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Providing municipal faecal sludge management services: lessons from Bangladesh

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Faecal sludge management (FSM) is a rising priority in the WASH sector, and governments and development agencies are increasing their investments in faecal sludge treatment plants (FSTPs). In Bangladesh there are plans to build 100 FSTPs in secondary municipalities. However, lessons from past experiences are not widely understood or considered. This article aims to fill that gap, shedding light on the drivers of success and challenges in the provision of municipal FSM services, analysing the cases of older FSTPs in four secondary towns in Bangladesh. Only one of these plants was fully operational, one was not operating, and two were partially operational. A challenge identified was that the faecal sludge treatment plants were not part of an integral and well-thought-out plan considering the whole sanitation service chain. Unbalanced partnerships between stakeholders was a crucial barrier to the long-term success of FSTPs, as it hindered the empowerment of the municipal governments to take ownership of FSM service provision. The financing and technical capacities of the municipalities were another barrier, which was covered by NGOs in the most successful plant. The study suggests that future investment in FSM services in secondary towns in Bangladesh and similar contexts should 1) put municipalities in the driving seat, 2) ensure adequate financing, 3) consider the whole sanitation service chain, and 4) strengthen the capacities of the local actors to deliver FSM services.

Keywords: faecal sludge management, faecal sludge treatment plants, sanitation, urban Bangladesh

THE SUSTAINABLE DEVELOPMENT GOALS (SDGs) include Goal 6, to 'ensure availability and sustainable management of water and sanitation for all' (United Nations, 2019) by 2030. Targets 6.2 and 6.3 highlight the need to ensure universal access to safely managed sanitation and reduce the release of waste, which ends up compromising water quality. Centralized wastewater treatment plants have historically been the primary response to this problem. These large sanitation systems receive substantial amounts of investment, including around a billion US dollars a year from official development aid, but show poor levels of functionality in low and middle income countries (WaterAid, 2019b). Acknowledging the fact that most urban dwellers in cities in developing countries are not connected to sewers, over the past decades, faecal sludge treatment plants (FSTPs) have been increasingly promoted.

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Since 2007 different actors have been introducing FSTPs across Bangladesh to address the dumping of untreated faecal sludge in the environment. Between 2007 and 2014, Government of Bangladesh and the Asian Development Bank (ADB) constructed 11 FSTPs in 11 secondary towns. After the completion of construction, however, the majority of the FSTPs in the project were not functioning, and in 2019 5 out of the 11 FSTPs were functioning, according to Government of Bangladesh's Department of Public Health Engineering (DPHE).

Other FSTPs were built by NGOs, such as Practical Action's FSTP in Faridpur, which was shut down seven days after completion when the surrounding communities protested against it, as they perceived it as a health and aesthetic hazard that would devalue their land (Jahan, 2019). More recently, in 2017, Practical Action constructed a new FSTP in Faridpur. In 2015, the Dutch NGO SNV constructed a plant in Khulna city and rehabilitated an existing plant in Jhenaidah (SNV, 2018). Similarly, WaterAid Bangladesh has constructed a FSTP in Sakhipur; the plant has been functional since its construction in 2016 (WaterAid, 2019a). These recent FSTPs are still functioning, partly because the NGOs have remained involved in the management or operation of the plants to this day (SNV, 2018; Jahan, 2019). But questions remain about the sustainability of these plants once the NGOs leave and hand over the work to local governments.

The existing literature identifies several factors that are key to the sustainability of sanitation infrastructure. First, the appropriateness, inclusivity, scalability, and economic viability of the technical design and operation and maintenance of a wastewater or faecal sludge treatment plant (WaterAid, 2019b). Second, the planning of such infrastructure should be in line with the broader strategic planning of water and sanitation at the national and local level (Reymond et al., 2015). A number of scholars have also addressed other enabling factors for the sustainability of wastewater treatment plants and FSTPs. Bassan et al. (2014) and Scharp et al. (2018) argue that an enabling environment at the national and local level is the driver to sustainable treatment plants. Political will and leadership and decentralization at the national and local levels are vital to stimulate long-term commitment (Reymond et al., 2015). Moreover, the sanitation utility should have institutional autonomy over its programmes and resources to deliver efficient decision-making processes and have access to sanitation capacity development and funds (Bassan et al., 2014). The enabling environment should also promote partnership among stakeholders including the private sector, public sector, and users (Reymond et al., 2015; Scharp et al., 2018;Eawag/Sandec, 2019). Schoebitz et al. (2015) also support establishing partnerships with the private sector since the presence of a profit-driven service is more likely to be sustained. Nevertheless, the incentives for the private sector are not high as FSTPs and faecal sludge management (FSM) in general require huge investments, which would not leverage short-term revenues as desired by the private sector (Schoebitz et al., 2015). A recent desk review about the sustainability of wastewater treatment plants also highlights the importance of skilled human resources to operate and maintain the plants, promoting social accountability and participation in the decision-making process as well as achieving financial sustainability (WaterAid, 2019b). A scoping study of FSTPs in South Asia and sub-Saharan

Africa highlighted the main failure reasons in both regions. In South Asia, the main failure reasons are low institutional recognition; insufficient coordination and communication between the involved stakeholders; variability of the quantities and qualities of faecal sludge arriving to the FSTPs; and low capacities of operation and management (Kinger et al., 2019).

Focusing on the point about local level leadership, it is important to note that the provision of FSM services in Bangladesh is the responsibility of local government institutions: city corporation in large cities and municipalities in small towns (Local Government Division, 2017). This builds on decentralization reforms over the past four decades (Panday, 2017). Some argue that decentralization efforts in developing countries including Bangladesh aim to increase central government power at the local level rather than increasing the efficiency of the government, which would explain why little actual control and power is handed down to local governments (Page and Goldsmith, 1987; Goldsmith, 2002; Panday and Assaduzzaman, 2011; Panday, 2017). This is the case for the provision of public services in Bangladesh, for which local governments are responsible – according to the 2007 Paurashavas Act (Bangladesh National Assembly, 2010) – but don't have the capacities or even willingness to deliver, given the legal and financial restrictions set by the central government and the heavy central bureaucracy (Panday, 2017). This will likely apply to the provision of FSM services in municipalities, which do not have earmarked financial resources and human capacity, and would heavily rely on central government support (Local Government Division, 2017).

Globally, there is growing interest by governments and development agencies in the construction of FSTPs. In Bangladesh in particular there are plans to take FSM to scale by setting up FSM services in over 100 municipalities, including building dozens of FSTPs over the next few years with funding from international finance institutions (Asian Infrastructure Investment Bank, 2019; International Development Association, 2019). It is therefore critical to gather evidence from past experiences and integrate the lessons in future initiatives. While there is considerable documentation of the functioning FSTPs initiated by NGOs, there is no publicly available documentation of the experience from the implementation of the 11 FSTPs from the ADB and Government of Bangladesh project mentioned earlier. This article aims to fill that knowledge gap, understanding the drivers of success and challenges in the provision of municipal FSM services through the analysis of four of those FSTPs. It presents recommendations for planning FSM services in the country and in similar contexts.

Methodology

The methodology combined a review of relevant literature, interviews with key informants, and visits to the plants. The review includes literature on FSTPs and sanitation infrastructure, grey literature on the status and implementation of the 11 FSTPs, and policy documents such as the 2007 Paurashavas Act and 2017 Bangladesh Institutional Regulatory Framework (IRF) for FSM in secondary towns (Local Government Division, 2017).

The primary data collection took place in April–May 2019, using qualitative techniques to gain deep understanding of the status and sustainability of the FSTPs from the managerial standpoint. Semi-structured interviews at national and municipal level and group interviews were complemented with visits to the four FSTPs. The four FSTPs were selected based on the preference of the Department of Public Health Engineering (DPHE) team. The plants are located in four secondary towns: Jhenaidah, Lakshimpur, Chowmuhani, and Narsingdi. The selected plants cover different levels of functionality – Jhenaidah is fully functional, Lakshimpur and Chowmuhani are partially functional, and Narsingdi is not functional.

The first author drew a list of open-ended questions (refer to supporting information 1) to examine the institutional arrangements, the human resources available and the finances of the four FSTPs, along with the level of community engagement in the towns. The study also explored the overall status of FSM coverage in each town in order to gain a better perspective of the other contributing factors inhibiting the sustainability of FSTPs. The lead researcher conducted 11 interviews (four with NGO professionals, two with researchers, and five with governmental organization professionals) and three group interviews with governmental organization professionals. The findings are presented as four case studies to present a comprehensive picture for the plants as each FSTP has unique arrangements and stakeholders involved (Yin, 1994). The lead researcher obtained ethical approval (MEEC 17-032) from the Maths and Physical Sciences and Engineering Faculty Research Ethics Committee at the University of Leeds, UK. Prior to each interview the first author and the research assistant provided an information sheet, clearly explained the research to the participants, and obtained verbal or written consent. The research assistant was fully briefed on the research ethics protocol. The first author analysed the interview findings inductively to identify the main themes in the light of the reviewed literature presented earlier and articulated recommendations in accordance with the second author's insights.

Since this study is focused on addressing the shortcomings of establishing FSTPs in secondary towns, the research team made sure to build rapport and trust with the interviewees to persuade them to discuss freely the lessons learned from implementing and managing the FSTPs, as there was some resistance to acknowledging existing problems. A research assistant was present to assist with interpretation; however, the language barrier limited the depth of the discussion with some interviewees. Furthermore, due to time constraints, the research team were not able to approach the ADB to discuss its views on the execution of the FSTPs. The study could not cover further FSTPs due to time constraints and because of the lack of communication between the project team and the municipalities.

Results

The FSTPs were part of the Government of Bangladesh and ADB country-wide project that was carried out from 2007 to 2014 in secondary towns. The project included capacity building and institutional support to local and central government, piped

water supply networks, community mobilization, and construction of private and public toilets (ADB, 2016). The construction of the FSTPs was not part of the original project plan, but was included later as a way to introduce FSTPs technology to the country. The project team decided on 16 plants in different locations across Bangladesh, but the mayors of five towns refused to collaborate, so only 11 plants were constructed.

The FSTPs were designed to provide basic secondary treatment of partially digested faecal sludge received from septic tanks and latrines. The sludge unloading chambers screen the sludge and send it to the planted drying beds. The beds contain filter media to percolate the water content; are planted with wetland/reed plants (biomass) such as *Phragmites karka*; and have ventilation pipes to prevent anaerobic conditions that harm the plants' roots. The drying beds consume the faecal sludge and produce biomass; the percolated water is then transferred to the collection pond using perforated pipes (Biswas, 2014).

The planted drying beds system has several advantages over other treatment systems. It requires minimum operation and maintenance (O&M) since it depends on natural processes to treat sludge; it does not require an energy source for operation and produces biomass (plants), which can be harvested and consumed; and does not require constant emptying of the treated sludge – emptied once every 6–10 years (Biswas, 2014). Moreover, the final treated sludge does not require further treatment prior to disposal. Nevertheless, this technology requires large spaces, which is not usually an issue in secondary towns since land is often available for low prices (Biswas, 2014). The following sections provide the history, components, and status of the four FSTPs in light of the current FSM practice in each of the four towns, while highlighting the institutional and financial arrangements in place.

Jhenaidah FSTP

In 2012, the Jhenaidah FSTP was constructed to serve Jhenaidah, a secondary town in Khulna Division; in 2011 the town had a population of 110,541 (Bangladesh Bureau of Statistics, 2014). At the time of construction, Jhenaidah municipality owned one Vacutug, mechanical faecal sludge emptying machinery, and since one Vacutug cannot meet all the demand, manual pit emptying was the leading FSM service. The plant comprised two screening chambers, five planted drying beds, three unplanted drying beds, and one filter media bed. The treated faecal sludge was collected and discharged to a nearby river. From 2012 to 2016, the plant was used for the sole purpose of dumping and storing low quantities of untreated FS; the waste was not being safely treated or disposed of. According to the mayor of the municipality, the plant was only used to store waste due to the lack of knowledge and skills in FSM, and in how to operate the plant properly.

Since 2014, SNV has been providing technical and financial support to the Jhenaidah municipality – focusing on the rehabilitation of the FSTP, providing Vacutugs to manage the emptying and transport of FS, in addition to FSM training and capacity building. By 2016, SNV had completed the rehabilitation of the FSTP,

and the municipality was handed the responsibility to manage the plant and the mechanical emptying and transport of faecal sludge in the town. Due to the low demand for FSM services and the lack of revenue, the municipality's FSM expenses had exceeded revenues in the first year, which resulted in a loss of around 200,000 BDT (US$2,350). The municipality then decided to reach out to AID Foundation in 2018, a private NGO, to help manage all the FSM services in the town through a 3-year concession agreement. The WASH committee, created by the NGO, is responsible for the FSM services. AID Foundation works collaboratively with the municipality and SNV to address any challenges related to FSM through regular meetings. The cost recovery of the FSM is gradually being achieved thanks to the growing awareness of and demand for the service. AID Foundation aims to achieve financial sustainability by introducing a co-composting component for the FSTP and then sell or use its products. SNV is helping AID Foundation in this by funding an action-research project with the Bangladesh Agricultural Research Institute (BARI) and the National Agricultural Research Organization under the Ministry of Agriculture.

Lakshimpur FSTP

The Lakshimpur FSTP was constructed in 2012 to serve Lakshimpur, a town with a population of 262,997 (2011) in Chittagong Division (Bangladesh Bureau of Statistics, 2014). The plant comprised two screening chambers, two planted drying beds, and a nearby dumping pond, and has been partially functional since its construction, under the management of an Executive Engineer and a Slum Development Officer. The quality of the effluent is tested yearly by DPHE and the International Training Network of Bangladesh at the Bangladesh University of Engineering and Technology (ITN-BUET) to ensure the safe dumping of faecal sludge in the surrounding environment. There are no operators or guards at the plant as the municipality presumes it does not require daily O&M activities. The mayor is keen to ensure the success of the FSTP; in 2017 he constructed the access road to ease the transport of the Vacutugs to and from the plant – the cost of building this road was covered by the municipality's businesses (commercial centre and lands rental) and taxes.

The DPHE considers the Lakshimpur FSTP a success story as no technical issues were reported and it is independently managed by the municipality. However, the plant receives much less sludge than it was designed for and is therefore underused, since the municipality only carries out pit emptying twice a week.

Narsingdi FSTP

The Narsingdi FSTP was built in 2013, to serve Narsingdi, a secondary town with a population of 185,128 in the Dhaka Division (Bangladesh Bureau of Statistics, 2015). The plant initially comprised two planted drying beds and a nearby dumping pond. Currently, the plant is still under the management of Narsingdi Municipality, but it is abandoned and damaged. Since the completion of its construction, the plant itself has never been operational for technical and political

reasons. At the time of the FSTPs construction, the town did not have appropriate sanitation facilities and, according to the municipality, the pit latrines and septic tanks were poorly built structures; the waste would leach into the ground and therefore faecal sludge was never emptied and transported to the FSTP. One year after the plant's construction, a Vacutug was introduced to Narsingdi for drain cleaning. However, the use of the Vacutug, and the management of faecal sludge in general, is still not widespread despite the well-developed infrastructures and accessible transportation systems.

The municipality staff did not receive any FSM training or partake in any FSM sensitization workshops prior to the plant construction, so they also lacked the required technical expertise to run the plant. More importantly, the mayor was not willing to cooperate with the DPHE when the FSTP was constructed as he did not consider the plant to be a priority for the town. Although the DPHE office at Narsingdi offers services in water and sanitation, and is eager to rehabilitate the plant; the management and decision-making process is controlled by the municipality itself. The municipality does not collect sanitation or water taxes, since it does not provide sanitation services and only covers 40 per cent of the town's water supply. Manual pit emptying is the common practice for FSM in the town, and the plant's location is not accessible for the manual pit emptiers to transport the FS.

Chowmuhani FSTP

The Chowmuhani FSTP was built towards the end of the ADB and DPHE project in 2014 to serve Chowmuhani, a secondary town in Chittagong Division with a population of 132,948 in 2011 (Bangladesh Bureau of Statistics, 2014). The plant comprised two planted drying beds and two screening chambers. The plant remained out of operation because of mobility constraints. The municipality reached out to the ADB and DPHE after the construction of the plant to gain support in the construction of an access road, but they were not able to fund it. Hence, the municipality took the responsibility to construct the road, but this did not happen quickly due to other priorities and lack of funds in the municipality. In 2018, the newly elected mayor instigated the construction of the plant access road.

Since the plant was constructed at the end of the ADB project, the municipality staff did not have the opportunity to attend the FSM training and sensitization workshops, affecting the uptake and operation of the plant. The plant is currently under the supervision and management of the Slum Development Officer, who oversees all sanitation-related affairs in the municipality. The officer had no prior training in FSM or sanitation. Recently, the municipality staff have been attending FSM training workshops run by the DPHE.

The household demand for pit emptying services is low due to the lack of awareness and high cost of the Vacutug services. As a result, the municipality empties around seven household septic tanks a month, and the plant is underused. Nobody operates the plant, given it has reportedly not required any desludging or maintenance to date.

Table 1 The FSTPs level of functionality and key factors

Town (year of construction)	*Functionality*	*Key factors*
Jhenaidah (2012)	Functional since 2016	Technical support from INGO increased the capacity of the municipality
		Operation by an NGO via 3-year concession agreement increased the management efficiency
		WASH committee to coordinate FSM services clarified resourcing and responsibilities
Lakshimpur (2012)	Partially functional	Ownership by the mayor helped mobilize resources from the municipality and the community to build access road
		The plant is underused due to low volumes of FS, linked to irregular emptying and transport
		Untrained staff and irregular maintenance
Narsingdi (2013)	Not functional	No interest in operating the plant from the municipality
		Leaching toilet containment infrastructure means infrequent emptying and no FS reaching the FSTP
		Demolished and neglected infrastructure
Chowmuhani (2014)	Partially functional since 2018	Lack of access road until 2018 hindered operations
		The plant is underused due to low volumes of FS, linked to irregular and expensive emptying and transport
		Untrained staff and irregular maintenance

Source: Authors own, 2020

Discussion

Despite the varying statuses of the four plants, there are several common factors, as presented in Table 1.

The key drivers for success/failure have been identified and are discussed in the following sections.

Lack of integrated whole-chain FSM planning and management

As the literature suggests, the success and sustainability of a project depends primarily on comprehensive planning and management, which ideally need to be present right from the start of a project (Reymond et al., 2015). When looking at the four FSTPs, the planning and management of the projects were inadequate. According to the DPHE, the plants were not considered at the design stage of the project with ADB, but introduced later on to stimulate dialogue and efforts to prioritize faecal sludge treatment in the country.

Moreover, the project did not consider the whole sanitation service chain. The FSM service in the four municipalities of the FSTPs consists mainly of mechanical emptying and transportation, and reaching a small population (Biswas, 2014), in addition to management of the FSTP, a narrow focus that brought many problems. In Narsingdi, for instance, low demand for emptying services and prevalence of manual emptying were not considered, which correlates with Kinger et al.'s (2019) conclusion that the quantities and qualities of FS is a main reason for failure of FSTPs in South Asia. As a result, the plant was not in use and septic tanks and pits are emptied very irregularly and the faecal sludge is then dumped in nearby water bodies or drains instead (Local Government Division, 2017). This correlates with the desk review findings: social inclusion and accountability to the community are crucial for the sustainability of a treatment plant (WaterAid, 2019b).

Unbalanced partnerships and unclear roles

Linked to the planning issues highlighted earlier, decisions were made exclusively by the central project team at DPHE and therefore the municipalities were not involved until the implementation phase. There was also ambiguity regarding the roles and responsibilities of the involved stakeholders. The municipalities thought the ADB and DPHE were responsible for the construction of the access roads to the plants – whereas the DPHE believed this was down to the municipalities. A municipality officer from Chowmuhani mentioned 'we reached the DPHE and the evaluation team of ADB who visited the project after completion to construct approach road but they refused because it was not part of the project items and no fund available for it'. This has delayed the start of FSTP operation for four years in Chowmuhani; a similar scenario happened with Lakshimpur FSTP. This confirms that building partnerships and collaboration among the relevant stakeholders is a key to sustainable management of sanitation infrastructure (Reymond et al., 2015; Scharp et al., 2018; Eawag/Sandec, 2019).

It is worth noting that at the time of the construction of the FSTPs, FSM was not formally part of the legal duties of municipalities (Bangladesh National Assembly, 2010). The recently developed municipalities IRF-FSM has made considerable steps in clarifying the roles and responsibilities of the government and partners institutions at the start of projects (Local Government Division, 2017).

Lack of ownership from municipalities

The poor involvement of the municipalities resulted in a low level of ownership from the municipalities towards the FSTPs. Mayors from some of the originally selected municipalities refused to accept the construction of FSTPs in their towns. The other mayors simply accepted the construction of the FSTPs but did not consider them a political priority, including the development and support of other FSM services in their towns. The current mayors of Jhenaidah, Lakshimpur, and Chowmuhani show a more positive involvement in FSM as they are constantly attempting to improve the FSM services in their towns. This attitude is a result of the political position of the mayors and their interest in becoming sanitation champions and

being acknowledged by the central government. Whereas in Narsingdi, this is still lacking as a central government employee in Narsingdi highlighted: 'the mayor prefers investing in road and drain infrastructures, issues more frequently requested by his communities, and that can help him to gain votes and get re-elected'. It is evident from the four FSTPs that the political will of a mayor in a secondary town is crucial to the success of any utility project. This correlates with findings of a similar study in Egypt by Reymond et al. (2015).

Municipalities' technical and financial capacities

In order to achieve sustainable management of any service or infrastructure project, the service provider, in this case the municipality, should possess the required technical and financial capacities (Bassan et al., 2014; Kinger et al., 2019). The municipalities at the time of construction, however, lacked the technical and financial capacity to provide FSM services sustainably. First, the municipalities' staff are not trained in FSM and do not have the relevant skills and experience to manage FSM and do not focus on FSM services. This is seen as secondary to many other tasks including solid waste management or even slum development (Biswas, 2014).

Second, the financial resources of most of the municipalities are limited and designated for other activities, so they can't fully finance the provision of FSM services without support from other institutions. As mentioned earlier this is related to weak fiscal decentralization, whereby municipalities' financial sources and decisions are fully dependent on central government institutions such as DPHE, and lack the autonomy to access internal and external funds to cover O&M and further investments in FSM (Bassan et al., 2014; Panday, 2017). It is worth mentioning that recently the IRF-FSM stated that municipalities are entitled to receive substantial funds from the government to cover capital expenditures in FSM (Local Government Division, 2017); however, the interviewees did not mention receiving any funds from central government for FSM, but this may change in future efforts.

Development partners' participation

The fact that the FSTP in Jhenaidah is fully functional is closely related to the collaboration with SNV, which has been providing technical and financial support and created a linkage with a national NGO that has taken over FSM service provision. The engagement and support of an international NGO and private service providers are common elements of the current well-functioning FSTP in Jhenaidah, and FSM services in other towns in the country, including those mentioned in the introduction. This shows how such partnerships are crucial to sustainable sanitation programmes (Reymond et al., 2015; Scharp et al., 2018; Kinger et al., 2019).

There are, however, challenges to the successful involvement of private service providers in secondary towns, such as the capacity to make any investments beyond the regular running costs and the fact that they receive little support from research and government institutions, leading to dependency on international NGOs.

This finding correlates with Schoebitz et al.'s (2015) argument that the private sector alone cannot offer a financially sustainable business model for FSM.

Interviewees also highlighted that academic and research institutions, such as Khulna University of Engineering & Technology (KUET), have recently played an important role in promoting FSM across Bangladesh. In addition, the Bill & Melinda Gates Foundation has funded a two-year capacity building project run by DPHE, in partnership with ITN-BUET, to tackle the FSM knowledge and skills gap.

Conclusion and recommendations

This article presents the outcomes of implementing and operating FSTPs in four secondary towns in Bangladesh. The findings suggest several success factors for managing FSTPs in Bangladesh and similar contexts. First, active provision of the services is required along the earlier links in the chain – faecal sludge emptying and transportation services – given that poor demand and high cost can lead to the underuse of FSTPs. Second, the municipalities should be engaged in the decision-making process from the design stages, as a way to ensure their ownership of the project. This shapes their political will to provide FSM services, including the FSTPs operation, maintenance, and rehabilitation. Third, the technical and financial capacities of the municipalities need to match the O&M requirements for the provision of these services. In some cases, support of international and local NGOs helped fill those gaps and promote good performance and sustainability of the treatment plants while gradually strengthening the capacity of municipalities.

The insights from this study provide useful ideas for the development of FSM in secondary towns in Bangladesh and in similar contexts:

- *Put municipalities in the driving seat*. Municipalities are ultimately responsible for FSM service delivery and should also be in the driving seat throughout. Transparent planning and clear allocation of roles and responsibilities is a good start and will help avoid unforeseen issues in the plant O&M. Central government and development partners could explore ways to incentivize political prioritization, and municipal ownership could be explored, such as recognizing sanitation champions, creating healthy competition between towns, or using cleanliness rankings.
- *Ensure adequate financing*. FSTP construction and FSM service provision more generally need to come with clear business plans, and sufficient financing for operation, maintenance, and rehabilitation. Public funding is likely to be required in order to complement income from fees/tariffs and sale of treatment products. As the IRF-FSM is rolled out, the central government could develop its financial dimensions to enable municipalities to access the required resources for FSM service delivery. Given the fact that agriculture is a key livelihood in and around secondary towns, it is important to consider and promote the reuse of treatment products as fertilizer, collaborating with agriculture institutes and agricultural service providers to increase sales, as well as exploring innovations such as co-composting with organic waste.
- *Consider the whole sanitation service chain*. Donors, central, and local governments should approach FSM more holistically, supporting the provision of appropriate

faecal sludge emptying and transportation services along with building FSTPs. They should also take into account current containment infrastructure and existing emptying services (including informal) in the target area.

- *Strengthen the capacity of local actors to deliver FSM services*. The central government has the technical and financial resources to lead a comprehensive capacity building effort, based on a thorough needs assessment covering planning, management, and monitoring of FSM service delivery. It should cover a wide range of actors, including municipal decision makers, municipal staff, sanitation workers, private service providers, and sanitation entrepreneurs. The private sector and NGOs could be involved, but given their limitations and reach, many municipalities will have to deliver the services on their own. Those municipalities are likely to need additional human resources and capacity development. It would also be wise to choose processes and technology options that are simple to operate and maintain.

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Appendix 1: Semi-structured Interviews/group interview guide

Providing municipal faecal sludge management services: Lessons from Bangladesh

a. Institutional arrangements:

- What is the level of autonomy of the sanitation utility or municipality in charge to other state institutions?
- Do political changes have an influence on the management and decision-making process for the FSTP?
- Which organisations are involved in the management of the FSTP?
- What is the decision-making protocol for the FSTP management, e.g. internal hierarchy between the involved organisations and communication protocol among the concerned staff? E.g. who reports issues to whom and who is responsible for dealing with these issues?
- What are the arrangements made to regulate the pit emptiers' work to ensure the delivery of FS quantities to the FSTP for it to function?

b. Human resources management:

- Are there any institutions in Bangladesh offer training needed for wastewater and faecal sludge treatment projects (planning, design, construction and O&M of sanitation infrastructure)? Does it cover the country's needs?
- What are the hiring conditions (level of education and training, contract type, financial incentives, and training opportunities) offered to the operators and management team of the FSTP?

c. Financial arrangements:

- What are the financial requirements to operate the FSTP?
- What are the energy requirements to operate the FSTP?
- What are the available funding resources to operate the FSTP? Are there enough funds in place?
- Were there any resource recovery plans of the treatment end-products, e.g. compost, energy?

d. Community mobilisation:

- What is the level of involvement of the surrounding communities in the FSTP's different phases, were there community outreach plan before constructing the FSTP? For example, were they interested in purchasing compost from the plant? Were they aware of the benefits of constructing these plants? Were they interested in working with the FSTP management (e.g. pit emptiers delivered the collected FS to the plant?).
- Were the pit emptying groups in the FSTP's area made aware of the nature of the FSTP? Did they show interests of collaboration? For instance, deliver the collected FS to the plant?