)	7 (14)	-- (0)
4. For emptying someone needed to enter into the pit/ septic tank								
Irrespective of households with safe and unsafe latrines (N=856)	11 (106)	3 (6)	15 (100)	<0.0001	26 (37)	56 (19)	9 (23)	9 (21)
Among households with safe latrines only (N=607)	11 (75)	3 (3)	14 (72)	<0.0001	26 (25)	50 (11)	10 (20)	9 (16)
5. Equipment & tools used by the emptier								
Irrespective of households with safe and unsafe latrines	N=856							
i. Protective equipment & chemicals:								
Boots	27 (240)	23 (44)	30 (196)	0.429	40 (56)	76 (26)	35 (89)	11 (25)
Gloves	38 (330)	35 (69)	39 (261)	0.610	40 (57)	50 (17)	57 (146)	18 (41)
Face mask	47 (399)	52 (102)	45 (297)	0.416	26 (37)	32 (11)	62 (161)	39 (88)
Body cover	14 (121)	10 (19)	15 (102)	0.382	18 (25)	24 (8)	14 (37)	14 (32)
Ash/kerosene/phenol/bleach/ quicklime	13 (93)	25 (48)	7 (45)	0.160	-- (0)	-- (0)	17 (45)	-- (0)
ii. Manual empty: Shovel, spade, bucket, rope, etc.	80 (657)	98 (191)	71 (466)	<0.0001	67 (95)	74 (25)	60 (154)	84 (192)
iii. Mechanical empty:	18 (182)	1.5 (3)	27 (179)	0.000	23 (32)	24 (8)	36 (92)	11 (26)
Non-motorized manual pump[11]	5.1 (49)	1.5 (3)	7 (46)	0.005	2.8 (4)	--	16 (40)	0.9 (2)
Small motorized pumps	11 (112)	--	17 (112)	0.000	20 (28)	24 (8)	20 (52)	11 (24)
Vacuum tankers	2.1 (21)	--	3.2 (21)	0.013	8 (11)	--	3 (7)	1 (3)
iv. No response/don't know	2 (17)	0.5 (1)	2.4 (16)	0.016	2 (3)	3 (1)	2 (5)	3 (7)
Among households with safe latrines only	N=607							
i. Protective equipment & chemicals:								
Boots	27 (166)	25 (27)	28 (139)	0.167	39 (37)	64 (14)	33 (65)	13 (23)
Gloves	39 (241)	35 (39)	41 (202)	0.192	43 (41)	59 (13)	57 (114)	19 (34)
Face mask	53 (315)	62 (68)	50 (247)	0.702	33 (32)	41 (9)	64 (128)	43 (78)
Body cover	15 (94)	10 (11)	17 (83)	0.054	17 (16)	32 (7)	15 (30)	17 (30)
Ash/kerosene/phenol/bleach/ quicklime	15 (74)	35 (39)	7 (35)	0.115	-- (0)	-- (0)	18 (35)	-- (0)
ii. Manual empty: Shovel, spade, bucket, rope, etc.	77 (453)	98 (108)	69 (345)	<0.0001	70 (67)	59 (13)	56 (111)	86 (154)
iii. Mechanical empty:	21 (142)	0.9 (1)	28 (141)	<0.0001	27 (26)	36 (8)	43 (85)	12 (22)
Non-motorized manual pump	5.6 (38)	0.9 (1)	7.4 (37)	0.004	2.1 (2)	-- (0)	17 (33)	1.1 (2)
Small motorized pumps	13 (88)	-- (0)	18 (88)	<0.0001	14 (13)	36 (8)	24 (48)	11 (19)
Vacuum tankers	2.3 (16)	-- (0)	3.2 (16)	0.022	11 (11)	-- (0)	2 (4)	0.6(1)
iv. No response/don't know	2 (12)	0.9 (1)	2.2 (11)	0.188	2 (3)	3 (1)	2 (3)	3 (4)

10 Few of the households used self-initiatives and sweeper both.

11 It's a type of mechanical pump used to pull loads but no motorized technology is not associated with it.

2.5
Fecal Sludge Transportation and disposal

Overall, only 2.1% of fecal sludge transportation was done by vacuum tanker, 13% using motorised vehicles and the majority 83% transportation was done manually using either pushcart, hand carry or manual van as presented in Table 3.5. Vacuum tankers and motorized transportations were used mainly in urban areas. In regards to mechanical emptying services, the qualitative investigations via Focus group discussion revealed that there are only a few vacuum tankers of different capacities in Bangladesh and those are available only in larger cities and in a few large municipal towns (Paurashavas). However, use of vacuum tankers are very limited and can be used only by institutional/ departmental set up due to its complex management requirements. For instance, in Rangamati municipality, the authority reported to have a vacuum tanker of 1000 litre capacity but it was lying unused in the municipality garage. However, in Dhaka North and South City Corporations, a very limited service by vacuum tankers was provided by some private operators and NGOs on commercial basis (FGD details in Appendix F). In rural areas, there is no use of motorized vehicle or vacuum tanker as yet and the entire fecal sludge transportation (99.5%) is done manually using pushcart, manual van or by hand carry. Different levels of health risks are associated with manual emptying and transportation of fecal sludge as in most cases, manual emptiers and transporters do not use protective equipment adequately. This is further discussed in section 4.6 and 4.7 of this report.

Considering Households having safe facilities, fecal sludge transportation scenario is very much similar and transportation services using vacuum tankers is available only in large city corporations (11%) and in medium towns (2%). Manual transportation is still very high in small towns (86%) and in medium towns (66%). In LICs of large cities, 36% fecal sludge transportation using motorized vehicles have been reported while 59% transportation is done manually.

Table 3.5 – Transportation of emptied fecal sludge and disposal

Indicators	National**	Rural	Urban	Statistical	CC- Resi.	CC-LICs	MT	ST
	% (n)	N=200	N=644	Difference:	N=128	N=34	N=253	N=229
		% (n)	% (n)	Ru. vs Ur.*	% (n)	% (n)	% (n)	% (n)
1. Means of transportation								
Irrespective of households with safe and unsafe latrines12)	N=856							
Manually carried/push cart/van	83 (690)	99.5 (194)	75 (496)	0.000	68 (96)	74 (25)	70 (182)	85 (193)
Used motorized vehicle[13]	13 (128)	-- (0)	19.4 (128)	0.000	22 (31)	23 (8)	25 (64)	11 (25)
Used vacuum tanker	2.1 (21)	-- (0)	3.2 (21)	0.013	8 (11)	-- (0)	3 (7)	1 (3)
Do not know/non-response	1.8 (17)	0.5 (1)	2.4 (16)	0.016	2 (3)	3 (1)	2 (5)	3 (7)
Among households with safe latrines only	N=607							
Manually carried/push cart/van	81 (476)	99 (109)	74 (367)	0.000	70 (67)	59 (13)	66 (132)	86 (155)
Used motorized vehicle	15 (103)	-- (0)	21 (103)	0.000	16 (15)	36 (8)	30 (60)	11 (20)
Used vacuum tanker	2.3 (16)	-- (0)	3.2 (16)	0.022	11 (11)	-- (0)	2 (4)	0.6 (1)
Do not know/non-response	1.9 (12)	0.9 (1)	2.2 (11)	0.188	3.1 (3)	4.6 (1)	1.5 (3)	2.2 (4)
2. Disposal of transported fecal contents								
Irrespective of households with safe and unsafe latrines	N=856							
Safely disposed:								
Buried in pit/covered pit within compound[14]	36 (306)	38 (75)	35 (231)	0.273	15 (21)	6 (2)	29 (76)	58 (132)

12 Data of 856 Households that had actually emptied their latrine pits or septic tanks.
13 Some Households emptied fecal contents using non-motorized manual pump but transported using motorized vehicles. This the reason that the number is here 128 which is more than the number 112 who emptied using small-motorized pumps in Table 3.4.
14 35 households of 182 those mechanically emptied the fecal contents, buried in pit or covered in pit in the compound.

Transported outside the compound and disposed of at designated disposal/ treatment site	10 (78)	13 (26)	8 (52)	0.513	13 (18)	3 (1)	9 (23)	4 (10)
Among those did manual empty	4 (35)	-- (0)	5 (35)	<0.0001	11 (15)	-- (0)	6 (16)	2 (4)
Among those did mechanical empty	6 (43)	13 (26)	3 (17)	0.071	2 (3)	3 (1)	3 (7)	3 (6)
Unsafely disposes:								
Disposed to uncovered pit/open ground/water body or elsewhere	17 (136)	25 (49)	13 (87)	0.110	9 (13)	3 (1)	12 (31)	18 (42)
Throwing/discharged into the open environment outside	32 (291)	23 (44)	37 (247)	0.012	50 (71)	85 (29)	45 (116)	14 (31)
Do not know/non-response	5 (45)	0.5 (1)	7 (44)	<0.0001	13 (18)	3 (1)	5 (12)	6 (13)
Among households with safe latrines only	N=607							
Safely managed:								
Buried in pit/covered pit within compound	42 (252)	48 (53)	40 (199)	0.449	17 (16)	9 (2)	34 (68)	63 (113)
Transported outside the compound and disposed of at designated disposal/ treatment site	12 (65)	20 (22)	9 (43)	0.234	16 (15)	5 (1)	9 (17)	6 (10)
Among those did manual empty	4 (29)	-- (0)	6 (29)	<0.0001	15 (14)	-- (0)	6 (11)	2 (4)
Among those did mechanical empty	8 (36)	20 (22)	3 (14)	0.045	1 (1)	5 (1)	3 (6)	3 (6)
Unsafely managed:								
Disposed to uncovered pit/open ground/water body or elsewhere	13 (72)	21 (23)	10 (49)	0.042	9 (9)	-- (0)	6 (12)	16 (28)
Throwing/discharged into the open environment outside	27 (180)	10 (11)	34 (169)	<0.0001	41 (39)	82 (18)	46 (92)	11 (20)
Do not know/non-response	6 (38)	0.9 (1)	7 (37)	<0.0001	18 (17)	5 (1)	5 (10)	5 (9)
3. Disposal points								
Irrespective of households with safe and unsafe latrines	N=856							
Buried in <30 m away from the premise-safe	46 (366)	64 (124)	37 (242)	0.001	14 (20)	9 (3)	34 (88)	57 (131)
Buried in >30 m-safe	8 (67)	7 (13)	8 (54)	0.642	1 (2)	12 (4)	14 (36)	5 (12)
Into field/drain/bush outside/moving water body/static water body	37 (329)	28 (55)	41 (274)	0.168	56 (79)	68 (23)	43 (110)	27 (62)
Directly to crop field (to fertilize crops)	0.2 (2)	-- (0)	0.3 (2)	0.150	0.7 (1)	-- (0)	-- (0)	0.4 (1)
Into fecal waste disposal/treatment point-safe	2.9 (29)	-- (0)	4.4 (29)	0.000	14 (20)	3 (1)	2 (5)	1 (3)
Unsafely stored somewhere for composting	0.8 (7)	0.5 (1)	0.9 (6)	0.521	-- (0)	6 (2)	-- (0)	2 (4)
Do not know/non-response	6 (58)	1 (2)	8 (56)	0.000	14 (20)	6 (2)	7 (19)	7 (15)
Among households with safe latrines only	N=607							
Buried in <30 m away from the premise-safe	49 (282)	67 (74)	42 (208)	0.013	15 (14)	9 (2)	40 (79)	63 (113)
Buried in >30 m-safe	8 (49)	10 (11)	8 (38)	0.455	2 (2)	9 (2)	12 (24)	6 (10)
Into field/drain/bush outside/moving water body/static water body	31 (196)	21 (23)	35 (173)	0.236	45 (43)	64 (14)	39 (77)	22 (39)
Directly to crop field (to fertilize crops)	0.3 (2)	-- (0)	0.4 (2)	0.150	1 (1)	-- (0)	-- (0)	0.6 (1)
Into fecal waste disposal/treatment point-safe	4 (26)	-- (0)	5 (26)	0.000	21 (20)	5 (1)	1 (2)	2 (3)
Unsafely stored somewhere for composting	0.7 (5)	-- (0)	1 (5)	0.048	-- (0)	9 (2)	-- (0)	2 (3)
Do not know/non-response	7 (49)	2 (2)	9 (47)	0.000	18 (17)	9 (2)	9 (17)	6 (11)

*Cluster adjusted p-values are calculated using generalized estimated equation (GEE) model
** Weighted percent

Table 3.5 also presents data on disposal of emptied fecal sludge. Of the fecal sludge emptied, 46% was disposed of apparently safely (either buried in pits and covered (36%) nearby/within premises, or transported off-site to designated disposal/treatment sites (10%)) and 49% disposes unsafely to open ground/water body or elsewhere; 5% Households were not responsive about disposal.

Among Households with adequate containment latrines only, 54% apparently disposes safely by burying in pits (42%) within/nearby of premises, and transporting off-site (12%) to designated disposal/treatment sites. Disposal pit locations are mostly within 30 meters from premises. Unsafe disposal of fecal sludge emptied from Households having latrine with adequate containment facilities is still high at 40%. The qualitative data also revealed that disposal locations are limited across city corporations and municipalities. In Dhaka City Corporation for instance, the available locations for disposing fecal sludge are quite far, and reaching these locations had to face considerable traffic jam and travel barriers. The study results imply that unsafe disposal of fecal sludge is still very common practice in Bangladesh.

2.6
Treatment and reuse of fecal sludge

Across all sampled household respondents, the study team assessed the level of knowledge in regards to the purpose of transportation of the emptied fecal sludge and specifically what they actually did know. Nationally, 21% respondents reported that they knew the purpose of transportation of emptied fecal sludge (see Table 3.6). 7% reported disposal of emptied FS wherever; this practice was reportedly more in urban areas (11%) than in rural (3%). 6% mentioned dumping into pits again more in urban areas (9%), 6% reported disposal after treatment, while 5% reported reuse of treated FS. Good proportion of respondents (45%) showed interest on treated sludge or end product, however yet it is unknown whether really the similar proportion people will use it or not. Details are shown in Table 3.6. Household practice of using fecal sludge either treated or untreated is diverse as can be seen Table 3.6. Table 3.6 – Fecal sludge treatment and reuse: knowledge, practices, interest and agreement/disagreement

Table 3.6 – Fecal sludge treatment and reuse

Indicators	National**	Rural	Urban	Statistical	CC- Resi.	CC-LICs	MT	ST
	N[15]=3149	N=689	N=2460	Difference:	N=542	N=577	N=641	N=700
	% (n)	% (n)	% (n)	Ru. vs Ur.*	% (n)	% (n)	% (n)	% (n)
1. Know the purpose of fecal contents transporting outside (knowledge)	21 (732)	15 (106)	25 (626)	0.005	21 (113)	12 (69)	37 (234)	30 (210)
2. Fecal contents transporting out for (knowledge)								
Directly re-use for fertilizer or biogas	1 (36)	0.4 (3)	1 (33)	--	--	--	--	--
Directly dispose/dump into pit	6 (250)	3 (22)	9 (228)	0.006	4 (19)	1 (8)	11 (70)	19 (131)
Directly dispose anywhere outside	7 (280)	3 (20)	11 (260)	0.000	9 (51)	10 (58)	17 (111)	6 (40)
Treatment and dispose	6 (202)	5 (32)	7 (170)	0.175	6 (33)	1 (6)	14 (89)	6 (42)
Treatment and re-use	5 (143)	7 (48)	4 (95)	0.214	3 (17)	0.7 (4)	6 (39)	5 (35)
3. Households utilize different forms of fecal contents (practice)								
Directly to the fishpond as fish feed	0.2 (6)	0.2 (1)	0.2 (5)	--	--	--	--	--
Directly as poultry feed	0.2 (6)	0.2 (1)	0.2 (5)	--	--	--	--	--
In kitchen gardening/ food crops	1 (31)	1 (7)	1 (24)	--	--	--	--	--
Non-food crops/ plants	0.4 (14)	0.2 (1)	0.5 (13)	--	--	--	--	--

15 The field team attempted taking data across all (3149) participating households.

Used as biogas or charcoal	0.2 (5)	--	0.2 (5)	--	--	--	--	--
Utilized for composting	0.6 (18)	0.3 (2)	0.6 (16)	--	--	--	--	--
Buy/bring manure from treatment plant	0.4 (14)	1 (10)	0.1 (4)	--	--	--	--	--
4. Household showed interest in using the treated sludge/end product (interest)	45 (1224)	54 (373)	35 (851)	0.000	26 (141)	34 (196)	30 (193)	46 (321)
5. Can be used treated fecal sludge as fertilizer for agricultural cultivations								
Agree	19 (647)	18 (124)	21 (523)	ns	27 (144)	36 (210)	16 (103)	9 (66)
Disagree	25 (840)	21 (147)	28 (693)	ns	27 (148)	14 (83)	39 (248)	31 (214)
Does not know	56 (1662)	61 (418)	51 (1244)	ns	46 (250)	49 (284)	45 (290)	60(420)

*Cluster adjusted p-values are calculated using generalized estimated equation (GEE) model

2.7
Safely Managed on-site sanitation status

This section is prepared based on the common denominator, i.e., 3147 of total survey households that could be reached out during the present SMOSS study. Objective of this section is to understand overall country status irrespective latrine with adequate & inadequate containment systems or no latrine facilities. The detailed data are presented in previous tables in this result section. Data presented in Table 3.7 are that of nationally representative, 3147 Households. As shown in the table, nationally, while 50% of the population use latrine & adequate sanitation facilities (including 7% limited facility), only 23% required emptying of their latrine pits and septic tanks yet only 19% actually emptied. Only 3.9% did mechanical emptying using either manual pump (non-motorized), motorized pump, or vacuum tanker, whereas 15% emptied manually using local equipment such as Shovel, spade, bucket, rope, etc. Of 3.9% Households who emptied mechanically, 3.3% transported the emptied fecal sludge using motorized vehicle i.e., motorized transportation of fecal sludge that were mostly from Households using mechanical emptying. Overall, 2.2% of emptied fecal sludge disposed of at designated disposal/ treatment sites and majority of these Households were using mechanical emptying; however, some Households though used manual emptying, transported emptied fecal sludge using vans or push carts and disposed at designated disposal sites. A significant number of Households (8%) emptied their pits and septic tanks and buried the emptied fecal sludge within or near to premises. Thus, a total of 10% Households disposed the emptied fecal sludge apparently safely either by burial into covered pits or transporting them at designated disposal sites (Table 3.7). The difference between rural and urban with respect to latrine with adequate containment use, emptying requirement, emptied proportions and the so-called safe disposal of fecal sludge is very low and statistically not significant but the differences across different types of urban facilities seems significant. However, for mechanical emptying and motorized transportation of fecal sludge, the difference between urban and rural is high in favor of urban and the difference is statistically significant as can be noticed in the Table 3.7.

Table 3.7 SMOSS by Service Chain

Indicators	National**	Rural	Urban	Statistical	CC-Resident	CC-LIC	Medium Town	Small Town
	N=3147	N=689	N=2458	Difference:	N=540	N=577	N=641	N=700
	% (n)	% (n)	% (n)	Ru. vs Ur.*	% (n)	% (n)	% (n)	% (n)
Among households those had safe latrines only								
1. Used safe latrine	50 (1543)	55 (378)	47 (1165)	0.301	37 (198)	8 (49)	67 (428)	70 (490)
2. Empty required	23 (724)	21 (144)	24 (580)	0.402	18 (99)	4 (22)	36 (230)	33 (229)
3. Emptied	19 (607)	16 (110)	20 (497)	0.195	18 (96)	4 (22)	31 (199)	26 (180)
4. Manually emptied	15 (453)	16 (108)	14 (345)	0.778	12 (67)	2.2 (13)	17 (111)	22 (154)

5. Mechanically emptied	3.9 (142)	0.2 (1)	5.7 (141)	<0.0001	4.8 (26)	1.4 (8)	13 (85)	3.1 (22)
6. Transported in motorized vehicle	3.3 (119)	-- (0)	4.8 (119)	<0.0001	4.8 (26)	1.4 (8)	10 (64)	3 (21)
7. Disposed at designated sites[16]	2.2 (65)	3.2 (22)	1.7 (43)	0.397	2.8 (15)	0.2 (1)	2.6 (17)	1.4 (10)
8. Safely disposed overall[17]	10 (317)	11 (75)	10 (242)	0.821	5.7 (31)	0.5 (3)	13 (85)	18 (123)
Among household those had either safe or unsafe latrine								
1. Used safe latrine	50 (1543)	55 (378)	47 (1165)	0.301	37 (198)	8 (49)	67 (428)	70 (490)
2. Empty required	35 (1080)	39 (267)	33 (813)	0.406	28 (151)	6 (34)	49 (317)	44 (311)
3. Emptied	27 (856)	28 (195)	27 (661)	0.911	26 (141)	6 (34)	40 (258)	33 (228)
4. Manually emptied	22 (657)	28 (191)	19 (466)	0.107	18 (95)	4 (25)	24 (154)	27 (192)
5. Mechanically emptied	5 (182)	0.4 (3)	7 (179)	<0.0001	8 (43)	1.4 (8)	15 (99)	4 (29)
6. Transported in motorized vehicle	4.1 (149)	-- (0)	6.1 (149)	<0.0001	7.8 (42)	1.4 (8)	11 (71)	4 (28)
7. Disposed at designated sites[18]	2.7 (78)	3.8 (26)	2.1 (52)	0.376	3.3 (18)	0.2 (1)	3.6 (23)	1.4 (10)
8. Safely disposed overall[19]	12.5 (384)	14.7 (101)	11.5 (283)	0.491	7 (39)	0.5 (3)	15 (99)	20 (142)

*Cluster adjusted p-values are calculated using generalized estimated equation (GEE) model

** Weighted percent

Urban sanitation services chain was looked at more closely classifying them into four categories - large cities, LICs in large cities, medium towns and small towns. As can be seen in the Table 3.7 above, there are statistically significant differences among these categories in terms of use of safe latrines, emptying - manual and mechanical, use of motorized vehicles for fecal sludge transportation, disposal of emptied fecal sludge. Overall, while the medium towns show relatively better performance compared to large cities and LICs in large cities. The LICs within large cities lack services in all functions of the sanitation services chain. Also, presented in Table 3.7, data of Households that are using latrines with adequate containment systems only and of total Households using either adequate or inadequate latrines for comparing functions of different services elements in the sanitation chain. It was observed that some households, though were not using latrines with adequate containment systems, needed emptying and a few of those Households emptied the pits/septic tanks. Accordingly, a small number of Households who are not using latrines with adequate containment systems, yet they used mechanical emptying facilities, used motorized transportation system and disposed fecal contents apparently safely at designated sites.

16 Mostly latrines at households those had transported fecal contents using motorized vehicles, majority of fecal contents disposed at designated sites. Few of the households those emptied fecal contents manually, disposed fecal contents at designated sites using non-motorized van or push cart as well.
17 This included households those buried or covered the fecal contents into pits, plus households those disposed fecal contents at designated disposal sites
18 Mostly latrines at households those had transported fecal contents using motorized vehicles, the majority of fecal contents disposed at designated sites belonged to those latrines; in addition to that, some of the households those emptied fecal contents manually (without mechanical equipment) disposed fecal contents at designated sites using van or push cart.
19 This included households those buried or covered the fecal contents into pits, plus households those disposed fecal contents at designated disposal sites

3.
Interviews with decision and policy making departments and ageciess

The study team conducted 10 Key informant discussion with top level officials of related departments/ agencies that directly or indirectly influence policies and decision making in the sanitation sector in Bangladesh. Some important reflections from those interviews are presented in this section. Detailed Key informant interview data are provided in Appendix G.

3.1
SMOSS Situation

Nowhere in the country has a proper sewerage/sanitation system. The fecal sludge emptied from the septic tanks/pits are dumped into either lowland, drainage system, open canal or into water bodies. In urban communities, a significant portion of latrines are directly or indirectly connected to the drains or ditches or in the available open spaces. In this context, the key notes from the interviewed resource persons are depicted herewith. The Managing Director of Khulna City WASA mentioned, "In Khulna city there are about 60,000 toilets. Periodically emptying all these toilets remains a huge task. A majority of the toilets are connected to the nearby canals or water bodies."

During the interview, the DPHE official mentioned, "The National Sanitation Project was an anchor for our MDG achievements. In 2003, only 32% had sanitation facilities and improving that to 66% was our target. We achieved a coverage of 62% at the end of the MDG period. Currently, we nearly have zero open defecation. We are presently in a satisfying situation. Up until 2015 we have managed to make people agree to a fixed-point defecation. However, the key point is, we are not being able to say that we are safely managing our sanitation facilities. We were defining the project according to the MDG goals. According to the definition, we are making latrines, and bringing people to the latrines, but we were making a hole in the pit and connecting it to a canal, ditch, drain or to an open source. So currently, safely managed sanitation was not considered during the design or implementation phase of our ongoing project. The kind of latrine and other facilities we needed for safely managed sanitation - we did not develop the project according to that."

The other interview with the official of the World Bank country office explained, "The percentage of the population in Bangladesh getting safely managed sanitation is not acceptable. In rural areas about 41 percent have safely managed sanitation; in urban areas, it is not possible to discern what is and isn't there. Safely managed sanitation means that fecal sludge has to be dealt in a way such that it is away from people. The sludge has to be treated or disposed of. In Dhaka, only 20% of the people are connected to the offsite sanitation system at Pagla treatment plant. Among the remaining proportion of population, the government does not know how many homes have septic tanks that are going to the drain. In fact, most general people do not know where the sludge of their own homes goes. In Bangladesh, access to sanitation is something we have focused on. But when the issue of safely managed sanitation came into the picture, the reality is that the infrastructure is not present."These are the evidences depicted the appropriate scenarios in the country.

3.2
Demand versus capacity

Across all interviews with the informants and discussions in several groups of frontline workers indicated that present demands for emptying of fecal sludge are not up to the mark, meant to say people are not boasted or in other sense, people think about alternative way of how to get rid of the hassle of emptying. Yet, the most important point is, the service providing departments, groups, individuals do not have adequate capacity to meet the existing demands. For example, the informant interview with the Rajshahi City Corporation authority revealed that the city corporation receives demand for emptying 15 toilets per day, but they have capacity of only one or two because they have only one vacuum tanker. To note, the population of RCC should be close to 400,000 by now as per census data. As a result, many clean their toilets manually, without even letting the authority know. An availability of 9 vacuum tankers could satisfy the existing demand.

SNV, a pioneer NGO in this action area is working in several municipalities, specifically reported that they could provide services for emptying, transportation and treatment in their treatment plant not more than 20% of the requirement, though they have capacity little more than the actual services. The SNV could not meet the service up to their capacity because of the low demand. FGD with the frontline workers also revealed the same issue of low demand and much lower capacity than demand.

3.3
Tariffs of emptying latrine pits and septic tanks

As revealed by household survey as well as FGD with the frontline service individuals, in a year only a small fraction of the households seeks emptying services as we have seen in the household data that right from the installation till the survey dates, only one third of the households (33%) experienced emptying latrine pits and septic tanks, moreover, this 33% percent was based on 80% of the total households those had pits/septic tanks identifiable with the latrine superstructure. Emptying tariffs for pits and septic tanks vary from place to place, depending on types of uses e.g., household or commercial and also depth of pits/septic tanks. For example, in Cumilla City Corporation area, the rate varies from Tk. 1500-3500 per pit; from Tk. 3000-5000 per septic tank; and Tk. 15,000-20,000 for tanks in clinics/hotels/industries. In Rangamati municipality area the rate is between Tk. 2000-5000 for pits, and Tk. 5000-8000 for septic tanks; in Sunamganj municipality, the rate ranges from Tk 2000-3000 for emptying pit latrines, Tk 4000-5000 for septic tanks at household level, and for clinics or hotels, the range is Tk 15000-20000; in Satkhira municipality area, the service rate is from Tk 1500-2500 per pit, Tk 3000-5000 per septic tank at households, and commercial tanks' service rate up to Tk 25000. In Khulna City Corporation area, rate for household pit emptying is between Tk 2000 and 3500; for septic tanks, the rate depends on tank sizes: small @ Tk 5000, Medium @ Tk. 8000 to 10000 and large septic tanks @ Tk 15000 to 20000, and for commercial or industrial septic tanks, it varies from Tk 30000 to 50000.

The reported wage rates of the frontline emptiers/cleaner groups were a matter of great concern. While the individual groups or self-help groups did not have much concern about the wage rate, the frontline workers at institutional levels reported a much lower wage. The institutional level workers also raised the issue that they work as pay-roll workers i.e., they are not in salary system, and they also do not have any health insurance facilities. For instance, in Cumilla City Corporation, the daily wage rate of a frontline worker was very low at Tk 266 per day equivalent to US $ 3.13 per day.

Detailed findings of the FGD with the frontline workers/cleaners are presented in Appendix F.

Both FGD with services providing groups and Key informant interview with the key personnel in decision making agencies reported that there is no standard emptying rate for latrine pits or septic tanks. The fecal sludge emptying rate varies between emptying of pits and septic tanks and also depending on size and type, between households and commercial pits/septic tanks. Typical rates of emptying pits and septic tanks in different city corporations and municipalities are mentioned in section 3.7 above.

3.4
Fecal sludge dumping site

Specific locations for fecal sludge treatment and disposal are not common in the country. Limited small scale treatment and disposal of fecal sludge are being provided by some I/NGOs (e.g., SNV Bangladesh, Water Aid Bangladesh, WAB, Practical Action Bangladesh, PAB, Water and Sanitation for the Urban Poor, WSUP) in some city corporation areas and municipal towns. The specific challenges in regards to fecal sludge disposal are – in Dhaka North and South City Corporations, the existing locations are away from the communities, therefore, travelling to those locations take unpredictably long time due to inadequate transportation system, bad traffic situation, narrow width of the roads, transportation barriers by traffic police authorities, and people usually do not want to see fecal sludge being carried during the day time. In Rajshahi City Corporation, there is no specific disposal site. Currently the emptiers transport fecal sludge in the vacuum tankers to a dumping site which is 12 km away from the city. Basically, it is a crude dumping site opened in 2003, where medical waste is also dumped. Besides polluting the surrounding environment, it is possible that the groundwater is also being polluted since the water table in these areas is about 10-15 feet below the ground surface.

The I/NGOs mentioned above have projects in city corporations and municipal towns that consider complete sanitation services chain for fecal sludge management (FSM) including emptying services, transportation, treatment and disposal and/or reuse of the treated product. These cities have fecal sludge treatment plants and have vacuum tankers that collect fecal sludge from households, institutions, and transport it to the treatment plant, where it is treated and in some cases the treated product is locally marketed as fertilizer/soil conditioner.

3.5
Existing Laws

The country has city corporation level and municipal level sanitation related laws, policies and strategies; however, the problem is with the implementation of these laws, policies and strategies by the respective authorities. Interviews showed that the authorities of the city corporations and municipalities are well aware about the limitation of sanitation systems in the country and the authorities are thinking positively in regards to improving the sanitation system.

Both quantitative and qualitative investigation in this study evidenced that there are households with good toilets but the outlets from these toilets are connected illegally to storm water drainage systems, canals and open water bodies that is indicative of unethical actions, violations of sanitation acts and to some extent avoidance of responsibilities by concerned local authorities.

The interviews with the Asian Development Bank officials reported that the first challenge of a decentralized (on-site) sanitation system (the system of pit latrines and latrines with septic tanks) is the implementation of the building by-laws. The laws say that if a network of sewerage system is not available in an area then a septic tank system must be built according to the given specifications. The main challenge the city corporations and the municipalities have is the lack of capacity to monitor the households whether they have constructed adequately designed septic tanks connected to soak wells and that the outlets are not illegally connected to open drains, ditches, or any open water bodies).

The second challenge relates to desludging of fecal sludge without following a systematic scheduled action. An alternative approach is to have a scheduled desludging systems where households are contacted (or required) to arrange for emptying according to a fixed frequency. This is very important for FSM services to be sustainable and awareness building among users and the service providers is key to introduce this system. The common practice now is that people when they realize that their septic tanks are full or nearly full, call private agencies for emptying. The private operator then desludges the septic tanks, takes the emptied sludge to the outskirts of the town and dispose of the sludge in open fields, or a canal or a stream, which is totally unauthorized. This is very common in towns and cities where there is no specific site for treatment and/or disposal of fecal sludge.

Rajshahi City Corporation officials mentioned, "The latrine connections with the drains are illegal. The connections drain into 7-8 canals. When we get complaints, we file cases against them. But there is little awareness. I think awareness is the biggest problem. I believe that if the people are given the option of using a safe sanitation system, they will take advantage of it."

3.6
Capacity building and skill

Lack of capacity and skills appear to be another major barrier in ensuring safely managed sanitation services. Such barriers could be categorized in several areas – inadequate manpower, skill building, inadequate supply of equipment and machineries, lack of enforcement of sanitation related laws and regulations, lack of joint initiatives with NGOs and Govt initiatives, inadequate future plans and inadequate budget provisions. For example, the Rajshahi city corporation authority reported that the city corporation does not have enough people with required technical knowledge to implement a sanitation infrastructure project. Though they understand the concepts, there is no experience in implementation. They also do not have the institutional knowledge.

The LGD Additional Secretary mentioned, "There is a challenge in terms of the current capacity of the government. We do not have people for transportation, emptying, disposal of fecal sludge matter. But I believe that the private sector can be engaged here. Ensuring access to safely managed sanitation will not be possible by the government alone. It could be a PPP model but we do not have a good experience with that. The preferred option is to have the plants be fully privately run, with government just overseeing the operations. In addition, regarding the treatment of waste, we are leaning towards incinerators because we do not have enough land."
The DPHE authority mentioned, "The DPHE is an implementing agency not the operational agency. We can try to develop the fecal sludge management plants and hand it over to the local government institution, we can also do the required capacity building but we are not

mandated operate it. The local government institutions, e.g., Paurashava, the Upazila or Union Parishad will be in charge of running it. There is a dearth of safe transportation as well. We, the DPHE are trying to facilitate ensuring safe transportation by using vacuum tankers."

The interview with the World Bank authority mentioned, "Financing is not the main thing, building capacity and creating the policy to create awareness are very much necessary. The government is leading well, but the government cannot do it alone. They need partners. We are trying to foster partnerships. There are huge challenges in capacity building. We are supporting to provide training to DPHE, local government, and Union Parishad focus groups. The Union Parishad levels do not even know what SDG is. If they need to lead it, they need to learn what it is. We are giving them orientation and training, and we are also forming committees in those levels, and tracking their meetings. In every community, we are building sub-committees. We are also incorporating women of the communities and supporting to train them in the operation of safely-managed sanitation systems."

3.7 Future Initiatives

There are several leading NGOs in Bangladesh focusing their activities on fecal sludge management system. Some examples are WAB, SNV, PAB, WSUP, DSK, NGO Forum, WASH Alliance, etc. Specifically, SNV works in Khulna and Gazipur City Corporations and in some specific municipalities such as Jhenaidah, Kushtia, Benapole and Jashore. In Khulna, the focus is on regular emptying services. In Gazipur, they work on hand-washing and building septic tanks. In Benapole, they are improving the water seals of the toilet. However, the coverage for those specific focused locations is low. In Jhenaidah SNV provided two vacuum tankers that have the capacity of emptying and transportation for 38% of the city. The challenge is, demand is lower than the capacity. As a result, the SNV treatment plant in Jhenaidah does emptying, transportation and treatment services only up to 20% of fecal sludge in the city areas. Similarly, in Kushtia municipality, the SNV could reach up to 19% via vacuum tankers for emptying, transportation and treatment plant services. Similarly, Water Aid (WAB) has their projects in Shokhipur and Syedpur towns. Similarly, WSUP is working for their FSTP projects in Rangpur and Chattogram city corporation areas; NGO Forum in Mymensingh City Corporation; and PAB in Faridpur and Satkhira municipalities.

The main challenges that the NGOs face are, there is no monitoring from the authorized government departments in constructions of toilets/ septic tank systems, and appropriate knowledge sharing and coordination is absent as well. Other challenge is, no strict enforcement of by-laws in regards to installation of pits or septic tanks and connecting septic tanks to soak wells instead of in the open environment or in existing drainage system.

3.8 Budget Allocation

The current level of planning as well as availability of resources suggest that urban areas of Bangladesh would not be able to fully employ central sewerage system in all cities and towns in the near future. It is therefore expected that concerned authorities are considering employing multiple options of network and non-network systems including on-site sanitation facilities associated with fecal sludge and effluent management to ensure safely managed sanitation services for all by 2030. For example, the Rajshahi City Corporation (RCC) authority mentioned, "the RCC is planning to install a waste dumping site 25 km away in the outskirts of the city, and also we are interested in making a wastewater treatment plant. We are well aware that the city corporation has serious limitations in bringing the entire corporation area under a central sewerage system, and therefore, we wanted to put an option as community sewerage system.

In building the sewerage system, there is however, another complexity between the two authorities - WASA and the city corporation. We, the city corporation authority thought that it could be a joint implementation plan for a duration of 10 years, but it is yet to decided." Similarly, the Khulna WASA MD and ADB authorities reported, "a central sewerage system will not be able to serve all areas because of technical problems. The main barrier is the width of the road. We cannot take the machinery needed to establish connections into those roads. We also cannot dig deep because the houses will collapse. We need to dig up to three meters to give connections into the central sewer network. The ones not covered by the central sewer network will be served by the empty-carry method. So, overall sanitation will be of two types - one is centralized (sewerage) and the other is non-centralized (on-site)."

Currently World Bank (WB) listed five ongoing projects in Bangladesh – 1) Safely-managed sanitation systems are being implemented in 30 small towns in collaboration with DPHE; 2) Renovating Pagla Sewage Treatment Plant and rehabilitating associated sewer network in Dhaka with Dhaka WASA; 3) In rural areas, WB is launching 100% subsidized safely managed sanitation project for the poor across 98 Upazilas; 4) In the Rohingya camps in Cox's Bazar, the WB is launching a project to provide safely-managed sanitation to the Rohingya refugees and host communities; and 5) planning process to implement a safely managed sanitation project in Chittagong City in ongoing.

The DPHE authority says, "Besides the rural project in 98 Upazilas supported by the WB, we have other safely managed sanitation projects in 85 Pourashavas and 53 district towns. We are working with PKSF and WB so that we can support the groups that are marginalized under PKSF loan facilities."

3.9
Achieve SDG Goal 6.2

Interviews with the key informants highlighted some budgetary needs, allocations and sources of funding for the safe management of fecal sludge. For example, the Additional Secretary of LGD mentioned, "The Chattogram WASA would need USD 25 billion investment for safely-managed sanitation and for the Dhaka WASA, we need to invest USD 40 billion into sewage treatment plants and safely-managed sanitation by 2030."

In Khulna City Corporation, a total of Tk 2300 crores have been allocated for building the central sewer network and effluent treatment plant in which an amount of Tk 1400 crores are coming from ADB, Tk 600 crores will be spent on certain taxes like VAT and import duty, and the government is paying the remaining Tk 300 crores. The DPHE and WB authorities mentioned, "We currently have one project for the rural poor people, concerning safely managed sanitation. The WB is supporting this rural sanitation project where 98 Upazilas will be covered. The project will cost between Tk 5000-6000 crore. It has been decided that as much as 12% of the target will be pro-poor/ultra-poor households, will get free toilets."
The ADB authority said that they have a project in the pipeline for developing the sewerage system of Dhaka. Dhaka is the only city with a sewerage system but only a small percentage of households are covered. ADB is planning a USD 300 million project for developing a sewerage system in order to have a wider coverage under the safely managed off-site sanitation system.
PKSF sanctioned Tk. 45 crores as sanitation development loans to build offset twin-pit latrines across 46 unions in 21 Upazilas. The loans are disbursed to households via 48 NGOs. Each loan amount is Tk 15,000 with an interest of 9% and the target is to build 30,000 toilets. Soon, the PKSF will be launching another project with the World Bank targeting another 845 unions in 48 Upazilas with the aim to build 1.0 million toilets. This will be a USD 330 million project.

3.10
Steps to achieve the SDG

During the interview with the LGD Additional Secretary, we learnt that the country target is the same as the SDG target. An affluent portion of the population will be able to afford proper sanitation. But to target the ones who will not be able to do so, we are trying to create a mass awareness campaign about safely managed sanitation. Initiatives of proper emptying and offsite treatment of fecal sludge from on-site facilities are being taken. As of now, Dhaka, Khulna and Chattogram metropolitan cities have WASAs. In addition, a decision has been made to make WASA's in other 3 divisional cities as well. At the Pourashava level, the municipal authority will take the responsibility of ensuring that safely managed sanitation services exist, and DPHE will provide technical support to them. At the Pourashava level projects, the government is building fecal sludge management and treatment plants (FSM). The government is not implementing any WASH project without an FSM component. In 103 Pourashavas, there are ongoing FSM implementation which is about one-third of all Pourashavas in the country. In rural areas, the government is trying to develop safely managed sanitation systems in 98 Upazilas for hardcore poor. PKSF will be giving loans to the affluent in rural areas so that they can build their own safely managed sanitation facilities. At the Union Parishad level, the Department of Public Health Engineering will take responsibility of developing the safely managed sanitation system.

The DPHE authority said, "In the SDG era we need to clearly define and develop a clear understanding of safely managed sanitation system. During the MDG period, we have managed to make people come to a fixed-point defecation. The next step is to improve containment, ensure adequate treatment, and develop safe management for the entire sanitation value chain. If we ask the government what percentage of people have safely managed sanitation, the government would not be able to answer correctly. Until we can set the definition, we would not be able to implement this. For example, earlier we used to think safely managed sanitation consist of twin-pit latrines, which consist of two pits with a 'Y' junction. The longevity is two years at a time for each pit. The challenge with creating such is that in many cases you do not have enough space for this. Basically, the government does not have a new government sanitation project once the current National Sanitation Project ends.

We are planning to have localized fecal sludge management systems for every union. The Union Parishad can have one or two small devices that can suck out the material and you can clean it around the year. As per the requirement of each area, or planning, we can have several options for treatment e.g. co-composting. However, this depends on the number of latrines in the area. We have learnt from many failures and also from some achievements from the ongoing safely-managed sanitation options being targeted in 85 Pourashavas. As we had projects in 16 district town projects and we learnt that you can install the full system for a locality, but it gets abandoned because the local institutions cannot maintain it. Particularly, the project collapses when it comes to treatment."

3.11 Monitoring system

The interview with informants revealed that there is existence of some level of ongoing monitoring system. In this regards the LGD Additional Secretary cited, "We employ sanitary inspectors in Pourashavas already. At the upazila level too, there are sanitary inspectors. These are all staff of the Ministry of Health. What we do need to do however is, involve them more, hire more of them and decentralize them. But other than the sanitary officers, there is no one single oversight body. They have no plans yet but they have ideas. There needs to be a third party monitoring in addition to the DPHE."

The interviews conducted during this study indicated that there is a gap in establishing independent monitoring system. Further to say, the ongoing monitoring is limited to latrine installations only. This is because the interview data from the LGD Additional Secretary gave us ideas that there are sanitary inspectors employed at the Pourashavas and Upazila levels. Basically, they are staff of the Ministry of Health and may have different terms of reference. However, there are opportunities to engage them for more closely monitoring various aspects of safely managed sanitation services, increase their numbers and decentralize their activities. However, other than the sanitary officers, there is no other body/organization to monitor operations of sanitation facilities. As per LGD, there needs to be a third-party monitoring in addition to the DPHE. Basically, DPHE itself is a monitoring cell as well. They have a sanitation database for monitoring of sanitation facilities of the country. However, the DPHE authority said that DPHE does not have an independent monitoring cell. There is a monitoring cell only at the ministerial level and then there is Implementation Monitoring and Evaluation Division (IMED). The WB mentioned that there is a web-based monitoring project being developed at DPHE. WB provided grant money, technology and training support for that. Under this web-based monitoring project, sitting in Dhaka someone can see which household has installed a twin pit latrine using a GIS map.

4: Discussions on Study Findings

4.1 Safely managed sanitation services

JMP (2019) clearly mentioned three possible pathways to meet the new SDG criteria for safely managed sanitation services: (1) excreta produced at households are conveyed through sewer network and treated off-site at sewage treatment plants; (2) excreta are emptied from septic tanks and latrine pits, removed and treated offsite at facilities designed for fecal sludge; and (3) excreta are treated and disposed of in situ in septic tanks with appropriate soak-wells/leach-fields, or in latrine pits that are covered and left undisturbed when full (WHO/ UNICEF/JMP, 2019)sanitation and hygiene targets within the Sustainable Development Goals (SDGs. The underlying objective of setting these criteria is to ensure that safely managed sanitation system will protect people from exposure to disease-causing- excreta, at all steps of the sanitation chain: "Containment - Emptying/Collection -Transport/Conveyance - Treatment - Reuse and/or Disposal".

The extensive data in this study clearly revealed that though half of the population have access to latrine facilities with adequate containment knowledge and practice level of safe emptying, transportation, treatment, disposal and/or safe reuse of treated products, taking protective measures, and use of mechanical system are still minimum. The present study suggests that nationally, while 50% of the people have access to sanitation facilities, it is extremely difficult, if not impossible, to assess the coverage of population by safely managed sanitation services. Safe operation of an individual element in the sanitation chain, e.g., emptying or transportation or disposal, does not ensure safely managed sanitation services for people. For instance, this study suggests that emptied fecal sludge from 54% Households with adequate latrines are safely disposed of (see Table 3.5) that consists of 42% by burying emptied FS in pits near/within premises, and 12% by transporting to designated disposal/treatment sites. It is however, important to note that this is an estimation of sampled data from different locations - urban, rural, large cities, LICs, medium cities and small towns.

While apparently, this may seem to represent the national coverage status of safe disposal of fecal sludge and hence safely managed sanitation services, this, in true sense, is not the case as the underlying objective of 'protecting people from exposure to disease-causing-excreta' may not be achieved. For example, in a community, when a few Households practice safely managed sanitation in all respect i.e., each has safe containment, uses mechanical emptying of FS at regular intervals and FS transported to designated plant for treatment and disposal or may even bury emptied FS in pits within premises; but some neighboring Households do not follow these safe practices, rather they manually empty pits/ septic tanks when full/overflow and discharge FS into nearby low lands or open drains/water bodies; thereby exposing the people of the whole community to disease-causing-excreta, and thus the whole objective of safely managed sanitation services is defeated.

On a national scale, the safe service coverage of different functional elements of the complete sanitation chain as shown in the Figure-6 below, is very low. With 50% population using different adequate on-site sanitation containment facilities, only 19% Households emptied fecal sludge from pits/septic tanks although 23% Households required emptying and yet most of them (15%) emptied manually; only a handful 3.9% used mechanical emptying in urban areas only. Use of motorized vehicles including vacuum tankers for transportation of emptied fecal sludge (3.3%) is available only in urban areas, and only 2.2% was transported to designated disposal/treatment sites. Safe disposal only of emptied sludge is apparently considered to be 10% that includes burial of sludge into pits near/within premises and fecal sludge that is transported to designated disposal/treatment sites.

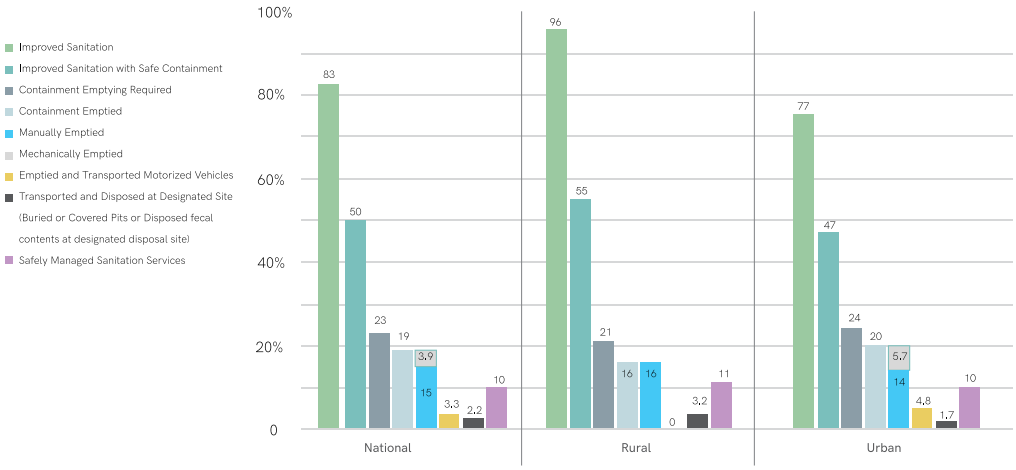


Figure-6: National SMOSS service chain status

Figure-7: presents a breakdown of status of different functional elements of SMOSS for different categories of urban areas viz. large city corporations, LICs in large cities, medium towns and small towns.

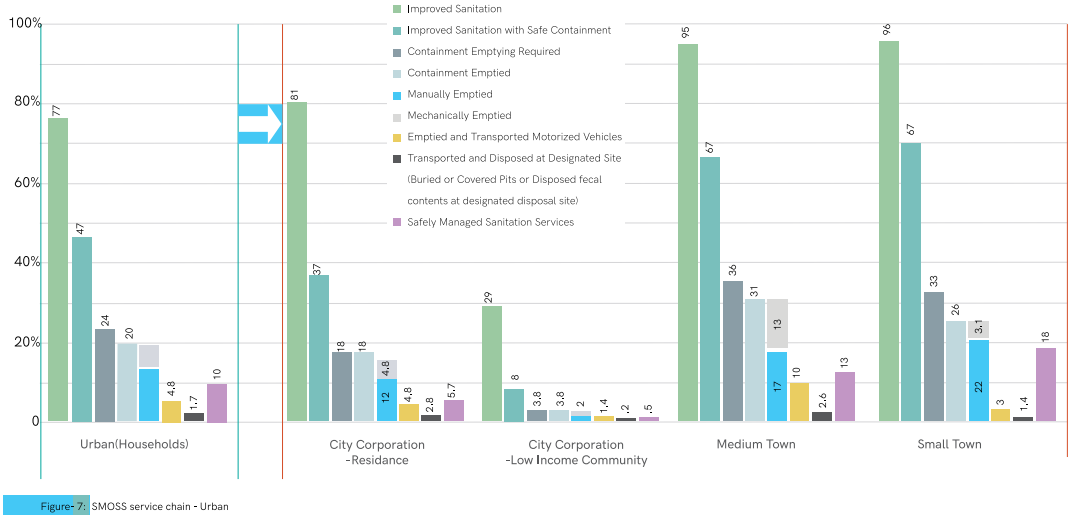


Figure-7: SMOSS service chain - Urban

Within urban areas, significantly higher number of Households have access to latrines with adequate containment in small towns (70%) and medium towns (67%) and also show relatively better status of functional elements of SMOSS in terms of emptying, motorized transportation, and so-called safe disposal, compared to large city corporations.

The worst-case scenario is with the LICs of large cities having only 8% latrine with adequate containment coverage with SMOSS services virtually absent. Though most of them have access to shared latrines that discharge directly to drain (unsafe latrine). Use of shared latrines and having no containment facility e.g., septic tank or pits, are primarily due to space constraints, tenure ship issue and cost.

Again, as mentioned earlier, individual performance of SMOSS functional elements (and not the complete integrated service chain) at diverse locations of urban or rural areas does not ensure safely managed sanitation services to the people of an area. It is in this context, that we have to consider the progress of achieving safely managed sanitation services of a community as a whole. That means we need to consider area/ community-wide progress of safe sanitation services. This could be village/union-wide for rural areas, and ward/city-wide for urban areas meaning that to achieve the full benefit/ impact, the entire village or union or ward or town must be brought under safe sanitation practices throughout the entire sanitation service chain. This is easily achieved in case of off-site sanitation i.e., a fully functional sewerage system when a network of sewers covers a particular area, all Households are connected to the network, all wastewaters conveyed to sewage treatment plant, adequately treated and treated products disposed of and/or reused/recycled. For SMOSS also we need to ensure that all Households in a particular urban or rural area/community have safe services available throughout the entire sanitation chain. Otherwise, measuring progress of SMOSS services would not be meaningful.

4.2
Access to safe sanitation facilities

The different types of safe safe sanitation facilities that are in use in Bangladesh include flush or pour flush toilets connected to piped sewer systems, septic tanks or different types of pit latrines, ventilated safe pit latrines, pit latrines with slabs and composting toilets. This SMOSS study results show that 50% of the households have access to safe safe on-site sanitation facilities with adequate containment facilities (Figure 4) which is much lower compared to MICS 2019 data which is 77% excluding 7.2% sewerage coverage (MICS, 2019).

It is important to note that the SMOSS study identifies the latrines/ facilities having proper containment facilities that are considered safe, as different from other previous studies e.g., MICS (2019) that considered all safe facilities irrespective of having or not having containments. For instance, in addition to 50% of the households that have access to safe, on-site sanitation facilities, there is another 13% households with so-called safe facility e.g., septic tanks that are discharging fecal sludge into storm water drains or other surface water bodies and not containing them and hence are not considered safe.

Access to latrine with adequate containment in both rural and urban areas are lower (55% in rural and 47% in urban) in SMOSS study compared to 82% in rural and 61% in urban a year ago in MICS (2019) survey (considering access to on-site sanitation facilities only and excluding 29.5% sewerage coverage in urban areas that apparently appears to be confused with storm water drainage networks). Again, 6% households in rural areas and 16% households in urban areas use safe facility i.e., septic tanks but are considered unsafe as these are not containing fecal sludge and discharging into the environment e.g., storm water drains, low lands or open water bodies.

Therefore, the lower access to sanitation with adequate containment. (50%) in SMOSS study could be attributed to the fact that 'safe' septic tanks (13%) that are directly connected to drains, ditches or other open water bodies without going through soak wells are considered septic tanks with very low/poor containment of fecal sludge, and another 14% so-called 'safe' latrines/toilets that do not have any containment (pit or septic tank) at all and are directly discharging to drains or ditches, have not been considered also as safe facilities. While terming/labeling an unsafe facility as 'safe' facility could be misleading, it is emphasized that the SMOSS study focusses only on safe, safe facilities as the whole objective of this study is to look at the aspects of safely managed sanitation services.

It should be noted here that to ensure SMOSS service, containment of fecal sludge in pits or septic tanks is extremely important for safe and sustainable management of subsequent functions in the sanitation chain. Further, access to pit latrines with adequate containment during SMOSS survey was found to be lower (37%) compared to MICS 2019 survey (53%), because the SMOSS survey found that 20% pit latrines that are considered unsafe also includes, in addition to open unlined pits, lined, direct, single off-set and twin off-set pits because in most cases they were either of inadequate capacity and hence overflowing or some pits were discharging to ditches/open water bodies. The capacity of pits is usually not estimated by the householders considering storage volume required for certain number of users for a specified period nor there is any regulation or guideline for storage volume calculation. Consequently, pits with large number of users and smaller depth fill up too quickly and overflow.

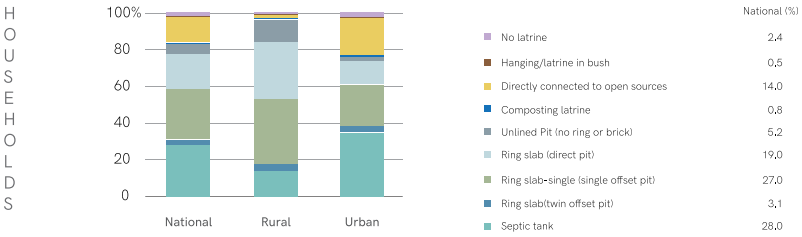


Figure- 8: Sanitation coverage by safely facilitie types

The use of septic tank system in urban areas as revealed by the present SMOSS survey is of particular importance. The survey found that 34% Households in urban areas were using septic tanks but close to half of them (16%) were not considered safe as their outlets are connected directly to drains, ditches or open water bodies. This data is similar to JMP assumption that 50% of septic tanks have containment. The MICS (2019) survey also found 32.9% Households using septic tanks but did not differentiate between safe and unsafe septic tanks. A further striking result of this study is the use of unsafe septic tanks in large city corporations. While 69% of Households in large city corporation areas use septic tanks, a staggering 41% households with septic tanks were unsafe discharging directly into storm water drains, canals, or backyard ditches and because of this direct discharge into the open environment, emptying septic tanks was also less frequent as sludge in most cases overrun the tank outlets and into the environment. This appears to be the main reason for very low demand for emptying and transportation services in large cities. In medium towns, also, of 41% septic tanks, 13% are unsafe; in small towns, the situation was still not as bad having only 2% unsafe of 13% Households using septic tank system. It is worth mentioning here that if these unsafe septic tanks can be transformed into safe ones, which may be possible relatively easily, a significant portion of urban Households would come under safe safe latrine coverage and this would also leverage to the development of sustainable FSM with more urban population enjoying safely managed sanitation services.

An important observation of SMOSS study is that a significant number of Households were using more durable and 'empty and reuse' type pits as reflected in the survey data showing more single off-set type pits (21%) compared to direct pits (10%). Single off-set pits were even more prominent in rural areas (24% compared to 13% direct pits); in urban areas single off-set pits were found in 20% Households and direct pits in 7%. Single off-set pit latrines were more dominant in small towns (35%) and medium towns (32%), with large city corporations having only 5% Households were using them. Twin off-set pits were still low at 3% only both in rural and urban areas that could be considered as safely managed on-site sanitation facilities when maintained, particularly the Y-junction, adequately. Direct pit latrines (pits directly underneath latrine superstructures) were considered not suitable/convenient for fecal sludge emptying as they were mostly inaccessible by the emptiers. Increased preference for single off-set pit latrines would be advantageous for emptying of FS that will help subsequent functions of FSM service chain.

Access to safe sanitation facilities in low-income communities (LICs) in large city corporations still remains a critical challenge. With only 8% access to safe sanitation, a staggering 85% LIC population resort to unsafe options that include 59% toilets that have no containment facility at all and are directly discharging into drains/ditches/open water bodies; 15% are connected to so-called unsafe septic tanks as their outlets are connected to open environment; and 12% practices open defecation. This extremely limited access to safe sanitation in LICs remains as a significant challenge and will retard the overall progress of safe sanitation services in urban areas.

4.3
Emptying fecal sludge from pits and septic tanks

The SMOSS study found that the majority (56%) of the Households surveyed that have safe sanitation facilities never required emptying their latrine pits or septic tanks as shown in Figure 5 below. MICS 2019 survey also reported exactly 56% Households who never emptied their pits and septic tanks. There could be several reasons for this; firstly, a major portion of the pits and septic tanks didn't reach the stage of emptying at the time when the survey was conducted, for instance 57% of the pits and 63% of the septic tanks surveyed (see Table 3.3) were found half or more than half empty; secondly, a significant number of Households are perhaps reluctant to emptying their latrine pits/septic tanks, unless it becomes absolutely essential, e.g., when overflowing, primarily because of the cost of emptying (see Section 3.8.3); and

thirdly, the study found, as presented in Table 3.3, some containment storage (9%,) are located inside the dwellings, e.g., inside kitchen, and also 14% pits are directly under the latrine superstructure that are not easily accessible and it is also possible that some pits and septic tanks have illegal hidden connections to drains and water bodies.

Only 38% of the surveyed households with safe safe facilities ever emptied their latrine pits or septic tanks and continued using them. Inspections during the survey found that 43% of pits and 37% of septic tanks were almost full or two-third portion full (see Table 3.3) indicating that a significant proportion of containment storages were filled up and require emptying but emptying of pits/septic tanks were relatively low. This situation is particularly critical for septic tank performance. Due to sludge build up there will be much less liquid volume left for sedimentation of solids within the septic tank resulting in the solids/ sludge overrun through the outlet device to the soak well leading to blockage of soak well and prohibiting infiltration of effluent into the soil and ultimately leaving a failed, overflowing soak well. Generally, septic tanks should be emptied when sludge build up reaches between one-third to less than half the volume so that septic tanks can function adequately, can retain most of the solids and restrict solids overflow with the effluent into the soak wells. It is therefore, extremely important to generate demand of emptying services for septic tanks and pits for continued functions of these onsite options.

While manual emptying is common in Bangladesh, this study revealed that only 21% Households employed mechanical emptying (Table 3.4) using non-motorized manual pumps (5.6%), small motorized pumps (13%) and vacuum tankers (2.3%). Mechanical emptying service was available almost entirely in urban areas (28%) and emptying services with vacuum tankers were available primarily in large city corporation areas (11%). The Key informant discussion with policy and decision making persons in government departments and I/NGOs reported that very limited mechanical emptying was available only in city corporations and in a few Paurashavas towns having projects in partnership with I/NGOs, and the coverage of mechanical emptying using motorized vehicles or vacuum tankers hardly exceeded 10%.

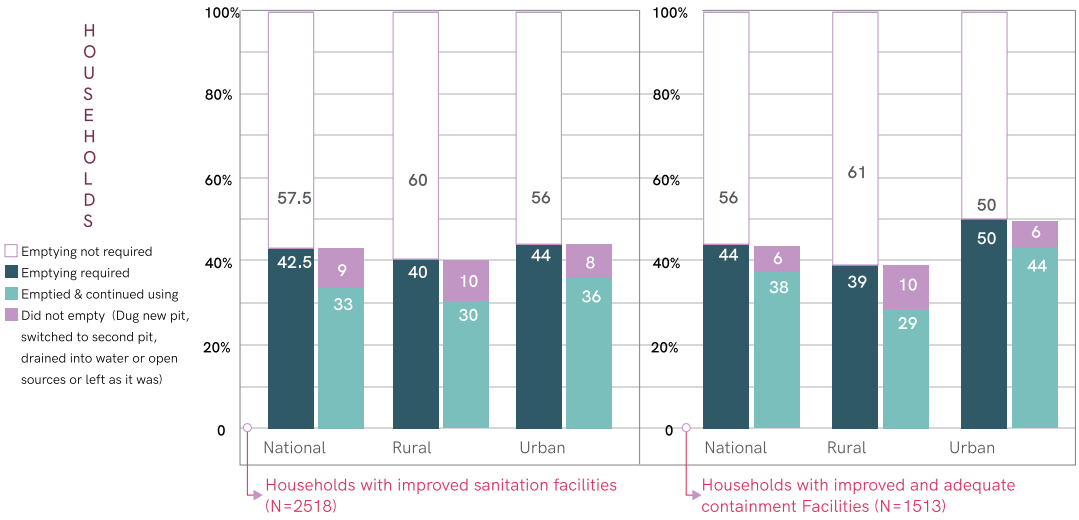


Figure- 9: Fecal sludge emptying practices.

Reportedly, during emptying of pits and septic tanks in Households with safe facilities, in 11% of cases, cleaners/sweepers needed to take up the risk of entering the pits or septic tanks for emptying. This could be because of latrine pits/septic tanks are installed in remote locations inside the dwellings without any consideration for emptying services. The study data also show that 28% of the pits/septic tanks belonging to the Households with safe facilities are either not accessible at all or difficult to access for emptying. In rural areas, this is primarily the cases with direct pit latrines underneath the latrine superstructure, and in urban areas the main reason could be space constraints within dwellings. During installations of latrine pits or septic tanks in Households with space constraints, the issue of accessibility for emptying service becomes less important to the dwelling people.

4.4
Transportation and disposal of fecal sludge

Transportation of 81% of emptied fecal sludge from Households with safe facilities is done manually using push carts or vans and is commonly associated with manual emptying and only 17% of emptied fecal sludge is transported using motorized vehicles (15%) and vacuum tankers (2.3%) mostly in large cities including some LICs and medium towns as shown in the Figure 6 below. The entire rural population (99%) resorts to manual emptying using local tools and techniques and manual transportation of emptied fecal sludge is the only option as mechanical emptying and motorized vehicle/vacuum tanker for transportation of fecal sludge is still out of reach.

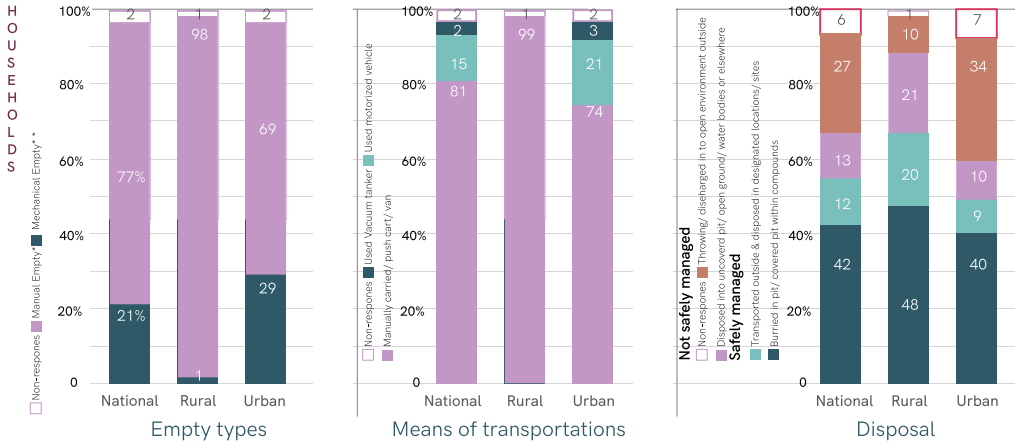


Figure- 10: Emptying, transportation and disposal of fecal sludge from HHs improved on-site facilities with adequate containment

Regarding disposal of emptied sludge from Households with safe safe sanitation facilities, 54% of the disposal is apparently considered safe, while 40% of the disposal was done unsafely in open environment such as discharging into storm-water drains, uncovered pits, open ground and open water bodies. Triangulation among quantitative data, group discussions with frontline worker and informant interviews revealed that the unsafe disposal of fecal sludge is due to lack of awareness, lack of disciplinary actions by law enforcement departments, lack of monitoring capacity of local authorities, and absence of designated disposal sites or treatment facilities.

An interesting observation of the study is that a significant 42% of the emptied sludge is buried in pits/covered pits within/near the premises whilst only 12% is transported outside premises to designated disposal/treatment sites. Burial in pits within/near premises is more common in rural areas (48% of emptied sludge) and in small (63%) and medium (34%) towns where space may not be a constraint. However, it is important to ensure that these disposal pits are properly covered and are not dug out before 18 to 24 months so that the pits content are fully sanitized. If this can be ascertained by the concerned local authorities through awareness building, motivation and regulatory enforcement, such disposal may be considered as safe. In addition, the twin off-set pit latrines, though very insignificant in numbers (only 3% both in urban and rural areas), when maintained as per design, can also be considered as safely managed sanitation system. In both cases, local authorities need to devise and enforce appropriate monitoring system in order to ensure that these options of fecal sludge disposal remain safe.

Transportation of fecal sludge off-site for treatment and disposal is linked mostly to mechanical emptying, the service that is yet not available everywhere, and at places where available associated costs of emptying and transportation are high that many cannot afford and/or are reluctant to avail the services. Fecal sludge treatment and/or appropriate disposal facilities are very limited. Absence of these facilities at nearby locations or at a reasonable distance could be one main reason for unsafe disposal of emptied and transported sludge. In large cities, in addition to large distances, complex traffic situation particularly during the day time also incites many FS transport operators to practice unsafe disposal. While the study could recognize a very good level of coordination among relevant government departments, UN agencies, World Bank, Asian Development Bank, NGOs and INGOs, and could reveal high level of interests among the funding institutions of their plans for investing in the development of safely managed sanitation system, these institutions remain skeptical about implementation and monitoring capacities of the implementing agencies.

4.5
Treatment and/or re-use

Household level engagement in treatment and re-use of fecal sludge is uncommon in Bangladesh. However, the SMOSS survey found that 21% of the Households could mention the purposes of transporting the emptied fecal sludge, and as expected, this is more so in urban areas (25%) than in rural areas (see Table 3.6). However, only a few of them reported in regards to the safe disposal and re-use, and indicated that people mostly believe that the transported fecal sludge are disposed of unsafely or unhygienically.

Focus group discussion and Key informant discussion revealed that there are fecal sludge management projects initiated by NGOs and commercial service providers partly across different cities in Khulna, Jhenidah, Kushtia, Jashore, Gazipur, Dhaka, and Mymensingh. The respondents reported that they did disposal at the authority allocated designated locations. However, the five municipalities and in big city corporation areas, the individual frontline workers reported that they do not have capacity and strength disposing fecal contents at designated locations because of costly, time consuming and person times. So, we estimated that in the areas where service providing support groups are available, over half (50%) in those locations disposed fecal contents safely.

Importantly, a good proportion (45%) of respondents including both rural and urban showed interest in using treated fecal sludge. 19% of them agreed that the treated fecal sludge could be used as fertilizer in agricultural cultivations.

4.6
Protective measures for emptying operations

Though nearly one-third (33%) of the survey Households irrespective of having safe or unsafe latrines and 38% of Households with safe facilities, ever emptied their latrines, use of protective equipment for the services were considerably lower. The common protective equipment used by the emptiers were face mask, gloves, boots, and very few individuals used body cover. As shown in the Figure 7 below, 53% of the cleaning workers used masks, 39% used gloves, 27% used boots and 15% used body covers.
In urban areas use of gloves, boots and body covers is slightly more compared to rural areas, while mask use in rural areas is higher. In 15% cases use of chemicals like kerosene, phenol, bleaching powder, quick lime, ash, are reported. These chemicals were used mainly in order to get rid of bad smells of fecal contents. However, it may be noted here that the above percentages of using different safety equipment, particularly the use of masks, may not be truly representative of pre-COVID period.

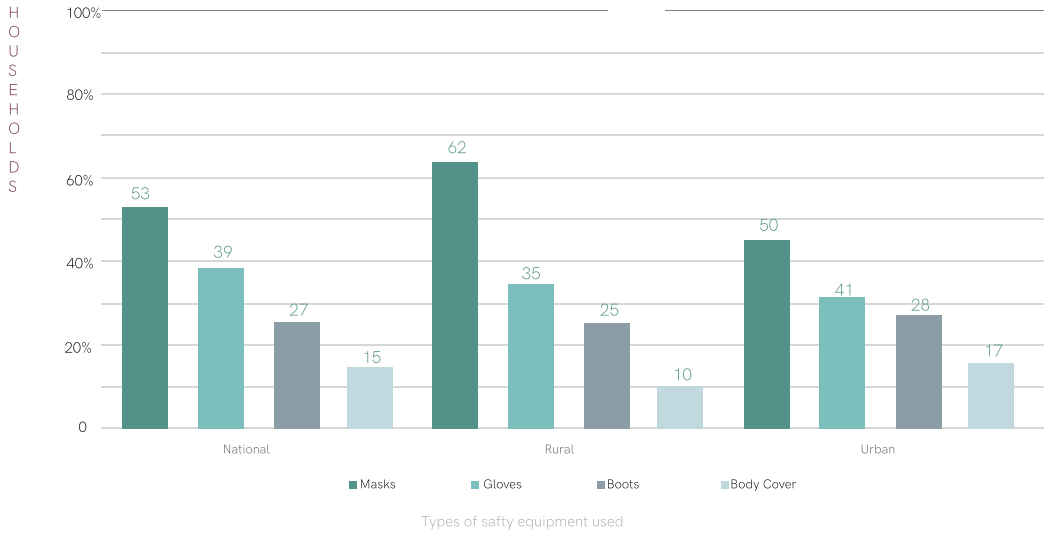


Figure- 9: Use of safety equipment by the emptiers

4.7
Occupational health hazards

People who are engaged in the occupations of emptying, transportation and treatment of fecal sludge, understands that they are exposed to different level of health risks including skin diseases, bronchial ailments, allergies, gastric/acidities, diarrhea/dysentery, and vomiting. Besides these occupational hazards, they also complained about the serious issue of explosion and fire and even death due to suffocation particularly while cleaning septic tanks. One verbatim quote from a group of frontline workers was "once we faced a serious incidence. As soon as the cover of a septic tank was opened, there happened a big explosion of fire. As a result, some of the workers got injured of burning of their hairs and portion of their limbs." Others issues were related to bad smell and disgust affecting them related to anxiety, in food habits, and in sleeping habits as well. They also face various injuries because of not mandatorily using the protective equipment primarily because these are not available from any source - client or institutions and/or individual emptiers cannot afford to buy them.

The occupational health hazards are primarily associated with manual emptying of pits and septic tanks. To overcome this extremely unhealthy and inhumane practice, manual emptying must be replaced by mechanical emptying. While the concerned local authorities take this initiative of gradually phasing out manual emptying, they should carefully look into the issue of loss of livelihoods of the traditional pit/ septic tank emptiers which can be addressed by engaging the traditional emptiers in mechanical emptying processes after proper training and education, or assisting them in availing different livelihood opportunities instead.

4.8
Some important challenges and limitations

The present SMOSS study could identify some important challenges and limitations in relation to fecal sludge containment, emptying, collection, transportation and disposal and/or treatment associated with on-site sanitation systems that include the followings:

Since half of the population is still using unsafe/unsafe on-site sanitation facilities that include latrines without storage/containment and latrine pits/septic tanks directly discharging into open environment, the demand for fecal sludge emptying and transportation services is very low. This situation affects the development of sustainable FSM systems that in turn leave most people without safely managed sanitation services in the country.

As pit/septic tank emptying is predominantly manually done and yet with a very low demand for these services, earnings/livelihoods of pit emptiers communities are facing a lot of challenges; cleaners/ emptiers who belong to institutions have very low wage rate and do not have any job security; adequate tools and safety equipment are not provided or available at affordable costs; the departments of local government institutions e.g., city corporations, municipalities in urban areas, and Upazila and union councils in rural areas, also lack mechanical equipment and related facilities; cleaning/emptying works during the day time are opposed by community people in most instances; night time works are challenging due to insufficient street light or lighting arrangements. The sanitation workers rarely received any training support in regards to their skill building and in maintaining safety and protection. Though there are some organizations that provide some level of training for example WaterAid, SNV, PAB, NGO Forum, DSK, etc., those trainings are limited to departmental/ institutional service workers. The workers in the self-help groups, for example workers in Khulna and Mymensingh Horijon palli, rarely receive a training. Fecal sludge treatment plants (FSTP) are very limited in Bangladesh. There are a few treatment locations available in Bangladesh, for example, FSTPs at Rajbandh in Khulna city corporation, in Faridpur, Jhenidah and Kustia Municipalities, Hogladanga in Khulna, FSTP in Satkhira, all facing a variety of operational challenges and limitations. Capacity of these FSTPs remains a serious issue. For instance, the Satkhira FSTP that was jointly implemented by PAB and the Satkhira Municipality, currently stopped operations after phasing out of the NGO support in 2017, because the Municipality does not have the capacity to operate. FSTPs in Khulna and Faridpur is running at under-capacity because of lack of fecal sludge supply to these treatment plants. The Hogladanga plant in Khulna produce fuel ball/cake by using sludge but faces the following challenges: 1) not enough water and adequate space to remove the clog of hose pipes and the community people consider their works as socially unacceptable, 2) during wet season, the treatment process face problem of drying due to lack of sunlight, 3) many people are reluctant to use the fuel ball/cake for cooking as those are made from fecal sludge.

The informant interviews reported that some major challenges that include – (a) lack of common understanding of the concept of safely managed sanitation system by all concerned, (b) regulations are not monitored by law enforcing agencies in installation of septic tanks and pits, (c) low demand of emptying due to unsafe practices such as connecting outlets of open environment, (d) lack of technical capacity and equipment, and (e) no harmonized monitoring system.

5:
Recommendatiion and way forward

5.1
Improving On-site Containment Systems

As half of the population is using sanitation systems with inadequate containment, the immediate focus should be on transforming them into adequate containment systems, ensure adequate containment of fecal sludge, and ready them for bringing under sustainable fecal sludge management (FSM) thus ensuring SMOSS. It shouldn't be too difficult to change the septic tanks into containment systems inadequate to adequate ones in urban areas except in a few densely populated areas of Dhaka and Chattogram cities where soak wells may not be successful primarily because of low infiltration capacity of soils. However, in these settings if the septic tanks can be modified/upgraded to produce better quality effluent which will then be discharged into soak wells filled with filtering media and as an interim measure, the overflows from soak wells can be discharged into storm drains until decentralized/ centralized networks are available for collecting effluents from septic tanks. Upgrading unsafe septic tanks (13%) could immediately increase safe, safe coverage to 63%. Another 14% Households that do not have any containment facility at all and discharge directly to drains and open water bodies, could be upgraded by enforcing installations of adequate containment facility, thereby enhancing safe, safe onsite sanitation coverage to 77%. Private sector organizations may be encouraged to produce and promote pre-constructed septic tanks of durable materials e.g., PVC, GRP etc. for varying number of users and following appropriate design. Such initiative would accelerate improving safe on-site containment system.

Both septic tanks with adequate & inadequate have to be checked for adequacy in design considering number of users e.g., checking tank dimensions having generally 2-chamber tanks with a length to width ratio of 3:1; properly positioned appropriate inlet and outlet devices; and adequately designed soak wells with appropriate filter media. This checking is extremely important to make sure that the system functions truly as septic tanks (and not simply as holding tanks or pits) whereby most solids are retained through sedimentation, anaerobic decomposition takes place, and the generated sludge is contained. Depending on the design, the accumulated sludge must be emptied on a regular interval. The desludging operation of septic tanks must be monitored by the local authorities (LGIs) following a "scheduled desludging plan" to be prepared as a part of overall MIS for SMOSS. Strict enforcement of such plan will increase demand for emptying and transportation of fecal sludge which subsequently will enhance demand for building more FSTPs, thereby completing the chain of SMOSS services in an area. This approach could be immediately initiated in urban areas, in large cities and medium towns, where septic tanks are widely used as a major onsite sanitation option.

Pit latrines with inadequate containment should be relatively easier to convert into safe ones. Undersized/ overflowing pits can be addressed either by increasing volume based on user numbers or converted them into twin off-set pits for alternate use whichever may be appropriate in a given context. In both rural and urban areas, where space is not a constraint, alternating twin off-set pit latrine should be promoted as a means of safely managed on-site sanitation option that does not require services for regular emptying, transportation and off-site treatment.

This can also enhance progress in SMOSS services rapidly. However, for alternate twin off-set pits to be considered as safely managed on-site option, two important criteria need to be fulfilled - firstly, each pit should be designed for adequate volume capable of accumulating fecal sludge continuously for 18 to 24 months so that during the alternate resting period the content is fully sanitized; and secondly, the Y-junction/ diversion pit must be properly designed, built and operated for smooth transfer of fecal sludge from one pit to the other.

Inaccessible pits e.g., direct pits underneath latrine superstructure and pits located inside dwellings would be rather challenging to rectify. Both technical and financial support from local government institutions, CBOs, NGOs would be required for arranging alternatives in these cases. This will quickly enhance the safe coverage of onsite systems and also improve containment of fecal sludge which is the first and most important functional element for ensuring SMOSS.

5.2
Special Attention to Sanitation Services for the LICs

SMOSS services in urban areas will not be effective unless the very critical situation in the LICs of large cities, as revealed by this study, is immediately addressed. With only 8% access to safe sanitation facilities, 59% toilets that have no containment facility at all and are directly connected to drains/ ditches/ open water bodies, 15% are connected to so-called unsafe septic tanks as their outlets are connected to open environment and 12% still do not have access to any kind of sanitation facility. The situation is very alarming and concerned authorities must pay immediate attention to improve the sanitation conditions in the LICs thereby ensuring safely managed, inclusive sanitation services for the city dwellers.

Individual or clustered latrines may be connected, perhaps through small sewer networks, to community septic tanks or multiple pits system wherefrom the fecal sludge could be emptied and transported to designated disposal/treatment sites. In LICs with very high population density, frequent desludging of the community septic tanks or small low volume pits would be needed to avoid latrines without containment and eliminate open defecation. Concerned authorities should also invest in arranging small motorized vehicles fitted with vacuum pumps so that these can navigate narrow roads in slums and LICs. It is also important that the concerned authorities consider giving financial support to the poor Households in terms of lowering the emptying and transportation charges and waiving sanitation tax where appropriate with the objective of rapidly enhancing the SMOSS services in LICs.

5.3
Ensuring Safe Emptying and Transportation of Fecal Sludge

Initiate shifting from manual emptying to mechanical emptying and targeting to gradually achieve 100% mechanical emptying of fecal sludge containments. While at present nearly 80% (almost entirely in rural areas) emptying is done manually, immediate focus should be given on ensuring use of safety gears/equipment by the emptiers and also use small motorized pumps or at least manually driven pumps in order to strictly avoid emptiers/cleaners entering into pits or septic tanks.

This will require adequate orientation and training of emptiers/sanitation workers/cleaners and adequate supply of safety gears/equipment, and must be facilitated by the local government institutions in both urban and rural areas with support from government technical agencies e.g., DPHE, LGED, WASA, and possible support from I/NGOs, and local CBOs. Local level strong monitoring system should be developed by the LGIs and must be in place to ensure safe emptying operation.

Fecal sludge emptied must be transported safely to designated disposal and/or treatment locations and motorized transport facilities must be enhanced/increased and gradually phase out manual transportation using push carts or vans. Transport operators must also follow the safety rules and use proper safety gears during fecal sludge transportation.

The issue of unauthorized disposal at different locations in the open environment must be seriously addressed and such disposal must be strictly prohibited. To avert this situation of unauthorized disposal, it is important that the concerned LGIs ensures designated disposal and/ or treatment sites at appropriate locations considering areas to be served, estimated fecal sludge volume, travel distance and availability of lands. A strong policing system following the recently developed Institutional and Regulatory Framework (IRF) for FSM (2017) may be developed locally by the LGIs with support from relevant government and non-government organizations.

5.4
Treatment of fecal sludge and Disposal/End-use of Treated Products

As revealed by the present SMOSS study, treatment of fecal sludge is very limited in Bangladesh; only a handful of small to medium FSTPs have been developed and being operated by some City Corporations and Paurashavas (municipality) mostly in partnership with I/NGOs. FSTPs in Chattogram, Khulna, Rangpur city corporations, and in Faridpur, Jhenidah, Kustia, Shakhipur, and Lakhsmipur municipalities are a few examples of fecal sludge treatment. Construction of some more FSTPs in different municipalities are in the pipeline through several government and external funded projects.

However, hundreds of more FSTPs are needed in urban and rural areas to accommodate increased amount of fecal sludge that will be generated at the onsite sanitation points. This will be particularly important as the unsafe onsite facilities are safe and containment facilities are adequately established and demand for emptying and transportation increased. Furthermore, as the motorized transportation of fecal sludge is enhanced, unauthorized disposal into open environment restricted/ prohibited, more fecal sludge will need to be treated at FSTPs.

It is therefore, important that the LGIs with technical and financial support from the central government and central government organizations, e.g., DPHE, WASAs, I/NGOs and development partners, immediately embark upon building FSTPs alongside improvement/ enhancement of other upstream functions e.g., emptying, transportation of fecal sludge. LGIs will require procuring lands and equipment e.g., vacuum tankers of varying sizes, to be planned and designed with provisions for future expansion, for specific urban or rural communities.
It is to be emphasized that involvement of the private sector in construction, operation and maintenance of FSTPs would expedite the whole process of fecal sludge treatment. LGIs could also consider various PPP models for establishing the entire sanitation chain of services including collection, transportation, treatment, disposal and/or reuse of treated products. This could lead to more rapid development of safely managed, sustainable, inclusive sanitation services.

However, as interim measures, transported fecal sludge can be safely disposed of at designated locations through trenching and covering with cover material and leaving undisturbed for 18 to 24 months. This will be particularly useful for rural areas where developing FSTPs may not be immediate. It is also important that people understand the reuse value of treated products. Popularizing safe use of treated end products, e.g., fertilizers, bio-energy, will also increase demand for SMOSS.

5.5
Enhancing Capacity of Institutions for Service Delivery

According to Local Government Act (2009), the overall responsibility of on-site sanitation management lies with the local government institutions (LGIs) e.g., City Corporations, Municipalities for urban areas, and Upazila (Sub-district) Councils, Union Councils for rural areas as mentioned in IRF-FSM (2017). However, these institutions have limited manpower, resources and capacity for planning, development, and management of sanitation services.

While the government has recognized the need for developing safe sanitation services for both urban and rural areas, it is extremely important that the capacities of LGIs are strengthened in terms manpower, resources and training and orientation which can then facilitate capacity building of stakeholders that are directly or indirectly related to SMOSS services development. LGIs must immediately undertake developing their own capacity building and resources management plans with support from the Local Government Ministry, CWIS-FSM Support Cell of DPHE, Capacity Development program of ITN-BUET that are already in place for the purpose. Apart from concerned LGI officials and staffs, fecal sludge emptiers, collection and transportation operators, FSTP operators are all important stakeholders needing skill development through orientation and training.

5.6
Awareness Raising for SMOSS Services

Enforcement of sanitation related laws and regulations may be very challenging unless all concerned people including local public representatives, government officials, civil society, and most importantly the users are sensitized of the benefits of safe on-site sanitation facilities and the complete chain of safely managed sanitation services. Proper sensitization will also help stop illegal/unauthorized connections of pits/septic tanks to open drains, ditches or water bodies as well as restricting unauthorized disposal of collected sludge into the open environment.

A major challenge in establishing the safely managed sanitation system is the lack understanding of its meaning by the general people across different level of sanitation services - access to safe sanitation, emptying, collection, transportation, treatment and disposal /re-use of fecal sludge. It is therefore critically important that concerned stakeholders including government agencies, I/NGOs, take initiatives to translate the concept and definition of safely managed sanitation systems into local context. Until this is done across all stakeholders, general people are sensitized and required support systems are made available, it would be extremely difficult to achieve the desired goal.

5.7
Monitoring progress of SMOSS Services

All the above six recommendations are critically important and need to be implemented in order to ensure safely managed sanitation services in the country thereby achieving the SDG target 6.2. The findings of this SMOSS Bangladesh study reveal that immediate actions are needed in every aspect of the complete sanitation chain starting with safe containment of fecal sludge, followed by emptying, transportation, treatment and disposal and/or reuse of the treated products. The study further suggests that, since all the system elements in the sanitation chain are interlinked, if fecal sludge can be safely contained (the first element in the chain) simply by improving the onsite sanitation options at households e.g., septic tanks and various forms of pit latrines, improvement of the subsequent functional elements of the sanitation chain would be accelerated.

5.7.1

Monitoring Safe and adequate containment of fecal sludge

Fecal sludge containment would be considered safe and adequate when the following lists of criteria/ indicators related to various on-site sanitation options are satisfied:

Septic Tank	Pit Latrines		
	Twin Pit Offset	Single Offset	Direct Pit
☐ A fully watertight, adequately designed/ dimensioned tank exists ☐ The tank is equipped with properly positioned inlet and outlet devices ☐ The tank outlet is connected to an adequately designed 'Soak Pit' or a sub-surface drain-field ☐ The tank bottom sludge accumulation depth does not exceed 40-45% of the total tank depth, beyond which sludge emptying would be essential ☐ The septic tank must have a clear freeboard of 0.3 meter above the top surface of scum layer ☐ The septage must not overflow at any time ☐ The septic tank outlet is not connected to storm water drainage/ ditch/ low lands/ open water body.	☐ Two lined or stable, unlined pits, separated by a distance equivalent to effective pit-depth, exist ☐ Both pits must have cover slabs with appropriate opening for sludge emptying ☐ Toilets/cubicles have commodes/pans fitted with proper water-seals and are connected to the offset pits through a Junction/ diversion pit ☐ Neither of the pits overflow at any time ☐ Y-junction / diversion pit is properly designed, built, and operated for smooth transfer of fecal sludge from one pit to the other pit ☐ Have 0.3-meter clear space between pit slab and top surface of fecal sludge of the pit which is operational while surveyed/ inspected ☐ Neither of the two pits is connected to storm drains/ water body/open space.	☐ Single lined or stable, unlined pit exists ☐ The pit must have a cover slab with appropriate opening for sludge emptying ☐ Pit does not overflow at any time ☐ Toilets/cubicles have commodes/pans fitted with proper water-seals and are connected to the offset pit ☐ The pit has 0.3-meter clear space between cover and top surface of fecal sludge ☐ Pit not connected to storm drains/ water body/ open space.	☐ Single lined or stable, unlined pit exists underneath latrine superstructure ☐ Latrine pan fitted with proper water seal exist ☐ The pit does not overflow or leak ☐ The pit has 0.3-meter clear space between cover and top surface of fecal sludge ☐ Pit not connected to storm drains/ water body/ open space.

5.7.2

Monitoring Safe emptying of fecal sludge

A safely managed containment system could turn harmful due to unsafe emptying practice. Based on SMOSS study result, sludge emptying service can be called safe when following criteria would be fulfilled:

Mechanical Emptying	Manual Emptying (To be phased out gradually)
☐ Pit emptier/sanitation workers use personal protective equipment (mask, gloves, gumboot etc.) ☐ Motorized pump/vacuum pump used for septic tank/pit emptying ☐ Emptying equipment are to be as per ISO standard and approved by local authority (no leakage in emptying pipe/tank etc.) ☐ In any case, pit emptiers/ sanitation workers do not enter pits or septic tanks ☐ Pit emptier/ sanitation workers do not take any food during emptying operation.	☐ Pit emptier/sanitation workers use personal protective equipment (mask, gloves, gumboot etc.) ☐ In any case, pit emptier/ sanitation workers do not enter pits or septic tanks ☐ Bucket, rope used as needed; emptied fecal sludge stored in drums/ containers of appropriate sizes, covered and readied for transportation by vans/ push carts ☐ Spade not used ☐ Pit emptier/ sanitation workers do not take any food during emptying operation.

5.7.3 Monitoring Safe transportation

Based on SMOSS Study's Focus Group Discussion and secondary data desk review, the following criteria/indicators are to be met to ensure safe transportation of fecal sludge that has been emptied safely from safe containment facilities:

Motorized Transportation and Discharge	Non-motorized Transportation and Discharge
☐ Fecal sludge transport operators and related staffs use PPE (mask, gloves, gumboot etc.) ☐ Use motorized vehicle fitted with sludge emptying pump/ vacuum tanker as per ISO standard and approved by local authority ☐ No spillage of fecal sludge during emptying, collection and transportation ☐ Fences and warning signs at critical locations along the route and around disposal point for accident prevention ☐ Collected fecal sludge disposed of at approved designated sites (trenches/ burying pits with adequate cover materials or FSTPs) and NOT into storm drains/sanitary sewage pump/ lift stations/ open water body/ low lands	☐ Pit emptier/ transport operators and related staffs use PPE (mask, gloves, gumboot etc.) ☐ Covered drums/containers filled with fecal sludge have adequate free-board and placed on the push carts/ manual vans/ tricycle vans in such a way that there is no spillage on the road ☐ Proper conduits/pipes used for transport to the burying pit ☐ No spillage of fecal sludge during emptying, collection and transportation ☐ Collected fecal sludge disposed of at approved designated sites (trenches/ pits with adequate cover materials or FSTPs) and NOT into storm drains/sanitary sewage pump/ lift stations/ open water body/ low lands

5.7.4 Monitoring of fecal sludge treatment adequacy

Treatment of fecal sludge may be considered complete, safe and adequate, and reuse potentials of the treated bi-product ascertained only when the following criteria are found to be satisfactorily performed:

Treatment of fecal sludge/ dewatering/ drying/	Treatment of separated liquid and disposal	Storage/ processing of dried fecal sludge/ reuse/ disposal
☐ Treatment plant operators and staffs use safety gears /equipment (Mask, gloves, gumboot etc.) ☐ The treatment plant adequately fenced ☐ The treatment plant is operational ☐ Treatment option employed is unplanted drying bed/ planted drying bed/ mechanical dewatering/others ☐ Dried sludge stored in a properly built shed/ left in the open ☐ Dried sludge transferred to other locations for further processing ☐ Separated liquid conveyed to specific units for further treatment ☐ In absence of a FSTP, transported fecal sludge is safely disposed of at designated location through trenching and covering with cover materials ☐ Disposed fecal sludge is left undisturbed for 18 to 24 months ☐ Odor, dust and leachate are under control.	☐ Treatment plant operators and staffs use safety gears / equipment (Mask, gloves, gumboot etc.) ☐ Site is adequately fenced ☐ Separated liquid treatment option e.g., ABR/ constructed wetlands/ anaerobic filter/ stabilization ponds ☐ The treatment plant is in operation ☐ Regular effluent quality testing protocol exists ☐ Test results of concerned parameters e.g., BOD, SS, FC, E. Coli, etc. are reviewed regularly and are found to satisfy the guideline values as per Bangladesh Environment Conservation Rules (ECR) 1997, for either reuse in agriculture, fish ponds or for disposal into the aquatic environment.	☐ Plant operators and staffs use safety gears /equipment (Mask, gloves, gumboot etc.) ☐ Dried sludge storage shed exist ☐ Dried sludge tested for moisture content, calorific value, Helminth eggs, other pathogens and nutrient contents ☐ Dried sludge taken for further processing for reuse as fuel and/or compost or for safe disposal at designated locations ☐ Odor, dust and leachate are under control. ☐ Test results fulfil the standards/ guideline values set by the competent authority e.g., the Department of Agricultural Extension, Bangladesh for the compost derived from dried sludge to be applied in agriculture.

5.7.5
SMOSS Monitoring Mechanism

Outcome Monitoring:

(1) Safely Managed Containment System Monitoring: National and International Survey e.g., MICS, DHS, SVRS, collect data on household sanitation facility and categorize them as "safe", "unsafe" and "open defecation". With some adjustments in these existing sanitation survey modules, outcome monitoring could be strengthened by incorporating suggested safe containment criteria.

(2) Safe Emptying and Transportation: Similar to containment criteria, safe emptying and transportation criteria could be included in the routinely used sanitation survey modules, e.g., MICS, to achieve required outcome monitoring results.

(3) Adequate Treatment and Disposal and/or Reuse: A specific module needs to be developed considering/incorporating suggested criteria for complete, safe and adequate treatment of fecal sludge including liquid treatment, and for reuse potentials of the treated bi-products.

Process Monitoring:

Currently no systematic process monitoring for SMOSS exists. Based on SMOSS study findings, following process monitoring system could be executed to strengthen SMOSS process monitoring.

(1) Safely Managed Containment System Monitoring: Department of Public Health Engineering, Directorate of Health have frontline staff up to lowest administrative tier called union. Also, WATSAN (Water & Sanitation) committees exist in union, upazila and district level. Quarterly household safe containment systems could be monitored through field staffs of DPHE, DG-Health and the WATSAN Committee members.

(2) Emptying and Transportation: Local Government Institutions (City Corporations, Municipalities, Upazila Parisad and Union Parisad) can develop systematic monitoring approaches to monitor safety status of sludge emptying and transportation services as per defined criteria for 'safe emptying and safe transportation of fecal sludge'.

(3) Treatment and Disposal: Sludge Treatment plant must record daily log sheet of fecal sludge collection, treatment and discharge details. Department of Environment (DoE), DPHE, and Department of Agricultural Extension (DAE) can jointly monitor adequacy of fecal sludge treatment including liquid treatment and disposal processes and/or reuse potentials of treated bi-product bi-annually.

5.8
Institutionalizing SMOSS Monitoring:

1) A high level 'National Coordination Committee (NCC)' is being instituted at the Ministry of Local Government, Rural Development and Cooperatives. The sanitation secretariat in DPHE is expected to act as the 'Secretariat' of the NCC. Alongside other roles and responsibilities assigned by the NCC, Policy Support Branch (PSB) can develop national and local level SMOSS monitoring protocols and is best positioned to monitor and track progress of National SMOSS situation.

(2) Policy Support Branch with support of sanitaion secretariat to develop household and institutional level safely managed containment inspection and monitoring protocols and orient DPHE and DG-Health frontline staffs and the WATSAN Committees to conduct the field inspection and monitoring.

(3) CWIS-FSM Support Cell is to develop safely managed emptying and transportation inspection and monitoring protocols and orient City Corporations, Municipalities, Upazilas and Union Parishads to undertake field monitoring, preferably by engaging private sector organizations with LGI officials overseeing the whole process.

(4) The NCC shall approve all relevant rules, regulations, monitoring protocols and approaches/ mechanisms and may form different sub-committees/ taskforce to steer monitoring and inspection activities for urban and rural SMOSS progress.

PART THREE:

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Appendix

Appendix A: Household questionnaire

Attached separately

Appendix B: FGD guides

Attached separately

Appendix C: Key informant interview Guides

Attached separately

Appendix D: Quantitative sampling detailed

Attached separately

Appendix E: Key informant interview sampling detailed

Attached separately

APPENDIX A:

Household questionnaire,

Safely Managed On-site Sanitation (SMOSS) Study, Bangladesh

Introduction and consent taking process

The objective of this survey is to explore the status of different stages in safely managed on-site sanitation (SMOSS) systems in Bangladesh. The survey is designed to describe how enabling of an environment currently exists in regard to safely managed on-site sanitation practices based on Bangladesh perspectives among both rural and urban households. This survey describes various aspects of SMOSS including containment/storing of feces, emptying, transportation, treatment and reuse.

The survey usually would take 30-45 minutes to complete. Any information that you provide will be kept strictly confidential and will not be shown to other people. The outcome of this information is NOT IN ANY WAY linked to your personal chances in regards to sanitation behavior and or services. It is an assessment study used strictly for sanitation management in Bangladesh for its policy and implementation level. This is voluntary and you can choose not to answer any or all of the questions if you want. If you choose not to participate, this will not impact or prevent you for getting benefit from any of the related ongoing interventions or future interventions if applicable. However, we hope that you will participate since your data are important. Do you have any questions? May I begin now?

Question-1: Did the household agreed to participate: No=0, Yes=1.

Note: Proceed with the interview once respondents of the household agreed participating the interview!

Question-2: Interviewer name and code:

SECTION-1: Household identification, and respondents and household members' demoFigureic characteristics

Sl #	Questions	Response	Codes	Skip notes
1.1	Cluster number id=generated unique serial numbers sample1= sampled into CC, MT, ST, rural Rural_urban3=1 rural, 2 urban Cluster4= cluster numbers for stratified analysis, p-values		Note look through the instruction manual. 1=CC-Residence, 2=CC-LICs, 3=MT, 4=ST, 5=Rural	
1.2	Household number		01 to 25 for every cluster	
1.3	Respondent name (Text)		Text	
1.4	Village/mahalla/para (Text)		Text	
1.5	Union/Ward #		Number	
1.6	Union/Pourashava/City corporation name (Text)		Text	
1.7	Upazila name (Text)		Text	
1.8	District name (text)		Text	
1.9	GPS reading: Latitude:		Collect	
1.10	GPS reading: Longitude:		Collect	
1.11	Contact cell phone to household:		Optional, note the numbers	
1.12	Sex of the respondent: R_sex2 R_sex2_f: respondent female=1, not female=0		1=Male 2=Female 3= Transgender	
1.13	Marital status		1=Single 2=Married 3= Transgender 4=Separated/divorced 5=Widow/ widower	
1.14	Age of respondent (interview between 18-60 years aged)		In years (approx..)	
1.15	Education of respondent		Number of formal education class passed	
1.16	What is the status of the respondent in the household?		1=Household head (HHH) 2=Spouse of HHH 3=Father/mother/father in law/mother in law of HHH 4=Children of HHH 5=Brother/sister of HHH 9=Others	

1.17	Sex of the HHH hhh_sex5 hhh_sex5_f: household head female=1, not female=0		1=Male 2=Female 3= Transgender	Skip if 1.16=1
1.18	Marital status of HHH		1=Single 2=Married 3= Transgender 4=Separated/divorced 5=Widow/ widower	Skip if 1.16=1
1.19	Age of HHH (Household head)		In years (approx..)	Skip if 1.16=1
1.20	Education of HHH (Household head)		Number of formal education class passed	Skip if 1.16=1
1.21	Total household income in the last month, include all sources (approximately)		Amount in Taka. 999=Do not know	
1.22	Total household income in last 12 months, include all sources (approximately) income6= annual income adjuster/corrected iquart=income quartile; 1= low-incme, 2=lower-middle, 3=upper-middle, 4=high-income iquart1, iquart2, iquart3, iquart4		Amount in Taka. 999=Do not know	
1.23	Number of household members ('Persons, either related or unrelated, living together and taking food from the same cooking pot constitute a household'…BBS def.) (Reported) tot_hhmem7=number of household members corrected/cleaned	Male: Female: Transgender:	Reported numbers	
1.24	Number of under-five years aged children (Reported) U5_child8=number of under-five years aged children	Male: Female: Transgender:	Reported numbers	
1.25	How many children under-five years aged do you have in the household who can not/do not use latrine for defecation? (Reported)		Numbers; 88=if do not have a latrine	
1.26	How old is the eldest baby in months among those who can not/do not use latrine for defecation? (Reported)		Age in months, 88=if do not have a latrine	

SECTION-2: ACCESS TO LATRINE FOR THE HOUSEHOLD AND POINT OF USE/CONTAINMENT

Sl #	Questions	Response	Codes	Skip notes
2.1	Latrine category that the household members are using (spot check only). Note: If the household owns>1 functional latrine those remain in use by household members, take data for the latrine that remains in bad condition. Q2_1r		Code list: 0= Do not use any specific latrine 1= Unsafe latrine1) 2= Safe latrine but excreta may not transportable (pit latrine)2) 3= Safe latrine where excreta are disposed in septic tank and the tank is not connected to any open network (drain, lake, open sources, …)	
2.2	Do you share this latrine with other people/individual/households who are not member of this households? (Reported) q2_2 imp_latS (means safe shared latrine; 0=No, 1=Yes)		Code list: 0=No 1=Yes 8=Not applicable 9=Don't know	Skip if 2.1=0

1 Unsafe latrine: open/hanging latrine, open pit (no measure for stopping of coming out flies and insects, or pit has leakage so that fecal sludge can pass to environment), latrine pit/septic tank is connected to a drain or to an open source

2 Safe latrine (basic): VIP, pit with slab, pit latrine without slab from which flies and insects easily can't come out.

2.3	How many people, including children, use this latrine? (Reported)		Code list: Insert the actual reported number 777=Uncountable/can not count 888=Not applicable 999= do not know	Skip if 2.1=0
2.4	Where is the sanitation facility located? (spot check)		Code list: 0= in own dwelling, 1= in own yard/plot (within the premises) 2= elsewhere 8=Not applicable 9= Donot know	Skip if 2.1=0
2.5	Distance of the latrine from the user household (approximately in meter, spot measurement only)?		Code list: Insert the distance in meter (approximately) 0= inside the dwelling 777=can't be measured 888= Not applicable 999= Do not know	Skip if 2.1=0
2.6	The last time passed stool by children <5y, what was done to dispose of the stools? Child faeces disposal/management: (observe and ask and insert most likely appropriate code in the box as appropriate)		Code list: 1=Child used latrine/toilet 2= Put/rinsed into toilet/latrine 3=Put/rinsed into drain or ditch 4= Thrown into garbage (solid waste) 5= Buried 6=Left it open 7=Used as manure 8=No feces disposal 88=Not applicable 99=Do not know	Skip if 1.25=0
2.7	Is there at least one member in your household that doesn't usually use the latrine for defecation? (Reported)		Code list: 0=No 1=Yes 8= Not applicable 9=Do not know	Skip if 2.1=0
2.8	If any or all members in the household do not use latrine (exclude children mentioned in 1.25), what are the reasons of not using latrine? (multiple options possible)(Reported)		Code list: 1=Elderly people, can not visit latrine 2= Some of the members not interested to use the latrine 3= Disabled 4= Injured 5=Reduced physical mobility 6=Long distance 7=Lack of privacy and safety 9=Do not know	Skip if 2.7=0, 8 and 9
2.9	When was the latrine installed? (Reported)		Code list: 0= <6 months 1= 6- <12 months 2= 1- <2 years 3= 2- <3 years 4= >=3 years 9= Do not know	Skip if 2.1=0

2.10	When was the latrine repaired last time?[3](Reported)		Code list: 0=Not repaired yet 1=In last one year 2=between 1-2 years 3=Before 2 years 9=Don't know	Skip if 2.1=0
2.11	What is the latrine/toilet containment (spot check)? q2_11 lat_cat (latrine categories reclassified) Codes: septic tank - improve; code 21 Ring slab (twin offset pit); code = 22 Ring slab (single offset pit); code=23 Ring slab (single direct pit); code=24 soak pit (no ring no brick); unlined pit; code 25 composting/urine diversion== ; code 26 septic tank - unsafe code 27 pit latrine (any pit) – unsafe code 28 No pit, directly connected to drain/ditch/open source; code 29 Hanging latrine/latrine in bush or open land; code 30 No latrine Code 31 Lat_cat_imp (safe or unsafe latrine; 0 unsafe, 1=safe)		Code list: 1= Composting latrine 2= Urine diversion latrine 3=Soak pit (no ring or brick) 4=Ring slab (single direct pit) 5=Ring slab (single offset pit) 6=Ring slab (twin offset pit) 7=Septic tank with sealed bottom and outlet connected to soak well or sewer 8= Septic tank with unsealed bottom and outlet connected to soak well or sewer 9= Septic tank with outlet connected to open drain/water body/open land 10=No pit, directly connected to drain/ditch/open source 11=Hanging latrine/latrine in bush or open land 12=connected to sewer system	Skip if 2.1=0
2.12	How deep is the latrine pit or septic tank below the ground surface? (meters) (if pit, ask how many rings and then measure) Q2_12 Note-1: Measurement would start from the top most point of the pit up to the bottom, which is height of the pit, also the measure length and breadth of the pit for septic tanks. However, for pit latrines it would be just height, because pits of the pit latrines are circular shape, standard pit should have 1.5 meter height and diameter of 1m. Standard septic tank size: Breadth=1m, length=4m, height=2.65m (Ref. WEDC) (Note-2: Do not need for all households, please check at least 10% households, depending on willingness and support from the household members)		In Meters (approximately) 777= Not taken 999 =Do not know	Skip if 2.1=0 or 1 Removed condition code 1, dated 17/11/2020
2.13	Approximately how full is your latrine pit/septic tank at the moment? Can you show me? (Spot check) (Do not need for all households, please check at least 10% households, depending on willingness and support from the HHH) (Sludge build up in pits/septic tanks) Q2_13		Code list: 1= Almost full 2= one-third portion empty 3= Half portion empty 4= More than half empty 5= Can not see the pit/septic tank 777= Not taken 999= Do not know	Skip if 2.1=0 or 1 Removed condition code 1, dated 17/11/2020

3 Repair means – changing/repairing of slab, pan, and pit so that the latrine remains in the category of safe latrine. Changing/repairing of superstructure is not included in this question.

2.14	How is the location of the containment facility (where in the pit /septic tank located)? (Spot check) Q2_14		Code list: 1= near the front side/close to the main entrance 2= Backyard 3= Located inside the dwelling structure 4= Pit is below the super structure of the latrine. 7=Other specify 8= Not applicable	Skip if 2.1=0
2.14a	If response of Q2.14 is other, specify Q2_14_Ot		Text	Skip if Q2.14~=7
2.15	Was the pit/septic tank easily accessible for the emptier? (Spot check) Q2_15 Code: 1 not accessible; 2 not easily accessible.		Code list: 1= Easily accessible 2= Not easily accessible 3= not accessible at all 4= could not find 7=Other: specify_____ 8=Not applicable	Skip if 2.1=0
2.15a	If response of Q2.15 is other, specify		Text	Skip if Q2.15~=7
2.16	Did the pit/tank leak, overflow or flood at any time in last one year so that pit/tank contents came out? (Reported)		Code list: 0=No 1=Yes 8= Not applicable 9=Do not know	Skip if 2.1=0 or 1
2.17	Can (ground) water get in or out of the pit/septic tank? (so the pit/septic tank is not "water tight or sealed") (spot check)		Code list: 0=No (water tight/sealed) 1=Yes (water can get in or out) 8= Not applicable 9=Do not know	Skip if 2.1=0 or 1
2.18	What is the nearby (in 100 meter) available drinking source water type? (Note: if the household owning more than one latrine, consider the one which is nearest to the drinking water source) (spot check) Q2_18		Code list: 0= No water source 1=Deep tube-well/pump 2= Shallow tube-well/pump 3= Protected well/spring 4= Unprotected well/spring 5= Water body (pond, lake, river, canal,..) 9= Do not know	Skip if 2.1=0
2.19	Observe and measure: what is the distance in meter (If <200m) to the nearest DRINKINGwater source from the latrine pit/septic tank? (Note: if the household owning more than one latrine, consider the one which is nearest to the drinking water source)		Code list: Actual distance in metersif the source water is <200 meter from the latrine pit/septic tank 888=No drinking water source noticed in 200 meter from the latrine 999=Do not know	Skip if 2.1=0
2.20	Is that drinking water source uphill or downhill from the latrine pit/soak well/septic tank? (Spot check)		Code list: 1=Downhill, 2=Uphill, 3=At the same level 9=Do not know	Skip if 2.1=0

2.21	ARE 'THE WALLS' AND/ OR "THE DOOR" OF THE TOILET IN PLACE? (Note: does the design of the toilet (walls and door) prevent other people from seeing and hearing what someone is doing when they use it? Does the toilet provide security to the intended users?) (Spot check)		Code list: 0=No 1=Yes 8= Not applicable 9=Do not know	Skip if 2.1=0
2.22	IS THE TOILET FREE FROM FAECAL SMEARS ON PAN, WALL AND FLOOR? (Note: Insert the actual data from observations. In case your observation may have doubt, ask questions to make your observed measurement correct) (Spot check)		Code list: 0=No 1=Yes 8= Not applicable 9=Do not know/could not observe	Skip if 2.1=0
2.23	Did you see the presence of child faeces in the yard or compound? (spot check)		Code list: 0=No 1=Yes 8= Not applicable 9=Do not know/could not observe	Skip if 2.1=0
2.24	(spot check) IS THE TOILET PAN FREE FROM USED CLEANING MATERIALS? (PAPER, STONES AND STICKS) (Note: Insert the actual data from observations. In case your observation may have doubt, ask questions to make your observed measurement correct)		Code list: 0=No 1=Yes 8= Not applicable 9=Do not know/could not observe	Skip if 2.1=0
2.25	What do you use for anal cleansing?(ask and then verify by spot checks) (Note: Insert the actual data from spot checks/observations. In case your observation/spot check may have doubt, ask questions to make your spot check measurement correct) (multiple checking allowed)		Code list: 0=Nothing 1= Water 2= Tissue / toilet paper 3= Ash 4=Soil / mud 5=Sticks / Other paper/ Grass/Leaves 6= Stones/ Corn cobs 9=Do not know	Skip if 2.1=0
2.26	How do you use water in your toilet? (select all that apply) (Reported)		Code list: 1= Anal cleansing 2= Flushing (pour or mechanical flush) 3= Handwashing 4= Cleaning floor and pan to remove faeces 9= Do not know	Skip if 2.1=0
2.27	Is water available in the toilet or nearby within 5m from the latrine? (Spot Check)		Code list: 0=No 1=Tap in the toilet 2=Tap or handpump within 5m 3=Stored water in the toilet 4=Stored water within 5m 8= Not applicable 9= Do not know	Skip if 2.1=0
2.28	Do you pay sewerage fee or sanitation tax to the service providing authority? (Reported)		Code list: 0=No 1=Yes 8= Not applicable 9= Do not know	Skip if 2.1=0

2.29	How frequently do you pay sewerage fee or sanitation tax? (Reported)		Code list: 1= Monthly 2= Quarterly 3= Annual 4= Others: specify_ _ 8= Not applicable 9= Do not know	Applicable if 2.28=1
2.29a	If response of Q2.29 is other, specify		Text	Skip if Q2.29~=4
2.30	Who is the sewerage/sanitation tax receiving authority? (Reported) (multiple checking allowed)		Code list: 1= Local level WASH related committee 2= Union Parishad 3= Municipality/CC 4= Private agency 5=Other (specify_ _ _ _ _) 8= Not applicable 9= Do not know	Applicable if 2.28=1
2.30a	If response of Q2.30 is other, specify		Text	Skip if Q2.30~=5
2.31	Who makes decisions about the household's latrine (e.g., pit emptying, construct-ing, improvements)? List all that come to mind. (Reported)		Code list: 1= Household head (HHH) 2= All members 3= Local level WASH related committee 4= Union Parishad 5= Municipality/CC 6= Private agency 7=Other 8= Not applicable 9= Do not know	
2.31a	If response of Q2.31 is other, specify		Text	Skip if Q2.31~=7

SECTION-3: FILLING & EMPTYING

Sl #	Questions	Response	Codes	Skip notes
3.1	An average, how many peoples (adults, children and infants) feces stored in the latrine pit/septic tank daily (approximately)? (Reported)		Number of persons 888=uncountable number 999=Do not know	Skip if 2.1=0
3.2	How many times has your pit filled up/septic tank overflowed till date? Enter 0 never full in the past. (Reported) Q3_2		Number of times 999= Do not know	Skip if 2.1=0
3.3	When was the last time, your latrine pit/septic tank required emptying? (Reported) Q3_3 Q3_3_0 (coding: 0 = never did emptying; 1= required emptying)		Code list: 0=Never 1=1-2 years ago 2=2-5 years ago 3=5-10 years ago 4=More than 10 years ago 8= Not applicable 9= Do not know	Skip if 2.1=0

3.4	When the pit/septic tank last needed emptying", what did you do? (Reported) Select all that apply q3_4_0 (Left it as it is/nothing was done) [code: 0=no, 1=yes] q3_4_2 (Dug/opened new pit) [code: 0=no, 1=yes] q3_4_3 (Switched to second pit) [code: 0=no, 1=yes] q3_4_4 (Emptied and continued using) [code: 0=no, 1=yes] q3_4_ot (Drained into water/open sources) [code: 0=no, 1=yes]		Code list: 0=Left it/nothing was done 1=Compost toilet, fecal sludge transportation and disposal is not necessary 2=dug/opened new pit 3=Switched to second pit (if twin pit) 4= Emptied pit/septic tank and continued using it77= Others: specify _ _ _ _ _ Other: 5=connected to moving water/drain/open sources 88= Not applicable 99= Do not know	Skip if Q3.3=0, 8 or 9
3.4a	If response of Q3.4 is other, specify q3_4_ot		Text Other: 5=connected to moving water/drain/open sources	Skip if Q3.4~=77
3.5	Who did the emptying? (Reported) (check all that apply) q3_5_1: Emptied by self-initiatives q3_5_2: Sweeper/Sanitation workers helped emptying q3_5_3: all others together		Code list 1=Emptied by self-initiatives 2= Sweeper/Sanitation workers helped emptying 3= Local WASH committee helped emptying 4= UP/Pourashava/CC helped emptying 5= Hired a private company to emptying 6= NGO helped emptying 77= Others 88= Not applicable 99= Do not know	Skip If 3.4~=4
3.5a	If response of Q3.5 is other, specify		Text	Skip if Q3.5~=77
3.6	Could you tell me the name/phone number of service provider? (Note: This question is pertaining to the last time the pit/septic tank was emptied.) (Reported)		Note name and phone number here; 9=Do not know	Skip If 3.4~=4
3.7	To empty the pit/septic tank, did someone need to enter into the pit/septic tank? (Reported) (Note: This question is pertaining to the last time the pit was emptied.) q3_7		Code list: 0=No 1=Yes 8= Not applicable 9= Do not know	Skip If 3.4~=4
3.8	Did emptier use any of the following? (choose multiple option) (Reported) (Note: This question is pertaining to the last time the pit/septic tank was emptied.) q3_8_1 boots q3_8_2 gloves q3_8_3 face mask q3_8_4 body cover q3_8_55: ash, kerosene, phenol, chun, bleaching powder		Code list: 1=Boots 2=Gloves 3=Face mask 4= Body cover 5= Other: specify_ _ _ _ 8= Not applicable 9= Do not know	Skip If 3.4~=4
3.8a	If response of Q3.8 is other i.e. 5, specify here what the other means.		Texts only	Skip If 3.8~=5
3.9	How was the emptying/digging equipment for the fecal contents emptied/removed? (Reported) (Note: This question is pertaining to the last time the pit/septic tank was emptied.) (multiple response possible) q3_9_1 q3_9_2 q3_9_3 q3_9_4		Code list: 1= Used hand-tools e.g. shovels, spades, buckets and rope 2= Used Non-motorized hand/manual pumps (e.g. gulper and MA-PET) 3= Small motorized pumps (e.g. gulper and MAPET) 4= Vacuum trucks/Vacutugs 7= Others: specify_ _ _ _ 8=Not applicable 9= Do not know	Skip If 3.4~=4
3.9a	If response of Q3.9 is other i.e. 7, specify here what the other means.		Texts only	Skip If 3.9~=7

3.10	Who provided the emptying/digging equipment mentioned in question number 3.9? (Reported) (Note: This question is pertaining to the last time the pit/septic tank was emptied.)(this question should go for each option in question 3.9)		Code list: 1= Provided by the household 2= Hired from WASH committee 3= Hired from UP/Ps/CC 4= Hired from a company 5= NGO 6=Self 7= Other: specify_ _ _ _ 8= Not applicable 9= Do not know	Skip If 3.9=8 or 9
3.10a	If response of Q3.10 is other i.e. 7, specify here what the other means.		Texts only	Skip If 3.10~=7
3.11	How did you contact the service provider who emptied your pit/septic tank?(check all that apply) (Reported)		Code list: 1= contacted by phone 2= someone from the house visited the service provider personally 3= communicated government authority/NGO/comm. provider 4= talked to locally elected representative/comm head 5=plumber 7=Not applicable 8=Other: specify_ _ _ _ 9=Don't know	Skip If 3.4~=4
3.11a	If response of Q3.11 is other i.e. 8, specify here what the other means.		Texts only	Skip If 3.11~=8
3.12	Who within the household took the initiative for emptying the filled pit/septic tank? (Reported)		Code list: 1=Household head (HHH) 2=Spouse of HHH 3=Father/mother/father in law/mother in law of HHH 4=Children of HHH 5=Brother/sister of HHH 6=Others: Specify_ _ _ _ _	Skip If 3.4~=4
3.12a	If response of Q3.12 is other i.e. 6, specify here what the other means.		Texts only	Skip If 3.12~=6
3.13	Please tell me your agreement/disagreement in the likert scale - strongly disagree, disagree, feel neutral, agree, or strongly agree with each of the following statements in regards to emptying transportation and disposal of fecal contents. If a statement does not apply to you, let me know.			
3.13.1	Dealing with my full pit/overflowing septic tank last time was stressful. (Reported)		Code list: 1=strongly disagree, 2=disagree, 3=feel neutral/ do not know, 4=agree, 5=strongly agree	Skip If 3.4~=4
3.13.2	Dealing with my full pit/overflowing septic tank last time took too long. (Reported)		Code list: 1=strongly disagree, 2=disagree, 3=feel neutral/ do not know, 4=agree, 5=strongly agree	If 3.4=4
3.13.3	Dealing with my full pit/overflowing septic tank last time required too much physical effort for a member of my household. (Reported)		Code list: 1=strongly disagree, 2=disagree, 3=feel neutral/ do not know, 4=agree, 5=strongly agree	Skip If 3.4~=4
3.13.4	Dealing with my full pit/overflowing septic tank last time was very expensive. (Reported)		Code list: 1=strongly disagree, 2=disagree, 3=feel neutral/ do not know, 4=agree, 5=strongly agree	Skip If 3.4~=4

SECTION-4: TRANSPORTATION and DISPOSAL

Sl #	Questions	Resp.	Codes	Skip notes
4.1	Where was the fecal contents transported to after emptying from the pit/septic tank? (Reported) Q4_1 : pooled the number of valid respondents Q4_1_1 : merged code 1 and 2 (Buried in pit/covered pit within compound) Q4_1_3 : code 3 (Disposed to uncovered pit/open ground/water body or elsewhere) Q4_1_4 : code 4 (Throwing/discharged into the open environment outside) Q4_1_5 : code 5 and 6 (Transported outside the compound and disposed designated treatment site) (Note : there was no response for code 7)		Code list: 1= Not transported outside the compound, buried in a pit 2= Not transported outside the compound, buried in situ in a covered pit. 3= Not transported outside the compound, disposed to an uncovered pit/open ground/water body or elsewhere. 4= Transported outside the compound for throwing/discharged into the open environment 5= Transported outside the compound and delivered to a designated site for dumping/burial at a designated site 6= Transported outside the compound and delivered to a designated site for treatment 7= Transported outside the compound for re-using without treatment/processing 8= Not applicable 9=Do not know	Skip if 3.4~=4
4.2	What were the means of transportation? (multiple response possible) (Reported) 1=van/manual, 2=motorized transport, 3=vacutag tractor; 9=do not know Q4_2		Code list: 1= Manually carried 2= Used protected removal pipe and motorized machine so that fecal effluents does not spread in the surrounding environment i.e. vacuum tanker 3= Vehicle without pumping system 4= Other: specify 7= Not applicable 9= Do not know	Skip if 3.4~=4
4.2a	If response of Q4.2 is other i.e. 4, specify here what the other means.		Texts only	Skip if 4.2~=4
4.3	Who was the owner of the transportation means – van/carts/pick up/ tractor? (Reported) (multiple options are allowed)		Code list: 0=Household initiatives 1= WASH committee 2= UP/Ps/CC 3= Private company 4= NGO 5= Other: specify_ _ _ 8= Not applicable 9= Do not know	Skip if 3.4~=4
4.3a	If response of Q4.3 is other i.e. 5, specify here what the other means.		Texts only	Skip if 4.3~=5
4.4	Did you have to pay for the emptying and transportation? (Reported)		Code list: 0=No 1=Yes 8= Not applicable 9= Do not know	Skip if 3.4~=4
4.4a	How much money did you pay? (Reported)		Code: Actual amount (Tk). 888= Not applicable 999= Do not know	Skip if 4.4~=1

4.5	What portion of cost (of emptying and transportation only?) was paid by the household? (Reported) (check all that apply)		Code list: 1=All associated cost 2= Shared with WASH related available committee support 3= Shared with UP/Ps/CC support 4=Shared with NGO support 5= Shared with Private company 6= Paid bribes only 8= Not applicable 9= Do not know	Skip if 3.4~=4
4.6	What was the disposal point for the fecal contents emptied and transported from your pit/septic tank containment last time? (Reported) (check all that apply) 0=No, 1=yes q4_61 q4_62 q4_63 q4_64 q4_65 q4_66 q4_67 q4_68 q4_69 q4_610 q4_611		Code list: 1=Buried <10 m away from the premise 2=Buried in 10-30 m 3= Buried >30 m 4=Into moving body of water 5=Into static body of water 6=Into field/drain/bush outside as waste 7=Directly to crop field (to fertilize crops) 8=Into waste treatment plant 9= Into fecal waste disposal point allocated by the authority outside (no treatment is done here) 10= safely stored somewhere for composting (safely means does not create environmental hazard/ contamination) 11= unsafely stored somewhere for composting 77= Not applicable 88= Other _ specify 99=Do not know	Skip if 3.4~=4
4.6a	If response of Q4.6 is other i.e. 88, specify here what the other means.		Texts only	Skip if 4.6~=88
4.7	Respond following statement using likert scale for each.			
4.7.1	I was satisfied with the overall transportation and disposal services provided by the service provider		Code list: 1=strongly disagree, 2=disagree, 3=feel neutral/ do not know, 4=agree, 5=strongly agree; 9=Does not apply to me	
4.7.2	I was satisfied with the price that the service provider charged.		Code list: 1=strongly disagree, 2=disagree, 3=feel neutral/ do not know, 4=agree, 5=strongly agree; 9=Does not apply to me	
4.7.3	I was satisfied with the safety of the methods used by the service provider.		Code list: 1=strongly disagree, 2=disagree, 3=feel neutral/ do not know, 4=agree, 5=strongly agree; 9=Does not apply to me	
4.7.4	I was satisfied with the ease of contacting the service provider.		Code list: 1=strongly disagree, 2=disagree, 3=feel neutral/ do not know, 4=agree, 5=strongly agree; 9=Does not apply to me	
4.7.5	I was satisfied with how completely the service provider emptied my pit.		Code list: 1=strongly disagree, 2=disagree, 3=feel neutral/ do not know, 4=agree, 5=strongly agree; 9=Does not apply to me	

SECTION-5: TREATMENT AND REUSE (Reported and spot checks)

Sl #	Questions	Response	Codes	Skip notes
5.1	Do you know the purpose of fecal contents transporting outside the compound? (Reported) Q5_1		Code list: 0=No 1=Yes 8= Not applicable 9= Do not know	
5.2	If you say yes in 5.1, what are the purposes of fecal contents transporting outside the compound? (multiple response possible) (Reported) (check all that apply) Q5_21 (Directly re-use for fertilizer or biogas; 0=no, 1=yes) Q5_22 (Directly dispose/dump into pit; 0=no, 1=yes) Q5_23 (Directly dispose anywhere outside; 0=no, 1=yes) Q5_24 (Treatment and dispose; 0=no, 1=yes) Q5_25 (Treatment and re-use; 0=no, 1=yes)		Code list: 1= Directly re-use 2= Directly dispose/dump into pit 3= Directly dispose anywhere outside 4= Treatment and dispose 5= Treatment and re-use 6= Other: specify 8= Not applicable 9= Do not know	Skip if 5.1~=1
5.2a	If response of Q5.2 is other, i.e. 6, specify other.		Text only	Skip if Q5.2~=6
5.3	Are you aware that fecal sludge is needed to be treated before disposal and/or reuse? (Reported)		Code list: 0=No 1=Yes 8= Not applicable 9= Do not know	
5.4	Does anyone of the household engage in any sort of fecal sludge treatment process?(Reported)		Code list: 0=No 1=Yes 8= Not applicable 9= Do not know	
5.5	If answer of 5.4 is 1, what sort of fecal contents do you engage in for treatment?(Reported)		Code list: 1=Waste water only 2=Fecal sludge only 3=Wastewater and fecal sludge 4=None 8=Not applicable 9=Don't know	Skip if 5.4~=1
5.6	If answer of 5.4 is 1 i.e. if treatment of fecal sludge is done, what type of treatment is practiced?(Spot check)		Code list: 1=Unplanted drying bed only 2=Unplanted drying bed followed by liquid treatment 3=Planted drying bed followed by liquid treatment 4=Mechanical drying 5=Co-treated with sewage treatment 6=Other method: specify 7=Not applicable 9=Don't know	Skip if 5.4~=1
5.6a	If response of Q5.6 is other method i.e. 6, specify other.		Text only	Skip if Q5.6~=6

5.7	Where is the treated fecal sludge (solids) disposed (or given/sold) to?(Spot check)		Code list: 1=Reuse or disposal on land and water 2=Landfill or safe burial 3=Use to vegetable manure 4=Use as crop manure 5=Other, specify_ _ 8=Not applicable 9=Don't know	Skip if 5.4~=1
5.7a	If response of Q5.7 is other method i.e. 5, specify other.		Text only	Skip if Q5.7~=5
5.8	Do/did the household use any of the fecal contents while is in the pit/septic tank of the latrine? (Reported) (check all that apply) q5_81: 1=Yes, directly to the fishpond as fish feed q5_82 q5_83 q5_84 q5_85 q5_86 q5_87 q5_88: 8= I buy composted manure from a fecal sludge treatment plant		Code list: 0=No 1=Yes, directly to the fishpond as fish feed 2=Yes, for poultry feed 3=Yes, in kitchen garden/ food crops 4=Yes, non-food crops/ plants 5=Yes, producing biogas or charcoal 6= Use for composting 7= Bring composted manure from a fecal sludge treatment plant 8= I buy composted manure from a fecal sludge treatment plant 9= Not applicable 99= Do not know	
5.9	Do the household feel like you wanted to use the treated sludge/end product? (Reported) Q5_9: 3 showed interest		Code list: 1=No demand, 2= No idea/do not know 3= Showed interest	
5.10	Do you agree that the treated fecal sludge could be used as fertilizer for agricultural cultivations? (Reported) Q5_10:1 1=strongly disagree, 2=disagree Q5_10: 2 4=agree, 5=strongly agree Q5_10: 0 3=do not know, 9=Does not apply to me		Code list: 1=strongly disagree, 2=disagree, 3=do not know, 4=agree, 5=strongly agree; 9=Does not apply to me	

6.1 Status of the survey: 1=Complete; 2=Incomplete

Q6.2 Write the name of enumerator/volunteer/data collector. (Text field)
_____

Reference sources: Resource materials from Cambodia study, SNV, JMP, WHO 2016 Draft Checklist, etc.

APPENDIX B:

Note: Although some questions look like individual interview but response for those would be collective agreement of the FGD group and separately in a different note book.

wet`™t GwU GKwU MvBW WKágõU, GUv ÜKvb c÷kúc¦ bq| KváRB c÷wZwU c÷ákúi DÀi Avjv`v ÜbvU KwcáZ wjLáeb| c÷wZwU c÷ákúi DÀi weøówiZ ÜbvU wjLáZ náe, ÜKvb ÜKvW wjLáeb bv| DÀi náj Zvi KviYmn wjLáZ náe hZUv mše|

RESPONDENT'S DETAILS (DÀi `vZvi cwiPwZ)

A1. Names (DÀi`vZviá`i bvg): _____

A2. Organization name (if any) (msØívi / ÜKvš'wb / wefváMi/ `fláii bvg)_____

A3. Titles or positions held in organization (if any) (msØív / ÜKvš'wb / wefváM/ `flái DÀi`vZvá`i c`ex)_____

A4. License number (if any) (msØívi / ÜKvš'wbi / wefváMi/ `fláii jvBám› hw` _)ãK_____

A5. Number of respondents alongwith their name and cell phone numbers (DÀi`vZvi msL®v, bvg Ges Ümj bvšvi mgn wjLb):

General Observations:

A5. GPS reading (Optional) (mše náj wbáeb, Ab®_vq `iKvi ÜbB)

Latitude :

Longitude :

A6. Location address (FGD Kivi RvqMvi wVKvbv wjLáeb)

Village/Mahalla:

UP/Ps/CC Name:

Upazila:

District:

A7. What is the dominant soil-type in this village (Üh Gwiqvi Z_® Übqv náîQ ÜmB Gwiqvi gwUi c÷Kviáf` wjLáeb)? (eSáZ mgm®v náj Üc÷áRáõUkvb WKágõU cvVvábv náqáQ, ÜmL Ü_áK wgwjáq wbáZ náe)

Solid rock ……..1

Heavy clay/loam ……..2

Fine sand ……..3

Gravel or coarse sand ……4

Fractured rock ……..5

SECTION CI: -Capital Investment (CI) (wK wK mš'` A®v€ A_ LvUvb náqáQ Zvi Z_®

CI_1. What capital did you invest in providing emptying or transportation or treatment services (cvqLvbv eR® wbØãvkb Ges enb evevØí®vcbvi KvR KiáZ c÷wZÜvb ev wefvM ev msØívwU wK wK cwR LwUáqáQb?

1. Manpower (KZRb gvblt)

2. Tools (specify..) (wK wK Ujm gváb cvqLvbvi eR® wbØãvkb Ges enb Gi Rb® nváZ ev Mváq e®venváii Rb® AváQ; weøówiZ wjLb)

3. Vehicles (ÜjvK Ges eR® enbáhvM® Mwo wK wK AváQ

4. Machinery equipment (höøcwZ wK wK AváQ)

5. Location/place/land development (GB KváRi Rb® Awdm ev Øívb Dbúqáb wK ev KZ UvKv LwUáqáQb?)

6. Finance (miscellaneous…) (Avil ÜKvb LvZ hw` _váK, ÜhLváb LiP KáiáQb, Zvi bvg eájb A®v€ KZ UvKv LwUáqáQb Zv ejb

7. Others_ specify (Avil hw` ÜKv_vI cqmv LiP Kái _váKb, bvg eájb A®v€ KZ LiP KáiáQb Zv ejb

8. Gross finance investment (Dcáii 1 Ü_áK 7 chöó KváR MZ 1 eQái ÜgvU KZ LiP KáiáQb?):

CI_2# Starting date/year of Business/services (msØívi / ÜKv§`wbi / wefváMi/ `fláii KvR ûii ZwiL, ev KZ eQi aái cvqLvbv eR® wbØãvkb Ges enb Gi KvR)Kiáq

CI_3. What were the challenges did you face in managing your invested capital? What causes the challenges? How do you think/recommend addressing the challenges? (cvqLvbv eR® wbØãvkb Ges enb Gi KvR KiáZ msØívi / ÜKv§`wbi / wefváMi/ `fli wUáK m§` ` Ges A_ eveØívcbvq wK wK mgm®vi m§ßLvb náZ náqáQ, KviY∏ájv wK wK, m§` ` Ges A_ eveØívcbvq mgm®v mgvaváb wK wK mcwik ev Avcbvi wK wK ejvi AváQ?

CI_4. Do you have any recommendations about how could you make your invested capital smooth in providing emptying and transportation services? (cvqLvbv eR® wbØãvkb Ges enb Gi KvR KiáZ msØívi / ÜKv§`wbi / wefváMi/ `fli wUáK m§` ` Ges A_ eveØívcbvq wK wK mgm®vi m§ßLvb náZ náqáQ, KviY∏ájv wK wK, m§` ` Ges A_ eveØívcbvq mgm®v mgvaváb wK wK mcwik ev Avcbvi wK wK ejvi AváQ?)

SECTION ET: EMPTYING AND TRANSPORT (ET) SERVICPROVIDER

ET1. Organization/department type (wK aiábi msØív / ÜKv§`wb / wefvM/ `fli

1. Government department – DPHE (ÜKv_vq ev ÜKvb ÜRjvq Ges DcáRjvq
2. Government department – Pourashava (ÜKv_vq ev ÜKvb ÜRjvq Ges DcáRjvq
3. Government department – CC (ÜKv_vq ev ÜKvb ÜRjvq Ges DcáRjvq
4. Government department – Upazila WASH related committee (ÜKv_vq ev ÜKvb ÜRjvq Ges DcáRjvq
5. NGO (ÜKv_vq ev ÜKvb ÜRjvq Ges DcáRjvq
6. Private company (commercial) (ÜKv_vq ev ÜKvb ÜRjvq Ges DcáRjvq
7. Academia and research organization (ÜKv_vq ev ÜKvb ÜRjvq Ges DcáRjvq
8. Individual shop/group/persons (ÜKv_vq ev ÜKvb ÜRjvq Ges DcáRjvq
9. Other: specify_____ (Ab®vb® ejáZ wK Zv wjLb Ges ÜKv_vq ev ÜKvb ÜRjvq Ges DcáRjvq
10. Do not know

ET2. What is your employment status (DÀi`vZvá`i c`wemgn wjLb)? (mark that all applies)

Probe: Do you work for yourself or for a company or for an organization?

1. Self-employed/proprietor (wbáRi KvR wbáR Kái, wbáRB gwjK
2. Company owner (ÜKvb GKUv ÜKv§`wbi gwjK)
3. Staff/worker for a private company (ÜKvb GKUv ÜKv§`wbi náq KvR Kiæ)Q
4. NGO staff
5. Government staff
6. Other (specify) (Ab®vb® ejáZ wK Zv wjLb)
7. Don't know

ET3. NAME OF THE COMPANY OR ORGANISATION, shop, department, institution (msØív / ÜKv§`wb / wefváM/ `fli Gi bvg wjLb, GKwaK msØív / ÜKv§`wb / wefváM/ `fli Üjv K náq _vKáj me∏ájvi bvg wjLb

Name_____

ET4. WHICH LOCATION(S) DO YOU /your company/department WORK IN (DESCRIBE BY DISTRICT, ZONE, VILLAGE ETC OF THE URBAN OR RURAL LOCATION)? Probe: PLEASE DESCRIBE ALL WITHIN WHICH YOU ARE ACTIVE.(msØív / ÜKv§`wb / wefváM/ `fli∏ájv wK wK GwiqváZ KvR Kái, Ühgb - cvqLvbv eR® wbØãvkb enb, gvBáµv ÜµwWU, j®vpbvrdmotion, hygiene promotion, agric, etc..... ÜmB Gwiqv∏ji bvg wjLb)

List name(s) of service area(s) _____ _____ _____ _____ _____

Don't know.....8

ET5. What are the OTHER Emptying & Treatment SERVICE PROVIDERS WORKING IN THE SAME AREAS (GB GwiqváZ Avi wK wK msØív / ÜKv§`wb / wefvM/ `fli AváQ hvnvi eR® wbØãvkb enb Gi KvR Káib, msL®v, bvg mn wjLæb

Number_____; Name: _____

Don't know……8

ET6. In the service providing communities, approximately how many households (% of households) use twin pit (do not need services, how many households (% of households) need services and how many do unsafe practices? (AvcbvivÜh GwiqváZ KvR KiáQb, ÜmB GwiqváZ KZ∏ájv LvbváZ ev kZKiv KZ msL®váZ eR® wbØãvkb I enb Gi KvR `iKvi, wbágúi wZb fváM LvbvI∏jáK Avjv`v Kib, KvQvKwQ nájB náe, GK`g mwVK msL®v bv náj Avmwéáa ÜbB, kZKiv náj, wZbUv wgáj 100 náZ náe)

i) Number/% of households use twin pit (do not need services) (msL®v ev kZKiv KZ LvbváZ wbáRá`i gZ mwVK eveØívcbv Kái _vákb, cvqLvbv eR® wbØãvkb I enb `iKvi nq b): _____

ii) Number/% of households need services: (msL®v ev kZKiv KZ LvbváZ eR® wbØãvkb I enb `iKvi)nq_____

iii) Number/% of households do unsafe practices (msL®v ev kZKiv KZ LvbváZ mwVK fváe eR® wbØãvkb Kái bv, ∂wZKviK fváe Kái): _vák__

ET7. WHAT SORT OF TOILET FACILITIES DO YOU/the company do EMPTY? (wK aiábi j®wU´b AvcbvEMPTY Kái _vákb, GKwaK aib náZ c)ái

Probe: SEPTIC TANKS, PIT LATRINES, OTHER FACILITIES?

Tick all that apply:

1. Septic tanks (ØvØí®m¦ßZ ÜmcwUK U®v°
2. Pit latrines (ØvØí®m¦ßZ wcU j®wU)´b
3. Other (specify) (Ab®vb® ejáZ wK Zv wjL)b
4. Don't know

ET8. WHAT TYPE OF EQUIPMENT DO YOU USE FOR EMPTYING (EMPTY Kivi Rb® wK aiábi höøcwZ e®envi Kái _vákb Zv)wjLb

Tick all that apply:

1. Nothing (ÜKvb höøcwZ e®envi Kwi)bv
2. Vacuum trucks , KZwU
3. Vacutugs , KZwU
4. Small motorized pumps , KZwU
5. Non-motorized hand/manual pumps , KZwU
6. Hand-tools e.g. shovels, spades, buckets and rope (wK wK weØówiZ msL®v Ges Øívbxq bvg wjLb...|)
7. Other (specify) (Ab®vb® ejáZ wK Zv wjLb)
8. Don't know

ET9. WHAT TYPE OF safety equipment DO YOU USE FOR EMPTYING (EMPTY Kivi Rb® wK aiábi ew≥MZ wbivcÀvi höøcwZ Ühgb ewWKfvi/ nvZ ev gL ev ÜPvL G e®envi Kái _vákb Zv wjL)b?

Tick all that apply:

Apron/body cover : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjLb)

Hand gloves : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjL)b

Face masks : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjL)b

Others : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjL)b

ET10. Do you think these equipment are enough for you, or do you have any choice/suggestions/recommendations? In case you have suggestions, choice in selecting equipment; mention those (EMPTY Kivi Rb® Üh aiábi ew≥MZ wbivcÀvi höøcwZ Ühgb ewWKfvi/ nvZ ev gL ev ÜPvL G e®envi Kái _vákb Zv c÷áqvRábi Zjbvq wVKgZ AvávQ wK? G weláq ÜKvb mcwik ev ejvi _vKáj ÿjb

ET11. WHAT TYPE OF EQUIPMENT DO YOU USE FOR TRANSPORT? (TRANSPORT Kivi Rb® wK aiábi höøcwZ e®envi Kái _vákb Zv jLb

Tick all that apply:

1. Nothing (ÜKvb höøcwZ e®envi Kwi bv
2. Vacuum truck with capacity of tank (specify in litre) (Vacuum truck avivY∂gZvmn KZUv, weØówiZ wjLb...)
3. Towed vacuum tank on wheels (specify capacity in litre) (locally manufactured, modified.. avivY∂gZvmn KZUv, weØówiZ wjLb...)
4. Towed tank on wheels (specify capacity in litre avivY∂gZvmn KZUv, weØówiZ wjLb...)
5. Non-motorized e.g. oil barrel cart, barrow, adapted cycle rickshaw, animal drawn cart (weØówiZ wjLb..)
6. Other (specify) Ab®vb® ejáZ wK Zv wjLb...)

ET12. WHAT TYPE OF safety equipment DO YOU USE FOR transportations? (transportations Kivi Rb® wK aiábi ew≥MZ wbivcÀvi höøcwZ Ühgb ewWKfvi/ nvZ ev gL ev ÜPvL G e®envi Kái _vákb Zv wjLb

Tick all that apply:

Apron/body cover : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjLb

Hand gloves : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjLb

Face masks : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjLb

Others : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjLb

ET13. ON AVERAGE, HOW MANY SEPTIC TANKS, PIT LATRINES AND OTHER SYSTEMS (SUCH AS COMPOST TOILETS) DO YOU EMPTY PER DAY/WEEK/ MONTH? (NOTE: ALLOW INTERVIEWEE TO DECIDE WHICH UNIT IS EASIEST TO USE) (Máo c÷wZwi`b ev c÷wZ mflván, ev c÷wZ gvám KZUv j®wU´b Gi mvnvh¨v® Kái _vákb?

Number (per day/week/month) _____per _____ (msL®v Máo c÷wZwi`b ev c÷wZ mflván, ev c÷wZ gvám)

Don't know.....(Rwbbv)

ET14. DO YOU DISCHARGE EACH TRUCK LOAD [OR VACUTUG OR TOWED TANK OR CART LOAD ...INSERT AS APPROPRIATE FROM ANSWER] TO THE SAME LOCATION?(cvqLvbv eR® wbØãvkb I enb Kái memgq wK GKB RvqMvq/c¯võUG Üdáj _vákb?)

Yes.....1

No.....2

Don't know.....8

ET15. HOW MANY DIFFERENT SITES OR LOCATIONS DO YOU VISIT AND DISCHARGE LOADS? (eR® wbØãvkb I enb Kái KZ∏ájv RvqMvq/c¯võUG Üdáj _vákb, RvqMv∏ájv wK aiábi, bvgmn wjLb?)

Number_____, bvgt_____, _____, ...

Don't know.....

ET16. IF discharged in different locations as mentioned in ET15, ON AVERAGE, OF ALL THE TRIPS YOU MAKE, WHAT PROPORTION DO YOU MAKE TO EACH ONE? (cvqLvbv eR® wbØãvkb I enb Kái hZ∏ájv wewfbú RvqMvq/c¯võUG Üdáj _vákb, ÜmB Øívb∏ájvi bvg Ges kZKiv KiZ Askt)

1. Treatment plant site/location name.....Proportion of all trips.....

(¯≠võU Øívábi bvg I kZKiv KZ Askt)

2. Site/location name.....Proportion of all trips.....

(¯≠võU evá` Ab®vb® Øívb náj, bvg I kZKiv KZ Askt)

3. Site/location name.....Proportion of all trips.....

(`≠vÕU evá` Ab®vb® Øívb náj, bvg I kZKiv KZ Askt)

4. Site/location name……..……Proportion of all trips……

(`≠vÕU evá` Ab®vb® Øívb náj, bvg I kZKiv KZ Askt)

5. Site/location name……..……Proportion of all trips……

(`≠vÕU evá` Ab®vb® Øívb náj, bvg I kZKiv KZ Askt)

6. Continue on separate sheet if necessary

(`≠vÕU evá` Ab®vb® Øívb náj, bvg I kZKiv KZ Askt)

7. Don't know……

ET17. DO YOU KEEP A RECORD OF ALL HOUSEHOLD EMPTYING & TRANSPORT ACTIVITIES THAT ARE CARRIED OUT? (Avcábiv EMPTYING & TRANSPORT KváRi meRECORD iváLb wK, gváb Káe, ÜKv_vq, wK wK aiábi j®wU´ áb mwfm w`áqáQb, BZ®w`...?)

Yes……1

No……2

Don't know……8

ET18. PLEASE CAN I SEE RECORDS FOR THE PAST ONE YEAR, please note the record for last one year? (EMPTYING & TRANSPORT KváRi ÜbRECORD ÜcáqáQb Zv Ü_áK weMZ GK eQáii Z_® ÜbvU Kib; Ühgb, KZ∏ájv Lvbv, KZ∏ájv e®emwqK j®wU´ áb mwfm w`áqáQb, BZ®w`...)

ET19. How many of you did receive capacity building training in either of fecal sludge emptying, transportation, disposal or treatment? (Avcbvá`i ÜKI wK ÜKvb cvqLvbv eR® wbØãvkb I enb, ev e®eØívcbv weláq c÷wkØY Ücáqáb, Ücáq _vKáj KZRb, ÜcáqáQb?)

ET20. What was the training contents that have received by the participants, who were the training delivery agencies? (Avcbvá`i ÜKI wK ÜKvb cvqLvbv eR® wbØãvkb I enb, ev e®eØívcbv weláq c÷wkØY Ücáq _vKáj wK wK weláq c÷wkØY ÜcáqáQb, Üm∏ji bvg eájb A®v€ ÜK ev ÜKv_v Ü_áK c÷wkØY ÜcáqáQb bvg wjLb?)

ET21. What sort of health hazard/diseases being workers in the area of emptying, transportation, disposal or treatment? (Avcbvá`i ÜKI wK ÜKvb cvqLvbv eR® wbØãvkb I enb, ev e®eØívcbv KiáZ wMáq ÜKvb iKági ØvØí® SwKáZ cáiáQb? cái _vKáj Üm∏ájv wK wK, weØówiZ wjLb/ejb?)

ET22. As per your impressions, how were the behaviors from the household members while providing fecal sludge emptying and transportation services? (Avcbvá`i c÷áZ®áKi AwfM®Zv Abhvqx cvqLvbv eR® wbØãvkb I enb, ev e®eØívcbv KiáZ wMáq Lvbv m`m®á`i KvQ Ü_áK ev ewYR®K j®wU´b KZcØ Ü_áK wK ÜKvb iKági Lviv c e®envi ÜcáqáQb, Ücáq _vKáj Üm∏j wK Zv ejb Ges ÜbvU KiÊb? wK wK, eØviZ wjLb/ejb?)

ET23. How were the payment system? (cvqLvbv eR® wbØãvkb I enb KváRi UvKv cqmvi Üjbá`bUv wK iKg wQj , weØówiZ wbáPi fvM Abhvqx wjLb?

i) Household level latrine fecal sludge emptying and transportation service providing: Note as mentioned by the respondents (Lvbv cvqLvbv eR® wbØãvkb I enb KváRi UvKv cqmvi Üjbá`b ÜKgb wQj?)

ii) Commercial level latrines (Commercial cvqLvbv eR® wbØãvkb I enb KváRi UvKv cqmvi Üjbá`b ÜKgb wQj?):

iii) Industrial level latrines (Industrial cvqLvbv eR® wbØãvkb I enb KváRi UvKv cqmvi Üjbá`b ÜKgb wQj?):

ET24. List the challenges by priorities in providing emptying and transportation services to the targeted communities. (cvqLvbv eR® wbØãvkb I enb KvR KiáZ wMáq mgm®vmgn wK wK wQj ?weØówiZwjLb...)

ET25. List the limitations by priorities in providing emptying and transportation services to the targeted communities. (cvqLvbv eR® wbØãvkb I enb KvR KiáZ wMáq Avcbvá`i wK wK weláq AcviwZv wQj fweØówiZwjLb...)

ET26. List the recommendations by priorities in providing emptying and transportation services to the targeted communities. . (cvqLvbv eR® wbØãvkb I enb KvR KiáZ wMáq Avcbvá`i wK wK mcwik Ges e≥e® AvaøqwówiZwjLb...)

Z_® msM´nKvixá`i bvg, Üdvb b¦imgn wjLbt

END INTERVIEW

TREATMENT SERVICE PROVIDER SURVEY; FGD tool#2

1. Names (c÷avb DÀi`vZvi bvg): _____

2. Organization name (if any) (msØívi / ÜKv¦`wbi / wefváMi/ `fláii bvg)? _____

3. Titles or positions held in organization (if any) (msØív / ÜKv¦`wb / wefvMxq `flá DÀi`vZvâi c`wemgn) ? _____

_____

4. License number (if any) (msØívi / ÜKv¦`wbi / wefváMi/ `fláii jvBám›`hvwvák)? _____

_____

5. Number of respondents alongwith their name and cell phone numbers (DÀi`vZvi msL®v,bvg Ges Ünj bv¦vimgn wjLb):

Fecal Sludge Treatment Gi Z_®t

T1. WHAT TYPES OF FAECAL WASTE DOES THIS FACILITY TREAT/RECEIVE (GB d®wQwjwU msØív ev `fliwU ev ÜKv¦`wb wU wK wK aiábi cvqLvbvi eR® wU´UágõU Kái _vák)?

Probe: OBSERVE IF THE FACILITY IS CONNECTED TO A SEWER (PIPE) OR IF FAECAL SLUDGE IS DELIVERED BY VEHICLES Ü`áL wbb Üh cvqLvbvi eR® wU´UágõU Kái _vák Ümf¶ájv wKfváe Ücáq sewer pipe Ü_áK Avám, bwK Mvox Gám W´c Kái hvq? hv Ü`Lájb Zv wjLb|)

cvqLvbvi eR®i aibt

1. HH pit latrine (Lvbvi MZ cvqLvbv),
2. HH septic tank, (Lvbvi ÜmcwUK U®v° cvqLvbv
3. Public toilet facilities(cvewjK cvqLvbv),
4. Industrial/commercial toilet facilities (Industrial/commercial cvqLvbv),
5. Ab®vb® náj Zv wK ÜmUv wjLb|

T2. WHICH EMPTYING/transportation SERVICE PROVIDERS DELIVER TO THIS TREATMENT WORKS? (†h EMPTYING/transportation SERVICE PROVIDERS cvqLvbvi eR® wU´UágõU Gi GB d®wQwjwU ÜZ eR® ÜWwjfwi w`áq _vák Zvá`i bvg Ges Ümj bv¦vi wjLb)hw` _vák|

Probe: DO YOU KEEP A RECORD OF ALL DELIVERIES TO THE TREATMENT PLANT? IF SO, PLEASE CAN I SEE IT? (hw` d®wQwjwUáZ hviv eR® ÜWwjfwi w`áq _vák, Káe wK A®v€ KZ cwigváb ÜWwjfwi w`áqwQj Zv wjwLZ _vák, ÜmLvb Ü_áK weMZ 1 gvámi Z_® wjLb)

1|

2|

3|

T3. WHAT IS THE FAECAL SLUDGE TREATMENT PLANT DESIGN CAPACITY? (d®wQwjwUáZ wK cwigvb cvqLvbvi eR® wU´UágõU Kiv hvq gváb K®vcwQwU KZ?)

Design Capacity _____(cubic meter/year) (cvqLvbvi eR® wU´UágõU Gi K®vcwQwU, wKDweK wgUvái wjLb)

T4. WHAT IS THE FAECAL SLUDGE FLOW THAT IS CURRENTLY TREATED (ANNUAL AVERAGE)? (d®wQwjwUáZ weMZ GK eQái wK cwigvb cvqLvbvi eR® wU´UágõU Kiv náqáQ?)

Probe: DO YOU HAVE RECORDS THAT COULD VERIFY THESE FLOWS? HOW DO YOU CALCULATE/MONITOR IT (d®wQwjwUáZ weMZ GK eQái wK cwigvb eR® wU´UágõU Kiv náqáQ Zv hw` wjwLZ _vák, ÜmLvb Ü_áK weMZ 1 eQái Üh Z_® AvPáQ Zv wjLb

Treated Flow _____(cubic meter/year) (Üh cwigvb cvqLvbvi eR® weMZ GK eQái wU´UágõU Kiv náqáQ Zv wKDweK wgUvái wjLb)

T5. WHAT IS SIZE OF POPULATION (Households) THAT THE TREATMENT PLANT SERVES? (d®wQwjwU KZ¶ájv Lvbv, cwewjK Üc¯m, d®v±wi/KviLvbv ÜZ mwfm w`áq _vák)?

Probe: DO YOU HAVE RECORDS TO VERIFY THIS FIGURE? (hw` Awdwmqvj wjwLZ _vák, ÜmLvb Ü_áK wj)Lb

_____ households (Lvbv msL®)

_____ public place (cwewjK Üc¯m Gi msL®v

_____ industries (d®v±wi/KviLvbvi msL®v

T6. WHERE DOES THE FAECAL SLUDGE COME FROM AND IN WHAT PROPORTIONS? (Üh cwigvb cvqLvbvi eR© wewMZ w`áb wU´UágõU Kiv náqáQ Zvi KZ Ask ÜKvb ÜKvb RvqMv Ü_áK Ücáqá Q?

Probe: DO YOU HAVE RECORDS TO VERIFY THESE FIGURES? (Üh Z_© Avcvb wjLáQb Zvi ÜKvb Awdmmqvj wjwLZ ÜKv_vI wKQ AváQ wKbv hvPvB Kái wbb

Complete for all sources that apply (wbáP ÜhLváb ÜhUv c´ áhvR© Zv cib):KiÊb

1. Proportion from domestic (%)_____ (Lvbv Ü_áK kZK)v

2. Proportion from commercial (%)_____(cvewjK Üc¯m Ü_áK kZK)iv

3. Proportion from industrial (%)_____(d©vPwi/KviLvbvi Ü_áK kZK)iv

T7. WHERE IS THE TREATED FAECAL SLUDGE (SOLIDS) DISPOSED (OR GIVEN/SOLD) TO (wU´UágõU Kivi ci Ümq¶ájv wK KáiáQ, wePówi)Z wjLb?

1. Reused as compost/soil conditioner in agriculture (Kwl RwgáZ Káš¿ v¯ mvi wnámáe Ü`qv náqám ev wePvq Kiv n)náqám

2. Reused as fuel (R°vjwb wnámáe Ü`qv náqám ev wePvq Kiv)náqám

3. Disposal on land and water (RwgáZ ev cwbáZ Üdáj Ü`qv n)áqám

4. Disposal as Landfill or safe burial (Rwg fivU Kiv náqám ev ØvØí© mšßZ fváe gwUi wbáP cáZ w`áqám),..ev..Ü.`q.....

5. Ab©vb© náj Zv wK ÜmUv wjLb|

T8. IS THE LIQUID FRACTION RESULTING FROM SLUDGE TREATMENT, TREATED (wU´UágõU Kiv cvqLvbvi eR© Ü_áK Üeo nIqv Zij eR© wK wU´UágõU Kiv náqwQj)?

Yes……1 (specify treatment methods...hw` cvqLvbvi eR© Ü_áK Üeo nIqv Zij eR© wU´UágõU Kiv náq _váK, Zv wK cwZáZ wU´UágõU Kiv náqám Zv wePówiZ wjLb)

No.....2

Don't know.....8

T9. Is the quality of treated liquid tested before disposal (wU´UágõU Kiv cvqLvbvi eR© Ü_áK Üeo nIqv Zij eR© hw` wU´UágõU Kiv náq _váK, ÜmB Zij eR© wVKgZ wU´UágõU Kiv náqwQj wKbv Zvi ¶bMZ w`K ÜU˜ Kiv náqwQj wK)?

Yes.....1

No.....2

T10. WHERE IS THE TREATED LIQUID FRACTION (EFFLUENT) DISPOSED (OR GIVEN/SOLD) TO? (wU´UágõU Kiv Zij eR© ÜKv_vq Üdjv náqwQj?)

INTERVIEWER: OBSERVE LOCATION AND DISCHARGE TO IT (IF ANY) (mšie náj ÜKv_vq Üdjv náqwQj Ü`áL Zvi ÜbvU wbb Ges wjLb |

1. Treated effluent used for plantation (wU´UágõU Kiv Zij eR© Kwl RwgáZ Káš¿ v¯ mvi wnámáe Ü`qv náqám ev wePvq K)iv.náqám

2. Treated effluent disposed into open water or land (wU´UágõU Kiv Zij eR© RwgáZ ev cwbáZ Üdáj Ü`)qv.náqám

3. Ab©vb© náj Zv wK ÜmUv wjLb|

T11. WHAT TYPE OF EQUIPMENT DO YOU USE FOR fecal sludge treatment services (wU´UágõU Kivi Rb© wK aiábi höøcwZ e©envi Kái _váKb?Zv wjLb

Tick all that apply (hv c÷áhvR© c÷áZ©K wU wjLb):

1. Nothing (áKvb höøcwZ e©envi Kwi)bv

2. Small motorized pumps , KZwU

3. Non-motorized hand/manual pumps , KZwU

4. Hand-tools e.g. shovels, spades, buckets and rope (wK wK wePówiZ msL©v Ges Øívbxq bvg wjLb.).|

5. Other (specify) (Ab©vb© ejáZ wK Zv wjLb)

T12. WHAT TYPE OF safety equipment DO YOU USE FOR fecal sludge treatment services (fecal sludge treatment services Kivi Rb® wK aiábi ew≥MZ wbivcÀvi höøcwZ áhgb ewWKfvi/ nvZ ev gL ev áPvL G e®envi Kái _vákb Zv wjLb)?

Tick all that apply:

Apron/body cover : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjLb)

Hand gloves : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjLb)

Face masks : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjLb)

Others : specify with number and categories (weØówiZ bvg, msL®v, BZ®w` wjLb)

T13. Do you think these equipment are enough for you, or do you have any choice/suggestions/recommendations? In case you have suggestions, choice in selecting equipment; mention those (fecal sludge treatment services Kivi Rb® Üh aiábi ew≥MZ wbivcÀvi höøcwZ Ühgb ewWKfvi/ nvZ ev gL ev ÜPvL G e®envi Kái _vákb Zv c´áqvRábi Zjbvq wVKgZ AvávQ wK?, G weláq ÜKvb mcwik ev ejvi _vKáj ejb)

T14. How many of you did receive capacity building training in either of fecal sludge emptying, transportation, disposal or treatment? (Avcbvá`i ÜKI wK ÜKvfecal sludge treatment services, ev e®eØívcbv weláq c÷wkØY ÜcáqáQb, Ücáq _vKáj KZRb, ÜcáqáQb?)

T15. What was the training contents that have received by the participants, who were the training delivery agencies? (Avcbvá`i ÜKI wK ÜKvfecal sludge

treatment services, ev e®eØívcbv weláq c÷wkØY Ücáq _vKáj wK wK weláq c÷wkØY ÜcáqáQb, Ümf¶ji bvg eájb A®v€ ÜK ev ÜKv_v Ü_áK c÷wkØY ÜcáqáQb bvg wjLb?)

T16. What sort of health hazard/diseases being workers in the area of emptying, transportation, disposal or treatment? (Avcbvá`i ÜKI wKfecal sludge

treatment services, ev e®eØívcbv KiáZ wMáq ÜKvb iKági ØvØí® SwKáZ cáiáQb? cái _vKáj Ümf¶ájv wK wK, eØÔviZ wjLb/ejb?)

T17. List the challenges by priorities in providing treatment and /or re-use services to the targeted communities. (fecal sludge treatment services KvR KiáZ wMáq mgm®vmgn wK wK wQj ? weØówiZ jLb...)

T18. List the limitations by priorities in providing treatment and /or re-use services to the targeted communities. (fecal sludge treatment services KvR KiáZ wMáq Avcbvá`i wK wK weláq AcviMZv wQj ? eØÔviZ jLb...)

19. List the recommendations by priorities in providing treatment and /or re-use services to the targeted communities. (fecal sludge treatment services weláq Avcbvá`i wK wK mcwik Ges e≥e® AvávQ? eØÔviZ jLb...)

T20. PLEASE CAN I TAKE A LOOK AT THE TREATMENT PLANT? IF SO, CAN I TAKE PHOTOS OF THE FACILITY? JUST LIKE THE REST OF THE INFORMATION THIS WILL ALSO REMAIN STRICTLY CONFIDENTIAL AND ANONYMOUS. (mßßvZ wbáq wU´UágõU c¯võUvU Nái Ü`Lb, Avcbvá`i cmõ` Abhvqx ÜbvU wjLb, Ges Qve wbb|)

T21. Take a look at the treatment plant (mßßvZ wbáq wU´UágõU c¯võUvU Nái Ü`Lb Ges m¤e náj wbágú evYZ Qvwe wbáeb|

If permission has been given by the service provider, take photos and mark

Inlet of the fecal sludge treatment plant (1 photo-only) ...label the photo (ÜhLvb Ü_áK cvqLvbv eR® wU´UágõU c¯võU G c÷áek Kivb nqZvi Qvwe wbb

1. Fecal sludge treatment processes (1 photo-only) ...label the photo photo (ÜhLváb cvqLvbv eR® wU´UágõU Gi Rb® c÷áQm Kiv nqZvi Qvwe wbb
2. Outlet of the fecal sludge treatment (1 photo-only) ...label the photo (ÜhLvbÜ_áKcvqLvbv eR®wU´UágõUvi ci ÜeoKáiÜ`qvnqZvi Qvwe wbb)
3. Fecal sludge acceptance/receiving location (1 photo-only) ...label the photo (ÜhLvb Ü_áK cvqLvbv eR® wU´UágõU Kivi ci Üeo Kái Ü`qvi ci Ab®¿ wbáq RvIqv nq Zvi Qvwe wbb)
4. Effluent treatment processes (1 photo-only) ...label the photo (cvqLvbv Zij eR® wU´UágõU Kivi RvqMvi Qvwe wbb|

Z_® msM÷nKvixá`i bvg, Üdvb bs imgn wjLbt

END INTERVIEW

Ref: WHO 2016 Checklist_

Appendix C:

Key informant interview: Policy making agencies/departments; Tool #3

TOPICS:
Strategic plan for fecal sludge management; rural, urban small cities (ST), CC plan, CC Slums,
Budget allocation
Responsible agencies departments
Capital management
Special financial schemes for FSM enterprises or similar enterprises
Capacity
Training
Monitoring
Achievements
Challenges
Lessons

IDENTITY
Name:
Org/Dept:
Designation:
Date:

Q1. Does the department show the existence of specific/viable plan for next 1 years or 2 years in regards to-
safe storage: specify_____
emptying: specify_____
transportation: specify_____
disposal: specify_____
treatment/reuse: specify_____

Q2. What is the target in regards to reaching number of latrines or households -
safe storage: specify_____
emptying: specify_____
transportation: specify_____
disposal: specify_____
treatment/reuse: specify_____

Q3. What was the achievement in regards to reaching number of latrines or households -
safe storage: specify_____
emptying: specify_____
transportation: specify_____
disposal: specify_____
treatment/reuse: specify_____

Q4. What is the status of budget allocation for the department-
In last financial year, what was the budget allocation in regards to the sanitation system management, in particular to emptying, transportation, disposing, treatment, etc.
This year or what funding cycle you are interested in.
Probe for gathering actual budget requested, approved, and allocated. How is that in comparison with previous years? Capture the "why" on budget allocations?

Q5. What are the responsible department doing what in regards to storage, emptying, transportation, disposal and treatment/reuse?

Q6. Do you have any private/public/NGO partnership in the mentioned five areas? If yes, what are those? What sort of partnership?

Q7. What is the capacity strength/weakness of your department in the areas of sanitation management, emptying, transportation, dumping and treatment services?
Make sure the interviewer captures the "why" behind the answer.

Q8. Do the department have any exposure of Training/orientation/cross visit in regard to the specific context?

Q9. Do you have specific monitoring cell/department? Are they performing well?
Follow-up question at the end of "why/why not?

Q10. What sort of specific challenges do you have? What are your recommendations for these challenges? What do you need to be more effective?

Q11. Mention lessons if any in regards to the mentioned five areas - storing, emptying, transportation, treatment, disposing, re-use, etc.

Appendix D:

Quantitative Sampling Detailed

The formulae used for calculating design effect (DE) and cluster numbers (K) (van Breukelen & Candel, 2012)(van Breukelen & Candel, 2012 are as below -

$$DE = [(n-1)\rho + 1] \quad \ldots\ldots (1)$$

$$K = 4\left(\frac{DE}{n}\right) \times \left(Z_{1-\gamma} + Z_{1-\alpha/2}\right)^2 \times \left(\frac{1}{d}\right)^2 \quad \ldots\ldots (2)$$

Where, n is the cluster size i.e. number of households in a cluster.

ρ is the ICC (Intra-cluster correlation coefficient), which, in our case is the proportion of outcome variance between clusters rather than between individuals within clusters. In a population-based survey, a less expensive and safe choice of ICC is to assume an intermediate choice of ICC between the range of 0.01-0.05. This is because, ICC estimates enable investigators to have precise sample size and adequate power to estimate the outcome of interest. However, ICC estimates for SMOSS study are not available in our country and we need assumption. Global literatures revealed, most of the ICC estimates ranged 0.01 to 0.1(Janjua et al., 2006). Considering low-cost approach and since the

geographical variations are not much in Bangladesh, we took the assumption based on an intermediate choice. To understand the impact of ICC on DE, the calculated DE in Table 1 per different choices of ICC using the equation (1) is presented.

Table 1: DE based on cluster size and different choices of ICC (ρ)

	ρ (ICC)				
	0.01	0.02	0.03	0.04	0.05
n	25	25	25	25	25
DE	1.24	1.48	1.72	1.96	2.20

$Z_{0.90\ (1-\kappa)}$ = 1.28 i.e. 90% power.

$Z_{1-\alpha/2}$ = 1.96; α=0.05

Effect size (Cohen's *d*) = P_1 - P_2 / σ-pooled

Where, σ-pooled =$\sqrt{[(\sigma_1^2 + \sigma_2^2) / 2]}$

P_1 and P_2 are intervention proportions and **σ**-pooled of σ_1 and σ_2 are the standard deviations for the baseline intervention phase. Effect size *Cohen's d* is calculated based on different level of variations of standard deviations of the proportion differences (McLeod, 2019). Table 2 shows the exercises of cluster number estimation using the formulae in equation number (2) based on estimated values of effect size (Cohen's *d*) assuming n=25 (cluster size) and DE shown in table 1.

Accordingly, it is proposed 23.09≅23 (rounded to 23 cluster sampling strategy) clusters per region could be a justifiable minimum choice for this study.

Table 2: Cluster number estimation (K)

K		DE				
1.12		1.48	1.72	1.96	2.20	
	0.1	208.3	248.58	288.89	329.20	369.52
	0.2	52.07	62.15	72.22	82.30	92.38
	0.3	23.14	27.62	32.10	36.58	41.06
	0.4	13.02	15.54	18.06	20.58	

With the vales of the parameters k=23 (clusters), n=25 (cluster size) and α =0.05 (error level), additional supporting data of power analysis is produced in Table 3 that shows choosing 23 clusters with a cluster size of 25 units could be an optimal choice of this study.

Power Analysis

Accepting null hypothesis (for example, a man is guilty) though the null hypothesis is not true is the Type II error (β), hence 1-a is called power of the study. Whereas rejecting null hypothesis though the null hypothesis is true is the Type I error a), hence 1-a is called confidence interval. Therefore, in research studies, consideration of power analysis is more important. Moreover, the power analysis exercise considers 95% confidence interval as well. Power analysis in Table 3 indicates, adopting 23 clusters could have 97% power of the sample size, which could be much convenient and an optimum choice for the researchers.

Cohen's *d*

Cohen's d is an appropriate effect size for the comparison between two means.

To calculate the standardized mean difference between two groups (for example control vs intervention), subtract the mean of one group from the other (M1 – M2) and divide the result by the standard deviation (SD) of the population from which the groups were sampled.

Cohen suggested that d=0.2 be considered a 'small' effect size, 0.5 represents a 'medium' effect size and 0.8 a 'large' effect size. Small effect size indicates higher deviation compared to medium or large effect size.

In our analysis we considered medium effect size = 0.4 i.e. standard deviation of sanitation behavior within the region is at medium level. This is because behavior characteristics in people among the communities in each of the regions may have similar in nature.

Ref.: McLeod, S. A. (2019, July 10). What does effect size tell you? Simply psychology: https://www.simplypsychology.org/effect-size.html

Table 3: Power analysis

1 – 0.01		0(ICC)				
		0.02	0.03	0.04	0.05	
d	0.1	22.0%	19.3%	17.3%	15.8%	14.6%
	0.2	66.2%	59.1%	53.1%	48.2%	44.1%
	0.3	94.6%	90.7%	86.4%	82.0%	77.6%
	0.4	99.7%	99.2%	98.3%	96.9%	95.2%

Summary of sample size

The idea of RCS design is, more we increase the cluster number, more likely it reduces the amount of error in the result of clustering. Considering the bottom line of 23 clusters @ 25 households per cluster, we estimated the summary of sample sizes in Table 4. In choosing cluster size, we remained liberal to increase cluster numbers (cluster numbers varied 24-30 based on different regions / geoFigureic locations). We estimated to collect data from a total of 3425 households from the total of 137 randomly selected clusters across the country, would be adequate enough representing country, regions and categories. This sampling technique would give us a multi-fold representation across categories of Rural, Small Town (ST), Large Town (LT), and City Corporations (CC). Further, the CC sampling would have two-way representation– resident and LICs/slum population. (Table 4)

Table 4: Sample size across regions

Category of pop	Rural	ST	MT	CC		Total Cluster	HH per cluster	Total HH
GEO. Region				Resident	LIC			
1. Rajshahi	5	6	6	5		22	25	550
2. Khulna	5	6	6	5		22	25	550
3. Sunamganj (Sylhet)	5	6	6			17	25	425
4. Chittagong	5	5	5	5	10	30	25	750
5. CHT	8	7	7			22	25	550
6. Dhaka CC				10	14	24	25	600
TOTAL Cluster	28	30	30	25	24	137		
HH per cluster	25	25	25	25	25			
TOTAL HH	700	750	750	625	600			3425

Note: ST: Small Town; MT: Medium Town/Paurashava (Municipality); CC: City Corporation; LIC: Low Income Communities; CHT: Chittagong Hill Tracts; HH: Households

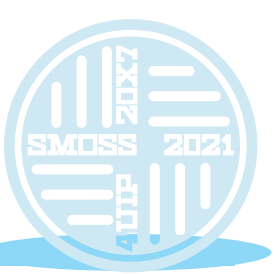
Appendix E:

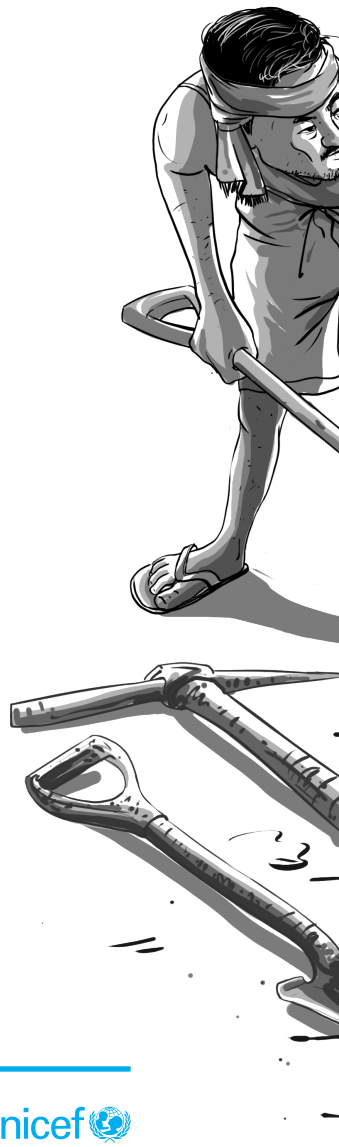
Key Informant Interview Sampling Details

Table 6: KII sampling-policy and decision-making level

Key persons

1. DPHE HQ
2. Municipality (Rangamati, Cumilla, Rajshahi)
3. District level DPHE (Rangamati, Cumilla, Rajshahi)
4. D-WASA
5. K-WASA 6. Representative of City Corporation
7. Ministry of Local Government Division (LDG)
8. DSHE
9. DPE
10. DGHS
11. Development partners/NGOs
12. Academia/research org
13. Upazila/UP
14. Municipal Association of Bangladesh
15. LGED
16. Chamber of Commerce, Sanitation Association
17. Bangladesh Bank
18. PKSF
19. Ministry of Planning, GED/Planning Commission
20. Ministry of Environment


SMOSS
2021
4UMP
20X7



For any further details, Contract:

Tushar Mohon Shadhu Khan (Addl. Chief Engineer -Planning, DPHE) - eetrndiv@yahoo.com
Syed Adnan Ibna Hakim (WASH Officer, UNICEF, Bangladesh) - saihakim@unicef.org

BILL & MELINDA GATES foundation
WHO UNICEF JMP
World Health Organization
unicef for every child