SFD Lite Report

Rangpur
Bangladesh

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ITN-BUET, Bangladesh

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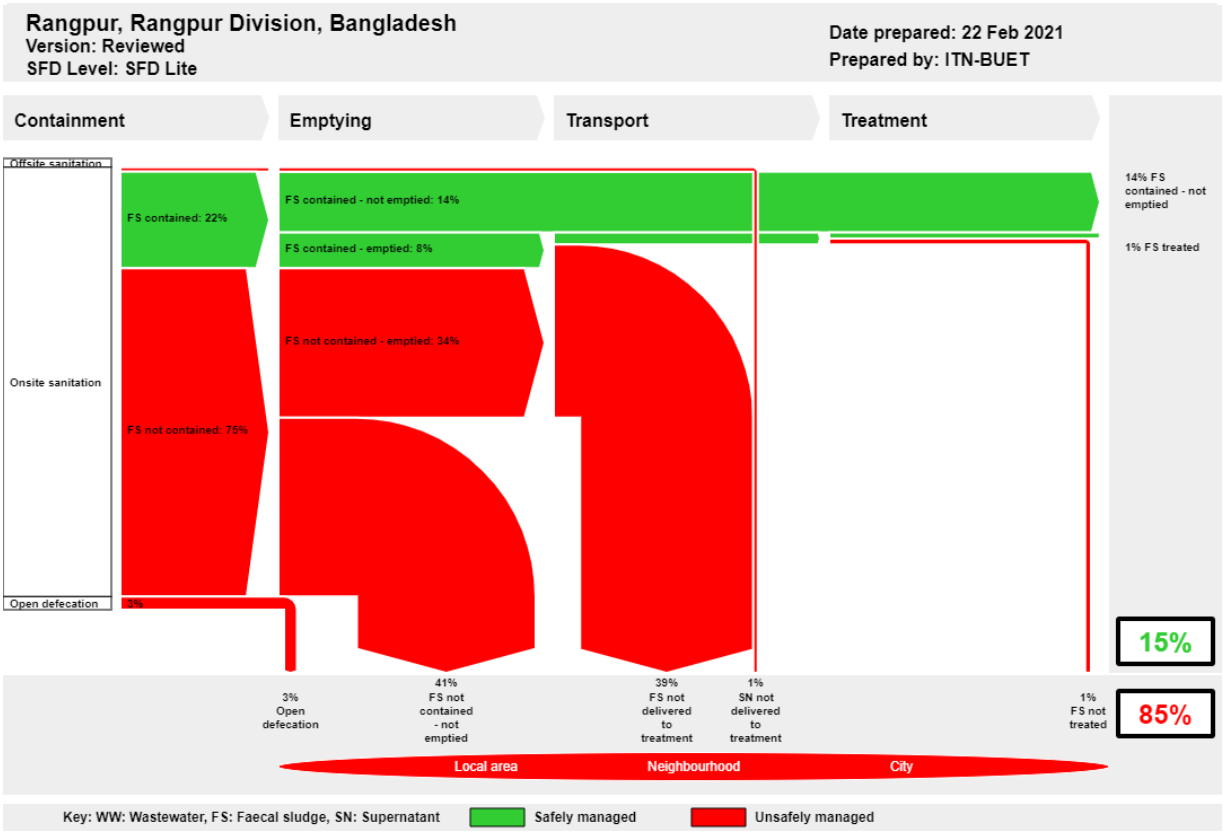
1 The SFD Graphic



The SFD Promotion Initiative recommends preparation of a report on the city context, the analysis carried out and data sources used to produce this graphic.
Full details on how to create an SFD Report are available at: sfd.susana.org

2 SFD Lite information

Produced by:

- Centre for Science and Environment, New Delhi, India.
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- Cooperation of Mr Md. Jekrul Hoque, Supervision Engineer and Md. Moslem Uddin, Business Development Officer, WSUP Bangladesh, Rangpur project office, FSTP supervisor & operator, local mason, emptier, SWEEP Brand promoter & public toilet operator are dully acknowledged for sharing information during KIIs and FGDs.

Collaborating partners:

- Rangpur City Corporation.
- ITN-BUET: Centre for Water Supply and Waste Management.
- Water & Sanitation for the Urban Poor (WSUP).

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3 General city information

Rangpur City Corporation (RpCC) is one of the twelve City Corporations in Bangladesh and is located in the Rangpur division, northern region of the country. The geographical coordinates of Rangpur City Corporation are 25.56° North and 89.25° East. Rangpur became a City Corporation from Paurashava on 28 June 2012 with an area of 205.7 km^2, and is divided into 33 Wards.[1] Figure 1 shows the administrative map of Rangpur City Corporation. According to the Rangpur City Corporation published data, the population of the Rangpur City Corporation area as of 2017 was 796,556, with 398,282 male and 398,274 female[1]. The population density is of 3,872 people per km^2 and the literacy rate of RpCC is 65%.[2] The total number of households in RpCC is about 124,764[2], and the total holding number is 51,163, which includes both private (50,705) and government (458) holding.[1] RpCC also has 49 slums comprising of about 8% of the total population of the city.[3]

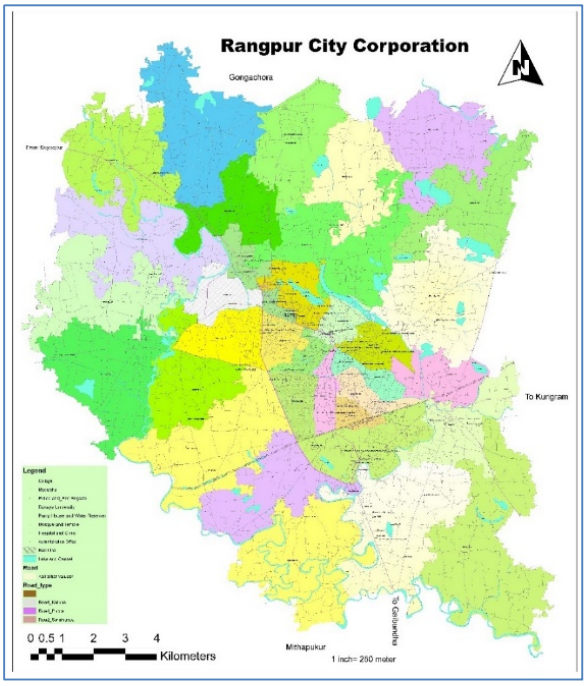

Figure 1: Administrative map of Rangpur City Corporation (source: http://www.rpcc.gov.bd/).

The city does not have a dedicated sewerage system. ITN-BUET and WSUP conducted a holding survey in 2020 which shows that 97% of the people in the city have access to toilets and 3% of the population have no access to toilets and they are practising open defecation.[4] The whole city mainly depends on onsite sanitation systems like pit latrines and septic tanks. Both fully lined tanks (container type) and properly designed septic tanks are usually called septic tanks.

Groundwater is the primary source of drinking water in Rangpur. People have access to individual tubewell within their premises (39%) and the City operated piped water supply systems (57%).[4] Shallow tubewell with 60-70 feet (18.2 - 21.3 m) depth produces good quality water.[5] The groundwater table in Rangpur is high, and groundwater depth remains within the suction head (i.e., 6 m from ground level), which keeps the shallow tubewell, and other suction-mode pumps operational round the

[1] https://rpcc.portal.gov.bd/site/page/0046cdb2-b2a0-499e-b4cf-1c1c0e89a49d [accessed on 19 February 2021]
[2] Population & Housing Census (2011), Zila Report-Rangpur, Bangladesh Bureau of Statistics (BBS), Statistics and Informatics Division (SID), Ministry of Planning, Government of the People's Republic of Bangladesh, October 2015
[3] Bangladesh Bureau of Statistics. (2015). Census of Slum Areas and Floating Population 2014. Dhaka, Bangladesh.
[4] ITN-BUET and WSUP (2020), FSM Assessment Report for Rangpur City Corporation
[5] Data received through Key Informant Interviews with Md. Nazrul Islam (Town Planner, RpCC) and Mr. Pankaj Kumar (Executive Engineer, DPHE, Rangpur)

year.[6] Tubewell is also the dominant water supply option in slums, and 98% of households in the slums use tubewell water for almost all purposes.[7]

The soil composition for Rangpur City is mainly (80%) alluvial soil (silt, sand, clay, and gravel) of the Teesta River basin, and the remaining is Barind soil (reddish and yellowish clay soils). Most low-income areas have loose, sandy soil and a high-water table. The uppermost, shallow aquifer is unconfined, having silty clay topsoil within 10-15 ft (3.0 - 1.5 m), followed by an extended depth of the different graded sand layers[6]. The temperature ranges from 32 degrees Celsius to 11 degrees Celsius, and the annual average rainfall is 2,931 mm.[8]

4 Service outcomes

Table 1: SFD matrix for Rangpur City.

Rangpur, Rangpur Division, Bangladesh, 22 Feb 2021. SFD Level: SFD Lite
Population: 796556
Proportion of tanks: septic tanks: 93%, fully lined tanks: 100%, lined, open bottom tanks: 100%

System label	Pop	F3	F4	F5	S4e	S5e
System description	Proportion of population using this type of system	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated	Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants	Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated
T1A2C6 Septic tank connected to open drain or storm sewer	3.0	37.0	6.0	50.0	0.0	0.0
T1A3C10 Fully lined tank (sealed), no outlet or overflow	22.0	37.0	6.0	50.0		
T1B11 C7 TO C9 Open defecation	3.0					
T1B9 C1 TO C10 Toilet failed, damaged, collapsed or flooded, connected to sewer, soak pit, open drain or storm sewer, water body, open ground or 'don't know where'	4.0					
T2A2C5 Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	18.0	37.0	6.0	50.0		
T2A3C5 Fully lined tank (sealed) connected to a soak pit, where there is a 'significant risk' of groundwater pollution	18.0	37.0	6.0	50.0		
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	32.0	63.0	7.0	50.0		

The SFD graphic for Rangpur City Corporation shows that only 15% of the excreta is classified as "safely managed," and the remaining 85% is classified as "unsafely managed". The 15% of safely managed excreta originates from Faecal Sludge (FS) not emptied (14%) and FS treated (1%). Overview on technologies and methods used for different sanitation systems through the sanitation service chain is as follows:

[6] Mohammad A. Mojid, Mohammad F. Parvez, Mohammed Mainuddin and Geo Hodgson [2019], Water Table Trend—A Sustainability Status of Groundwater Development in North-West Bangladesh, Water 2019, 11, 1182; doi:10.3390/w11061182
[7] Bangladesh Bureau of Statistics. (2015). Census of Slum Areas and Floating Population 2014. Dhaka, Bangladesh.
[8] https://en.wikipedia.org/wiki/Rangpur,_Bangladesh

4.1 Offsite Systems

There is no sewerage system in Rangpur City Corporation.

4.2 Onsite Sanitation Systems

Containment: The sanitation coverage for Rangpur City Corporation is 97%, of which 93% of the people have operational toilets, and 4% of these toilets have failed, damaged, or collapsed. The sanitation system in the entire city is covered only by on-site containment systems which include different forms of pit (single direct and offset and twin pit) latrines and septic tanks with or without soak pit. Septic tanks in the households are fully lined tanks and properly designed septic tank.[4]

In the Rangpur City, septic tanks are present in different types ranging from a single-chambered lined sealed tank with no outlet to multiple chambers (2 to 3 chambers) septic tanks connected to soak pit or open-drain/storm sewer. Key Informant Interviews (KIIs) with masons and interviews with the users revealed the typical shape of septic tanks is rectangular, the size (LxWxD) is 10 ft x 6-7.5 ft x 6 ft (3.0 m x 1.8-2.2 m x 1.8 m), and the circular shape of the soak pit is 5 ft (1.5 m) of diameter and 15-17 ft (4.5-5.1 m) in depth. Lined pits with semi-permeable walls and open bottom are the widely used form of pit latrines. The bottom of a soak pit and containment pit is located at a level where sandy layer soil strata starts, where this depth is typically 15-16 ft (4.5-4.8 m) from the ground surface.[9] A large portion of the toilets system often fails, becomes damaged, collapsed, or flooded during the rainy season and makes the sanitation system unhygienic.[5] The floating people (approximately 0.2%) use the 12 public toilets in the city.[4,5] Approximately 76% of low-income households use shared sanitation facilities[2]. Most of those who do not have latrines use community toilets, shared toilets or public toilets.

Figure 2: Pit (left) and septic tank with soak pit system (right) (Source: Binte, 2020).

ITN-BUET and WSUP conducted a holding survey (2020) which states that 61% of people have different forms of septic tanks and 32% have different forms of pit systems and 4% have damaged or failed toilets.[4] While 3% people are practising open defecation. Based on the type of containment technologies and its connection to discharge, containments are classified as: 22% of people have fully lined (sealed) tanks with no outlet or overflow (T1A3C10). 18% of people have septic tanks connected to soak pit (T2A2C5) and 18% have fully lined (sealed) tanks connected to soak pit (T2A3C5). For both the septic tanks and fully lined (sealed) tanks connected to soak pit, there is a "significant risk" of groundwater pollution. 3% of people have septic tanks that are connected to open drain or storm sewer (T1A2C6) and produced supernatant. 32% of people have lined pits with semi-permeable walls and open bottom with no outlet or overflow, where there is a significant risk of groundwater pollution (T2A5C10). 4% of people have toilets that have failed, damaged, collapsed or flooded (T1B9C1 TO C10). 3% population in the city have no toilets and practise open defecation (T1B11C7 TO C9).

Among the total production, FS from 22% of the population remains contained within fully lined tanks with no outlet/overflow systems, while 75% corresponds to FS not contained within the containment

[9] KIIs with Mr. Bipul, Mason and Mr. Abdulla Hel Kafi, Professor, Karmaical College, Rangpur City Corporation Areas

systems. Also, 1% of Supernatant (SN) is not contained and not delivered to treatment. The systems with FS not contained include septic tanks with soak pit, fully lined tanks with soak pit and line pits with semi-permeable walls and open bottom. The attributing factor for not contained within the containment system is the high risk of groundwater pollution from these systems. Septic tanks connected to storm/open drain are also considered another form of not-contained system.

Groundwater pollution: The water table in Rangpur is high, usually found within 15-20 feet (4.5-6.0 m) from the ground surface. The soil type for this depth is mostly sandy. More than 25% of sanitation facilities are located <10m from groundwater sources. 96% of drinking water is produced from groundwater sources.[4] Considering all these factors, it is estimated using the decision matrix in the SFD Graphic Generator that there is a significant risk of groundwater pollution in the city.

Emptying: The survey finds that manual, mechanical, and semi-mechanical emptying are practised in Rangpur City[4]. Among the 97% people that have toilet access, containment systems corresponding to 43% people (27% of pits and 16% of tanks systems) have emptied at least once since its installation. For 57%, containments have never emptied, including FS never emptied of 14% of people using fully lined tanks with no outlet/overflow which remains contained within the containment. Excreta from 46% of people is not contained within containment systems and not emptied, going directly to open environment. Converting emptying % for each type of the containment systems against the total emptying, we find that 63% [(27%/43%) x 100%] of pits, and 37% [(16%/43%) x 100%] of tanks have been emptied. Thus, variable F3 for pits was set to 63% and 37% for all types of tanks. There are three emptying service providers in RpCC, including City Corporation operating a mechanical emptying service, a private enterprise operating SWEEP service for mechanical emptying and manual emptying by the traditional emptiers[10].

Emptying frequency of containments varies as follows: 20% of the containments are emptied in 1 year, 13% in 2-3 years, 5% in 3-5 years, 5% in 5-10 years, and 2% in more than 10 years[4]. From the cost-benefit analysis of 7.5 months (14 Jan - 30 Aug 2020) of Shafi Enterprise Ltd. (operator of mechanical emptying under SWEEP brand in Rangpur), we find that they have emptied a total of 260 containments out of which pits (53%) and tanks (47%) are almost equal. The manual emptiers provide services mostly manually using the bucket and spread and semi-mechanically using a water pump and hose pipe[10]. The emptying data for City Corporation shows that they operate vacutug and for manual emptiers, data are not kept documented. Figure 3 shows examples of these techniques.

Figure 3: Mechanical emptiers (left) and mechanical emptying by SWEEP Enterprise during night (right) in Rangpur (Source: Jikrul, 2020).

[10] KIIs with Md. Moslem Uddin, Business Development Officer, WSUP Bangladesh, Rangpur project office, Ms. Roksana, Surveyor and Brand promotor, SWEEP Service, Rangpur and Mr. Lal Bahadur, Manual Emptier, Rangpur City

Transportation: KIIs with manual emptiers reveal that the fecal sludge emptied manually is never transported to a Fecal Sludge Treatment Plant (FSTP)[11]. Instead, they carry the emptied fecal sludge using the buckets to dispose of nearby land by digging into the soil and putting soil cover (Figure 4).

Figure 4: Bucket carried manual transportation (left) and modern mechanized transportation vehicle (right) for FS (Source: Jikrul, 2020).

If a drain is available nearby, the emptiers transport/discharge the emptied fecal sludge to the drain. Only the fecal sludge emptied mechanically using vacutugs (both by City Corporation and Safi Enterprise operated, Figure 4) is transported to the FSTP[10]. The record-keeping system in the FSTP on FS receiving shows that FSTP receives an average of 288.05 m^3 of FS per month from the mechanical emptying service providers[12].

FSTP has become operational for almost a year (from 14 January 2020). Analysis of ITN-BUET and WSUP survey (2020) data reveals that among the total emptying (43%), 20% of emptying has been done within the 1-year frequency, which is comprising of 3% by mechanical emptying, 16% by manual, and 1% by semi-mechanical[4]. Since 94% of FS emptied mechanically is transported to FSTP, FS mechanically emptied corresponding to 2.82% of the population is transported to FSTP. Again, among the total emptying by the mechanical emptiers, they carry out the emptying of septic tanks (37%) and pits (43%). From the analysis of log-sheet of mechanical emptiers and record-keeping system at the FSTP, it reveals that FS emptied mechanically is transported entirely to the FSTP for treatment[13]. This means that FS from 1.8% (63% of 2.82%) of pits and 1.02% (37% of 2.82%) of tanks is emptied mechanically and transported to FSTP for treatment. Transportation percentage of emptied FS to FSTP for both septic tanks and pits can be expressed in terms of total emptying as 6% [(1.02%/16%) x 100%] for tank systems, which is 7% [(1.8%/27%) x 100%] for pits. Thus, variable F4 for all types of tanks was set to 6% and 7% for pits. The septic tanks connected to the open drain or storm sewer produces supernatant, which is not captured and not delivered/transported to the treatment plant, and it goes to the water bodies/environment untreated. Therefore, variables S4e and S5e were both set to 0%.

Treatment/disposal: A newly constructed FSTP with support from Water & Sanitation for the Urban Poor (WSUP) has become operational this year from 14 January 2020[14] (Figure 5). The FSTP has a total of 20 functional beds and 2 reserve beds for using during cleaning or maintenance of an operational bed. The treatment system in this FSTP involves drying beds for solid-liquid separation and drying of fecal sludge, followed by liquid effluent treatment in an Anaerobic Baffled Reactor (ABR), constructed wetland, polishing ponds and surface discharge of treated effluent. The FSTP is designed in such an engineered way that it can receive 24 m^3 of fecal sludge per day in two beds. The FSTP receives FS 5 days in a week and operates 52 weeks per year. The plant can receive almost 480 m^3

[11] KII with manual emptier, Lal Bahadur
[12] Log sheet of FS received in the FSTP, Rangpur, January-October 2020, Md. Fazle Rabbi, Plant Supervisor
[13] Daily Cost-Benefit Report, January-August 2020, M/S Shafi Enterprise, SWEEP Service, Rangpur
[14] Photograph of FSTP/evidence from WSUP

FS per month in 20 beds.[15] The FS that comes to the FSTP gets treated.[16] The treatment plant is relatively new and there is no data to determine the efficiency of the plant. Hence, we assumed that fecal sludge that has been delivered to the treatment plant is 50% treated. Thus, variable F5 was set to 50% for all systems. The plant management conducted the first trial of making co-compost of dried FS with municipal solid waste, but the experiment was unsuccessful. They are now only storing the dried FS in their sludge loading unit and searching for alternative use of this dried sludge following safety measures.[17]

Figure 5: Bucket carried manual transportation (left) and modern mechanized transportation vehicle (right) for FS (Source: Jikrul, 2020).

4.3 Open Defecation

From the ITN-BUET and WSUP (2020) conducted holding survey, secondary document analysis, and KIIs, 3% people of Rangpur City Corporation are found to practise open defecation.

5 Data and assumptions

The availability of quantitative data on sanitation services in Rangpur City Corporation is limited. However, the survey conducted by ITN-BUET and WSUP on FSM assessment in October 2020 contains detailed data on different stages of the sanitation value chain. Desk review of relevant documents, records from private mechanical emptier, plant operator, and online sources were carried out. Apart from these, Key Informant Interviews and Focus Group Discussions were conducted to prepare the SFD graphic. Finally, data from all these sources were compiled to produce the SFD graphic. The last census was about 10 years ago, so the data presented on the website of Rangpur City Corporation on population, households and holdings were used for preparing this SFD graphic.

The following assumptions are made for developing the SFD graphic for Rangpur City:

1. Though all people generally call both properly design septic tanks and fully lined tanks as ‘septic tanks’, during the survey, the respondent cannot reply clearly, and it was not possible to dig into the matter fully. Hence, a septic tank with no outlet or overflow is classified as a “fully lined tank with no outlet or overflow”. Also, the total percentage of a septic tank connected with a soak pit is divided equally between the “septic tank connected to the soak pit” and the “fully lined tank connected to the soak pit”.
2. Single direct and off-set pits with different discharge outs were found to have, including no outlet and, outlets connected to open drain, soak pit or water bodies. In the usual case, the pit system containment technology should not have any outlet. So, it is classified as a “lined pit with impermeable walls and open bottom”.

[15] KII with Engr. Habibur Rahman, Sanitation Lead, WSUP Bangladesh
[16] KII with Md. Fazle Rabbi, Plant Supervisor
[17] KII with Mr. Jikrul Huq, Supervision Engineer, WSUP Bangladesh, Rangpur Project Office

3. The survey found that almost half of the twin off-set pits are emptied, which should not be in an ideal case. Also, the two pits are used alternately or simultaneously. So, this containment technology is also classified as "lined pit with impermeable walls and open bottom".
4. The proportion of FS in septic tanks, fully lined tanks and lined tanks with open bottom/all types of pits (step two of the Graphic Generator) was set to 93%, 100% and 100%, respectively, as per the guidance given in the Frequently Asked Questions (FAQs) in the Sustainable Sanitation Alliance (SuSanA) website.
5. Every holding has one containment system.
6. The fecal sludge treatment plant has become operational for almost one year and has been designed and constructed following proper procedure. Though the treatment plant is relatively new, there is no data on effluent/sludge to determine the efficiency of the plant. Hence, we assumed that fecal sludge that has been delivered to the treatment plant is 50% treated.

6 List of data sources

Reports, literature, and website:

- Population & Housing Census 2011: Zila Report-Rangpur, Bangladesh Bureau of Statistics (BBS), Statistics and Informatics Division (SID), Ministry of Planning, Government of the People's Republic of Bangladesh, October 2015.
- Aquaya & WSUP [2019], Research Brief, Sanitation policies, practices and preferences in Rangpur, Bangladesh, July 2019, Aquaya & WSUP-Urban Sanitation Research Initiatives.
- Mohammad A. Mojid, Mohammad F. Parvez, Mohammed Mainuddin and Geo Hodgson [2019], Water Table Trend—A Sustainability Status of Groundwater Development in North-West Bangladesh, Water 2019, 11, 1182; doi:10.3390/w11061182.
- Bangladesh Bureau of Statistics. (2015). Census of Slum Areas and Floating Population 2014. Dhaka, Bangladesh.
- Daily Cost-Benefit Report, January-August 2020, M/S Shafi Enterprise, SWEEP Service, Rangpur.
- Log sheet of FS received in the FSTP, Rangpur, January-October 2020, Md. Fazle Rabbi, Plant Supervisor.
- ITN-BUET and WSUP (2020), FSM Assessment Report for Rangpur City Corporation.

Online Key Informant Interviews (KIIs) during pandemic:

1. Md. Nazrul Islam, Urban Planner, Rangpur City Corporation.
2. Pankaj Kumar Saha, Executive Engineer, Department of Public Health Engineering, Rangpur.
3. Mr. Md. Jekrul Hoque, Supervision Engineer, WSUP Bangladesh, Rangpur project office.
4. Md. Moslem Uddin, Business Development Officer, WSUP Bangladesh, Rangpur project office.
5. Ms. Roksana, Surveyor and Brand promotor, SWEEP Service, Rangpur.
6. Mr. Lal Bahadur, Manual Emptier, Rangpur City.
7. Mr. Nayan, Plant operator (emptier), Safi Enterprise, RpCC.
8. Mr. Sagor, Plant operator (guard).
9. Mr. Fazle Rabbi, FSTP Supervisor.
10. Mr. Bipul, Mason, Rangpur City Corporation Areas.
11. Mr. Polash, Lease & operator, Public Toilet, Medical more, Rangpur City.
12. Mr. Abdulla Hel Kafi, Professor, Karmaical College, Rangpur.
13. Engr. Md. Habibur Rahman, Sanitation Lead, WSUP Bangladesh.

Focus Group Discussions (FGD)

1. Mechanical emptiers.
2. Manual emptiers.
3. Conservancy section of RpCC.
4. FSTP operators.

Figure 6: Focus Group Discussion with different groups in Rangpur (Source: ITN-BUET, 2020).

Field visits:

1. Community septic tanks in slums.

Figure 7: Visit to community toilets in Rangpur (Source: Binte, 2020).

2. Public toilets.

Figure 8: Visit to Public toilets in Rangpur (Source: Jikrul, 2020).

Rangpur, Bangladesh, 2021

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