

FSM

INNOVATION

**Tackling the Second-Generation
Sanitation Challenge at Scale:
Business Solutions for Inclusive Faecal
Sludge Management in Bangladesh**

NOÉMIE DE LA BROSSE, ROSIE RENOUF, SUMAN KANTI NATH

Tackling the Second-Generation Sanitation Challenge at Scale: Business Solutions for Inclusive Faecal Sludge Management in Bangladesh

Noémie de La Brosse, Rosie Renouf, Suman Kanti Nath

EXECUTIVE SUMMARY

Globally, Bangladesh stands out as a country that has made remarkable progress in eliminating the scourge of open defecation. However, this success has created a 'second-generation' sanitation challenge of how to deal safely with the faecal sludge collected from pit latrines and septic tanks. As on-site sanitation solutions develop, the question of sustainable and inclusive faecal sludge management (FSM) business models is now at the heart of the challenge in Bangladesh.

This case study looks at faecal sludge management from a small enterprise development, treatment, reuse and financial viability perspective, applying a holistic and multi-stakeholder focus. Based on three solutions for FSM service provision in Dhaka, Faridpur and Sakhipur, the examples demonstrate building the capacity of the public and private sector partners in operating safe FSM, to improve public health and provide business and labour opportunities. The examples illustrate good practices along the faecal sludge value and service chain, as well as smart subsidies to engage stakeholders from start-up to scale-up in a viable way to serve poor households in urban Bangladesh.

The key lessons from and drivers for successfully engaging the private sector and structuring FSM as a viable service and business include:

- Public sector ownership of the FSM system is strategic, and agencies should carefully consider the complexity of the political economy factors urban sanitation in changing contexts.
- Successfully engaging the private sector depends on viable business incentives that can be jointly designed for enterprises to crowd-in. Ultimately, an FSM service model should also be structured around the level of business competition and the potential

among local businesses to engage in human waste management.

- Mechanical FSM services can serve the poor and are viable in urban Bangladesh. Providing that institutional support and appropriate differential pricing strategies are established by the private and/or public actors with business development support, lower income consumers can be served without jeopardising a company's bottom line.
- Finally, FSM as a viable service relies entirely on awareness raising and the capacity to generate sufficient and sustained demand from a varied customer base. For a public private partnership (PPP) to be able to offer a strong framework in which multi-stakeholders can operate, an in-depth analysis of customers' demand, their willingness and ability to pay is essential in order to ultimately design models and tariff structures that enable the poor to access this service.

CONTEXT

Following an increase in the urban population from the mid-1960s to the mid-1990s, Bangladesh's cities face enormous challenges providing infrastructure and services to their citizens. The urban population growth rate is 3.5 percent per annum and Bangladesh is now one of the most densely populated countries in the world, with one third of its population living on less than ten percent of Bangladesh's total land mass. Thirty-four percent of Bangladesh's population of 161 million lived in urban areas in 2015 and this is projected to increase to more than 50 percent by 2050 (Figure 1).

The economy is resilient, enjoying consistent growth: gross domestic product (GDP) has increased by an annual average of 6.2 percent for more than a decade (Water and Sanitation Program, 2016). Despite this positive economic picture, national poverty rates

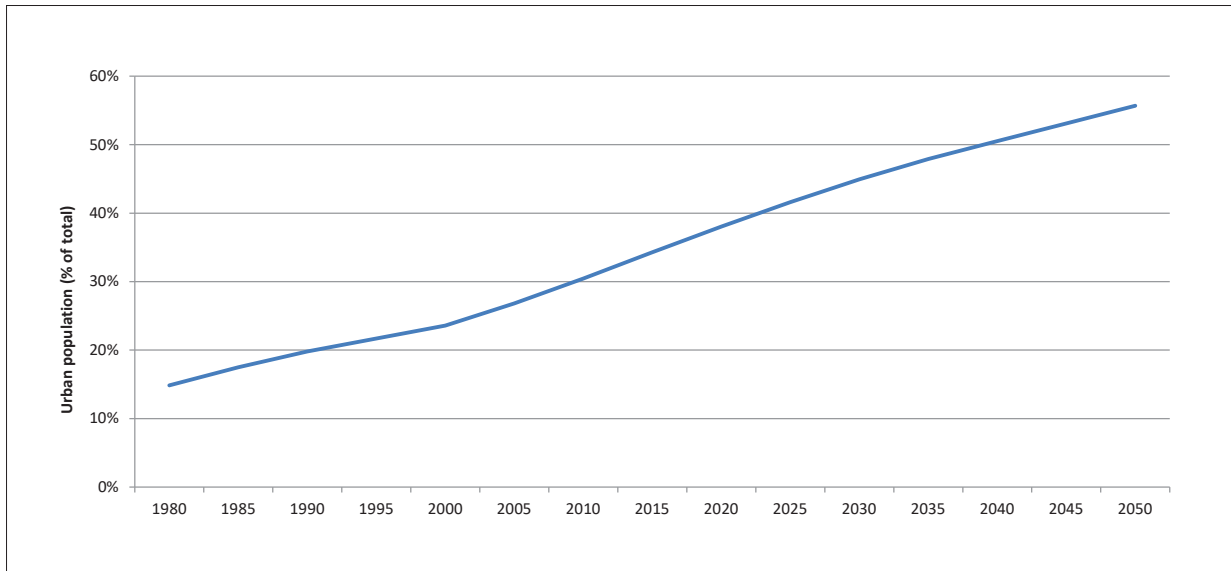


Figure 1: Urban population of Bangladesh, 1980–2050 (United Nations, 2014)

remain high and 21 percent of the urban population in Bangladesh still lived in poverty in 2010 (Riaz & Rahman, 2016). In Dhaka, nearly one third of Dhaka’s 16 million-strong population lived in slums in 2014 (Ahmed, 2014). This proportion is lower in Faridpur, a secondary town, where 10,600 residents out of a total population of 130,000 live in slums.

Bangladesh has made considerable progress towards achieving the Millennium Development Goals (MDG) on water and sanitation, reaching and even exceeding the South Asia MDG target of providing access to

improved sanitation for 61 percent of its population. Bangladesh’s near-eradication of open defecation is particularly remarkable, reducing from 34 percent in 1990 to one percent in 2015. This was achieved through concerted campaigns and community-led total sanitation interventions led by the government, as well as increased use of on-site sanitation systems (OSS) such as septic tanks and various types of pit latrine (now used by around 94 percent of Bangladeshis). However, access to improved sanitation facilities that separates users from faecal waste is lower, at around 60 percent. The country’s only sewerage network is in Dhaka and serves around 20–30 percent of households and institutions. Significant national growth in sewer access in the near- or medium-term future is unlikely, although the World Bank’s Dhaka Sanitation Improvement Project may improve access to sewers in Dhaka over the next decade or so.

The successful reduction of open defecation and increased reliance on OSS means that Bangladesh is now has a ‘second generation’ or ‘post-ODF’ challenge. The faecal sludge collected in sanitation facilities needs to be managed and treated to protect public health and the environment, but the FSM value chain beyond household containment is still underdeveloped. This poses a public health risk that will undermine the strong progress made in increasing toilet and latrine coverage. For example, 99 and 90 percent of human waste returns to the environment untreated in Dhaka and Faridpur respectively, and in Sakhipur, it is 79 percent.

This situation is likely to deteriorate as the country continues to urbanise, so sustainable solutions that respond to the complexities of urban sanitation in Bangladesh are desperately needed. Nationally, the



Figure 2: Street in Dhaka

Ministry of Local Government, Rural Development and Cooperatives is responsible for drinking water and sanitation at the statutory level. The Department of Public Health Engineering (DPHE) takes functional responsibility everywhere except Dhaka and Chittagong according to the World Bank sanitation project in 2015. Beyond the national level, there is little clarity regarding the assignment of roles between service providers, city corporations and municipalities until very recently as discussed below.

FSM SERVICES IN BANGLADESH

Brief historical FSM context

As a result of the factors detailed above, there is a gap in the FSM value chain that is being filled by unsafe practices. Toilets overflow or are manually emptied and untreated sludge is transported and discharged into nearby drains and water bodies, exposing residents to human waste and the problems traditionally associated with open defecation. In many areas, most septic tanks and pits are also connected directly to the storm drainage system, which is linked to open water bodies within or outside cities. This is exacerbated by frequent flooding.

There is a disparity in access to improved toilets and safe FSM services by income level and geographical area. Households and institutions in Dhaka connected to the sewerage network are mostly in mid- to high-income areas. Households in low-income and informal settlements use several types of pit latrine and septic tank and are less likely to be connected to the storm drain network, let alone the sewerage network. They rely on desludging services, which usually means collection and transport by carts and vans. It is estimated that 20 percent of residents in low-income areas are occasionally forced to practice open defecation due to the lack of containment infrastructure or the inability to access emptying services. In other towns, open defecation rates varied between 1 percent (Sakhipur) and 6 percent (Faridpur) before interventions.

THERE IS A GAP IN THE FSM VALUE CHAIN THAT IS BEING FILLED BY UNSAFE PRACTICES

Historically, unregulated informal manual emptiers have provided households with the immediate desludging services they need, which also has negative impacts on the environment, public health and safety.

In Faridpur, manual emptying of a tank or pit costs between USD 15.00 and USD 50.00 (De La Brosse, Stevens, and Islam, 2017). In lower-income areas of Dhaka, the typical cost is between USD 50.00 and USD 500 (the latter for larger tanks serving many households) (Renouf, 2017). In the town of Sakhipur, the fee for faecal sludge collection and transportation is USD 6.50 per trip within the municipality; while clients outside the municipality pay more for the extra fuel (Kanti Nath., Al-Muyeed, and Ranjan Sanyal, 2017). Mechanised systems to empty pit latrines with direct storage in concrete rings or latrines connected to septic tanks by pipe are not used in Sakhipur. It is common practice to seal a full pit, then dig a new one to replace it. When a pit or tank needs to be reused, manual emptiers are employed to evacuate it and transport the waste to the disposal points. Ultimately, the price of FSM services often depends on the volume of sludge, type of emptying (manual or mechanical), distance to a disposal site, ease-of-access, condition of the containment facility and the sludge, and the socio-economic status of the customer.

The absence of treatment facilities in most towns and cities also leaves a gap in the sanitation chain. In Faridpur, the sludge treatment plant started is currently operating at 40 percent capacity. In Bangladesh, the significant amount of solid waste and faecal sludge generated offers the possibility of combined composting. Co-composting is also a core part of the FSM business model developed by the Municipality of Faridpur with support from Practical Action and the Bill & Melinda Gates Foundation (BMGF).

Overview of institutional mandates and responsibilities

According to the regulatory guidance, the Water Supply and Sewerage Authorities (WASA) take the lead on water, sewerage and storm water drainage in cities where such bodies exist. This is relevant to Dhaka, as well as Chittagong, Rajshahi and Khulna. In other urban areas, the water supply and sewerage department of the city corporation or the municipality are responsible for solid, liquid and industrial waste management, according to the 2009 Local Government Act. Schedule II of the Act also states that the municipality should provide or identify sites for dumping waste and develop guidelines for residents. In practice, however, this guidance is never applied.

Local governments (and municipalities) have received little guidance on establishing new systems. Nor is there a strategy for significant investment in improving the quality of onsite sanitation facilities and FSM, although they share the responsibility of funding and

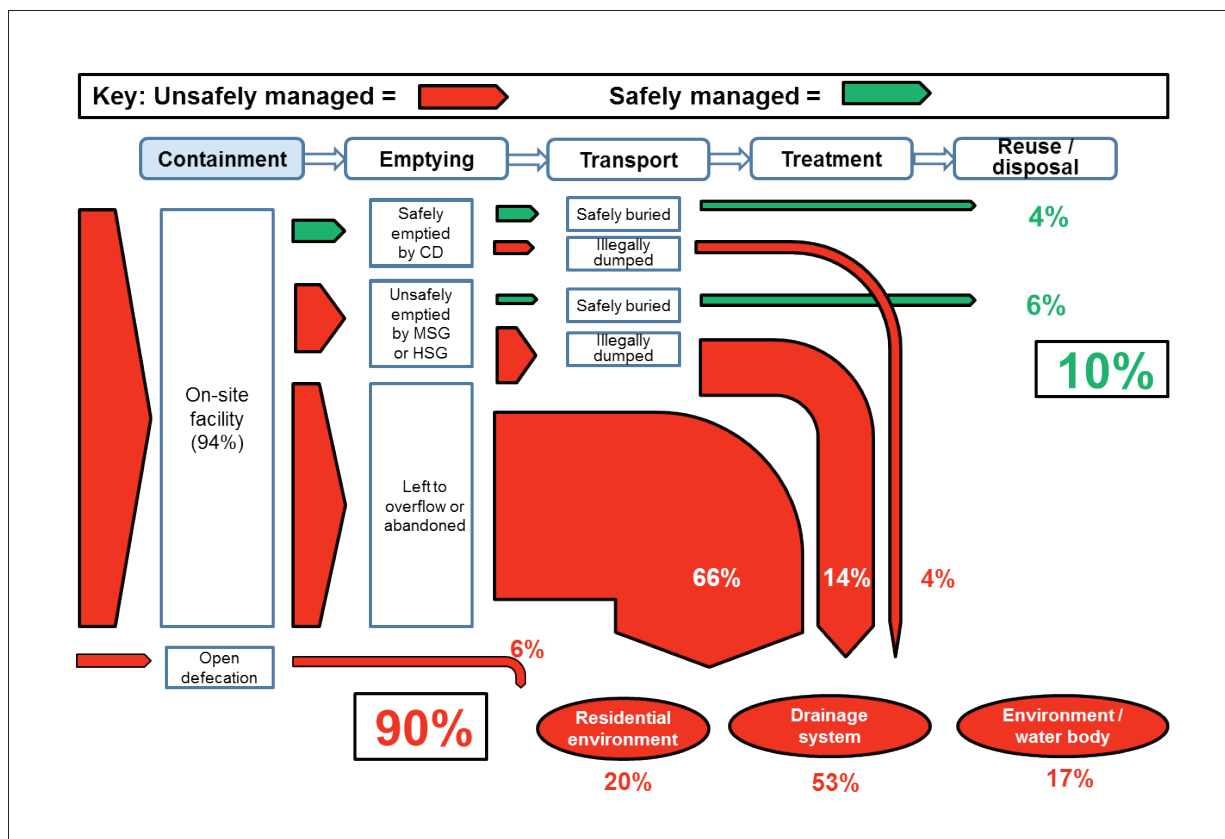


Figure 3: Faecal waste flow diagram Faridpur

implementing the infrastructure. In practice, the decentralised governance system has made it difficult for local governments to provide adequate sanitation because a detailed breakdown of responsibilities has not been available until recently, existing policies are often not enforced, and local governments do not have the budget to realise the policies they are mandated to provide. Key gaps in sanitation policy instruments are a significant challenge faced by the sector, and have led to:

- Continuation of unsafe and unhygienic manual emptying practices
- Lack of well-known and affordable sludge transportation options
- Few options and opportunities for sludge disposal or productive use of faecal sludge
- Lack of appropriate sludge treatment plants to ensure an effective sanitation value chain
- Few examples of successful sludge treatment models at scale
- Little interest from the private sector due to an absence of profitable business models

FSM IN NATIONAL AND CITY URBAN SANITATION POLICY

Legal Framework and Policies

Despite the insistence that municipalities manage waste of all types, faecal sludge is not specifically

referenced in the regulatory guidance, although it is alluded to under the term 'refusal' in the Local Government Act. Municipalities have not developed approaches, technologies, or treatment options for faecal sludge management. The National Water Supply and Sanitation Strategy, which is focused on large cities, also pays scant attention to FSM.

Other legislation also ostensibly covers various aspects of sanitation, although these leave many gaps in policy and in practice. For example, the Paurashava (Municipality) Act 2009 provides for the development of a Master Plan for each Paurashava which should effectively incorporate FSM, although most municipalities are yet to enact this due to its complexity. In addition, no building code currently specifies septic tank provision.

THE DECENTRALISED GOVERNANCE SYSTEM HAS MADE IT DIFFICULT FOR LOCAL GOVERNMENTS TO PROVIDE ADEQUATE SANITATION

The Paurashava Act defines 'garbage' as including rubbish, offal, 'night-soil' (faeces), animal carcasses, sewerage deposits, residue from latrines, dirt, waste

and any other polluted materials. Faeces is therefore recognised in the document, though the activities required for its management are not adequately addressed. Elsewhere in the Act, 'sewerage' means drainage, polluted water, rain water carried by drains and any type of polluted and dirty materials carried by canals. Faecal sludge is therefore not linked to sewerage. Similarly, 'drain' is defined as a rain or storm water drain, as well as the water tables, chutes and side drains that carry rainwater from streets, bridges or causeways.

The Institutional and Regulatory Framework

In September 2014, the Policy Support Unit (PSU) of the Ministry of Local Government, Rural Development and Cooperatives started to design an institutional and regulatory framework (IRF) for faecal sludge management in Bangladesh. Developed through extensive consultation, the IRF assigns roles and responsibilities throughout the FSM service chain to institutions based on existing laws, policies and strategies, thus avoiding overlap and taking into account infrastructure, socio-economic conditions and environmental concerns. The IRF was finalised in December 2015, approved in the National Forum meeting in April 2016 and approved by the ministry a year later in 2017.

The national government acknowledged that an appropriate institutional arrangement was a prerequisite for effective FSM. Since the entire FSM service chain is interlinked, it is important that the roles and responsibilities of institutions are clearly defined, integrated and are coordinated based on local conditions, skills, strengths and institutional commitment to an effective, safe and sustainable FSM system. The IRF identifies several institutions and stakeholders to play roles in the overall planning, development, implementation, practice, and monitoring and evaluation of FSM. Within national government, the following ministries are responsible for securing funding, providing technical support through respective line agencies (BMGF and LGED), ensuring enforcement of laws, policies, strategies and guidelines, initiating inclusive planning and execution of FSM, and monitoring through the National Forum for Water Supply and Sanitation (NFWSS), the Ministry of Local Government, Rural Development and Cooperatives, and several other ministries, including Environment and Forestry, Health and Family Planning, Agriculture, Housing and Works and Water Resources.

As the lead ministry, the Ministry of Local Government, Rural Development and Cooperatives, is in charge of:

- leading the planning, development, guidance and monitoring the overall system of FSM in Bangladesh,
- securing funding from central government and development partners, and
- disbursing funds among implementing agencies e.g., city corporations, WASA, municipalities or other urban local bodies as appropriate.

THE INSTITUTIONAL AND REGULATORY FRAMEWORK (IRF) ASSIGNS ROLES AND RESPONSIBILITIES THROUGH THE FSM SERVICE CHAIN

The Ministry will also update policies and strategies, facilitate enactment of laws/bylaws, and prepare guiding principles for FSM as required in consultation with the National Sanitation Taskforce and/or the National Forum for Water Supply and Sanitation. An important responsibility will also be to provide overall coordination among stakeholders/institutions and performance monitoring. Local government institutions and line agencies (Dhaka North City Corporation, Dhaka South City Corporation, other city corporations, Paurashavas and Union Parishads) are in charge of implementing the FSM system. They are supported by WASA, RAJUK (Capital Development Authority of the Government of Bangladesh), DPHE and LGED. The institutional and regulatory framework provides guidance on:

- The responsibilities of stakeholders for each step of the service chain, their roles and obligations, and the mechanisms responsible for the monitoring and enforcement of each activity;
- Proper design and construction of sanitation and disposal facilities, social sustainability (i.e. social discrimination, rights, and safety for desludging service providers), environmental sustainability (i.e. stopping illegal connections to and disposal into water sources with 'environmental police' ensuring compliance), and economic sustainability (i.e. sustainable FSM business models, including cross-subsidies for more pro-poor service-level agreements, and 'safe sludge transfer' incentives, gradually developing a database of all sanitation facilities and their emptying frequency);
- Involving the private sector in FSM services;
- Setting up relevant units in local government bodies (CCs, Paurashavas, and Union Parishads) for the effective delivery of FSM services;

- Collaboration/coordination with departments such as Environment and Agriculture Extension for environmental compliance, quality assurance and marketing of end products;
- Capacity building, training, and research including filling knowledge gaps, technical assistance, training, and quality assurance of processes and products (e.g. compost);
- Awareness-raising campaigns, promoting private-sector participation, and demonstrating FSM business models;
- Technical and funding support from the government for capital infrastructure and other assistance (e.g. securing land for treatment facility construction);
- Guidance on FSM business models, whereby treatment-plant operators pay the collection and transportation operators a discharge incentive to dump the sludge safely. This financial incentive rewards socially desirable behaviours, and encourages re-use and resource recovery.

EXAMPLES OF FSM INTERVENTIONS IN BANGLADESH

Most links in the FSM value chain will require significant support if they are to develop to the level needed to protect public health and ensure improved service provision. Given the complexity of the urban sanitation sector and the scale of the challenge surrounding FSM service provision in Bangladesh, any solution must be multifaceted and holistic, reacting to situations on the ground and taking advantage of the opportunities that arise.

The three city interventions developed by Practical Action, WaterAid Bangladesh and WSUP therefore take different approaches to various sections of the

IN BANGLADESH, ANY SOLUTION MUST BE MULTIFACETED AND HOLISTIC

FSM value chain in their respective cities, from collection to treatment (Figure 4), but all seek to develop solutions that will strengthen the national sanitation sector as a whole.

Between them, these projects undertake a range of activities, including: i) supporting the public sector and existing institutions that are responsible for urban sanitation, ii) developing business models and engaging with the private sector, and iii) improving treatment technologies and processes. As demonstrated in Figure 4 and Table 1, although the projects differ in terms of activities and area of focus, all support multiple local stakeholders to build their FSM capacity.

Overview of three urban FSM projects

In Dhaka in 2015, WSUP designed a PPP to be delivered through a lease contract between DWASA and a cleaning services business that wanted to move into FSM (Gulshan Clean and Care). Under this agreement, DWASA provided the company with two 2,000 litre vacuum tankers to use under the 'SWEEP' brand, developed by WSUP for use by sanitation SMEs in Bangladesh. Until recently, SWEEP targeted mid- to higher-income residences and commercial institutions, with lower income clients making up 15 percent of the customers. A new clause in the lease contract agreed by DWASA, the SME and WSUP mandates that the proportion of low-income

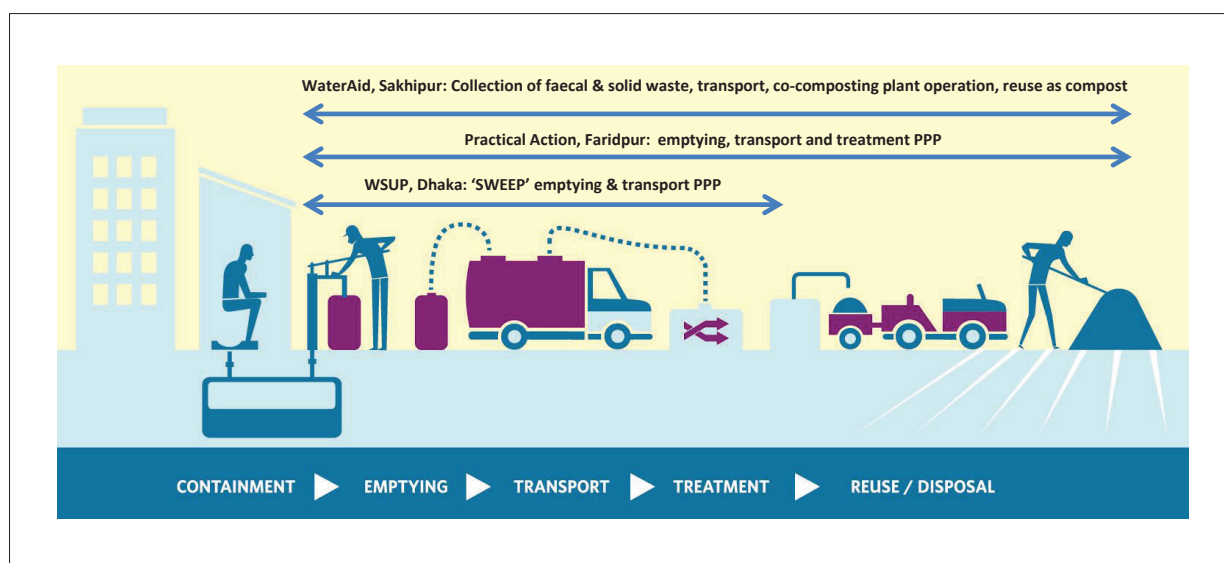


Figure 4: Links of the FSM value chain addressed by Practical Action, WSUP and WaterAid projects

	Dhaka	Faridpur	Sakhipur
Public sector	Dhaka Water Supply and Sewerage Authority (DWASA) Infrequent vehicle maintenance (e.g. major repairs) Mass marketing and demand generation Regulatory activity Replacing fleet Disposal/treatment of sludge	Faridpur Municipality Monitoring progress Appointing treatment plant operator Subsidising treatment plant Demand generation and awareness raising campaigns	Sakhipur Municipality Leasing land for co-composting plant Mechanical desludging (Vacutug) and manual desludging services for a fee (59 percent of the faecal sludge of the town is currently safely disposed and 38 percent is treated safely through the co-compost plant) Selling compost to farmers Promoting compost to farmers through Dept. of Agricultural Extension.
Private sector	Gulshan Clean and Care (SME) Paying lease fee and security deposit to DWASA Regular vehicle maintenance Providing desludging services to clients in exchange for market/fixd payment Transporting sludge to DWASA disposal points	Khutibari Cleaners Cooperative and Bandhob Polli Cleaners Cooperative (sweeper group cooperatives) Paying lease fee to municipality for machinery Providing desludging services to clients for a fee Treatment plant operator (Society Development Committee-SDC) Paying incentive to desludging service providers for sludge delivery Treatment of sludge for reuse (co-compost)	N/A
Other	UNICEF WSUP Technical and business management training Developing marketing and promotional strategy	Practical Action Bangladesh Supporting the municipality with demand generation activities Providing technical backstopping to all stakeholders	WaterAid Bangladesh Technical and financial support Bangladesh Association of Social Advancement (BASA) Implementing partner

Table 1: Major stakeholders and their roles in the FSM interventions in Dhaka, Faridpur and Sakhipur



Figure 5: SWEEP team with branded vacuum tanker in Dhaka

customers will rise to 30 percent. The SME will achieve this by increasing its advertising and brand promotion in targeted areas, and connecting with community leaders and residents who could act as sales agents.

Although Dhaka lacks adequate treatment capacity for its sewered and non-sewered populations, DWASA provides eight official disposal points for SWEEP. However, there are no facilities to ensure that sludge is treated and safe. WSUP is currently in discussion with the Dhaka City Corporation and DWASA about tackling the city's treatment deficit under the World Bank-funded Dhaka Sanitation Improvement Project. After a two-year pilot that ended in March 2017, SWEEP had reached over 120,000 people in Dhaka and emptied nearly 4,800m³ of sludge.

In Faridpur, Practical Action developed a PPP wherein two groups of informal pit emptiers (also known as the sweeper community) have been formalised into cooperatives that provide mechanical desludging services (collection, transport and disposal) for a fee. The municipality monitors progress through quarterly

THE CO-COMPOSTING PLANT IS EXPECTED TO INCREASE THE VOLUME OF TREATED SLUDGE FROM 21 PERCENT TO 58 PERCENT OVER THE NEXT TWO YEARS

targets to ensure quality control and safe disposal of the sludge at a new treatment plant. A multi-stakeholder steering committee oversees the service level agreements and incentives through a set of key performance indicators that ensure the system's responsiveness. A performance-based contract (including an equipment lease) was signed by between the municipality and the Khutibari Cleaners Cooperative, in December 2015. Bandhob Polli Cleaners, a second cooperative, has recently also entered the PPP.

The treatment plant pilot began in August 2016 and the municipality has recently appointed a treatment plant operator (TPO). The project was originally piloted in two wards of the city with a combined population of 26,000; the service is now available city-wide. In the first four months of operation, the Khutibari Cleaners Cooperative completed 149 trips to the treatment plant and earned USD 3,087 in emptying fees. From the start in August 2016 until June 2017, the cooperative emptied a total of 194 latrines and made 583 trips with the Vacutug (2m³ each). The collection, transport and disposal of 1,166 cubic meters to the treatment plant by the cooperative earned USD 9,577 in revenue. The model is expected to expand once the second cooperative receives its own vacuum tanker and adopts this business model.

In Sakhipur, aiming to address the twin problems of solid waste management and faecal sludge management, WaterAid Bangladesh and its implementing partner BASA helped Sakhipur Municipality develop a co-composting plant that will provide scientific and practical knowledge about co-composting as well as management and safety training. Construction began in 2015 and the plant became operational in January 2016. The intervention combined a co-composting plant alongside mechanical faecal sludge removal and transportation, and household solid waste collection and transportation.

The co-composting plant consists of unplanted drying beds, wastewater treatment through a constructed wetland, and aerobic decomposition of dried faecal sludge and organic solid waste. Customers are

charged USD 6.50 per trip using the municipality's Vacutug, currently in operation four days a week and collecting around 16,000-20,000 litres of sludge weekly. In the last 16 months, the Vacutug made 1150 trips to collect faecal waste. The solid waste for the plant is collected from households for a monthly fee of USD 0.40 and sold by the municipality to farmers for USD 0.20 per kg. Shit flow diagrams developed to quantify the pre- and post-condition of FSM in Sakhipur demonstrate that the co-composting plant is expected to increase the volume of treated sludge from 21 percent to 58 percent over the next two years (Figure 10). Currently, the plant handles 1,200 tons of faecal sludge and 125 tons of solid waste annually and produces approximately 24 metric tonnes of



Figure 6: Desludging by Khutibari Cleaners Cooperative



Figure 7: Signing the performance based contract in Faridpur



Figure 8: Emptying fee being paid in Faridpur

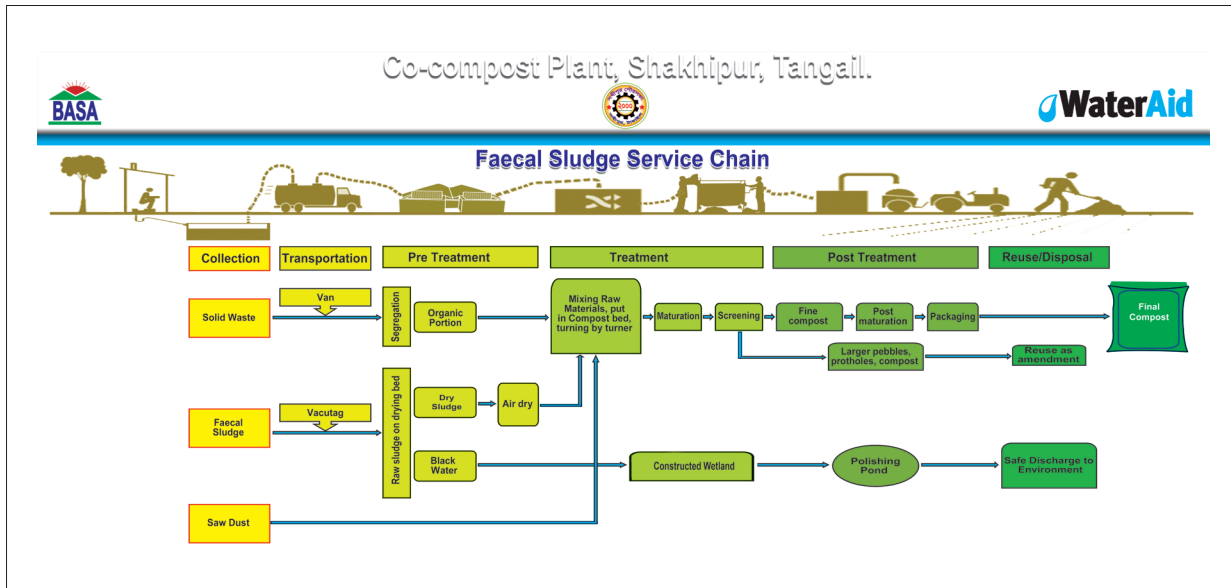


Figure 9: The sanitation service chain in Sakhipur

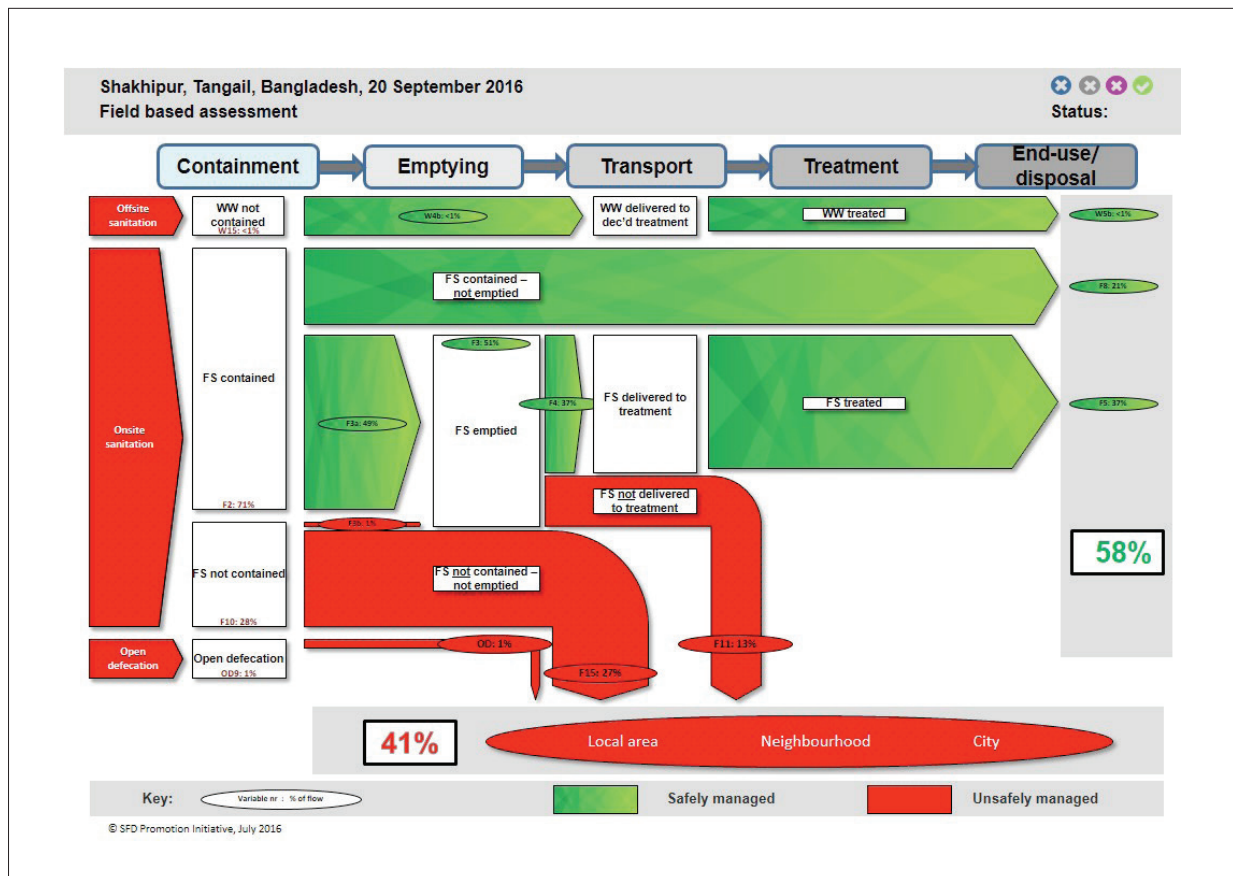


Figure 10: Target shit flow diagram for Sakhipur

compost per year. Laboratory tests demonstrate that the compost has a carbon to nitrogen ratio in the range of 16–20 and the average moisture content is around 16 percent (Kanti Nath, Al-Muyeed, Ranjan Sanyal, 2017).

The three projects offer cost-efficient ways of meeting the needs of diverse groups – not just removing and treating faecal sludge in a hygienic

manner, but also providing reusable end products for farmers and business models for SMEs that can be adopted and then adapted according to the needs of customers and cities. The projects are not just providing a needed service, but developing tools and models that stakeholders operating in each municipality/city corporation can use to extend service provision city-wide.



Figure 11: Drying bed in Sakhipur



Figure 12: Sludge turner in Sakhipur

FINANCIAL ASPECTS AND INCLUSIVE BUSINESS MODELS

Public-private partnerships are often the best way to create a competitive environment for mechanical desludging operators to enter the market. Under the contract signed in Dhaka, the 'SWEEP'-branded SME provides desludging services and disposal under a

lease agreement with DWASA for use of their vehicles, and DWASA provides eight official disposal points and mass marketing. The total profit generated by SWEEP by October 2016 was BDT 700,000 (USD 8,700) as shown in Figure 13.

In Faridpur, the informal desludging groups formed two cooperatives in partnership with the Municipality. The partnerships include an equipment lease agreement and formalises the service level agreement, and an arrangement with the treatment plant operator. This model replaces an inefficient system of service provision where the municipality and the informal desludging groups were competing with each other.

Desludging fees and compost sales can generate revenue. In Faridpur, revenues from the sale of compost made from dried sludge are expected to be low in the first year of operation (USD 1,600) due to challenges marketing and certifying human waste as a fertiliser (cultural acceptance of these products can be low). However, sales of compost as an extra source of revenue have a potential to alleviate the pressure on the FSM business model and could even become a key driver for financial sustainability. See Figure 14.

In Sakhipur, the municipality has revenue streams of an estimated USD 7,000 collected annually from the fees for faecal sludge and solid waste collection services by the Vacutug operators, and an additional USD 6,000 per year from sales of compost, purchased by farmers from the plant operators. An estimated USD 20,000 is spent annually on labour for faecal sludge and solid waste collectors, plant operators, fuel, part replacement, maintenance and other

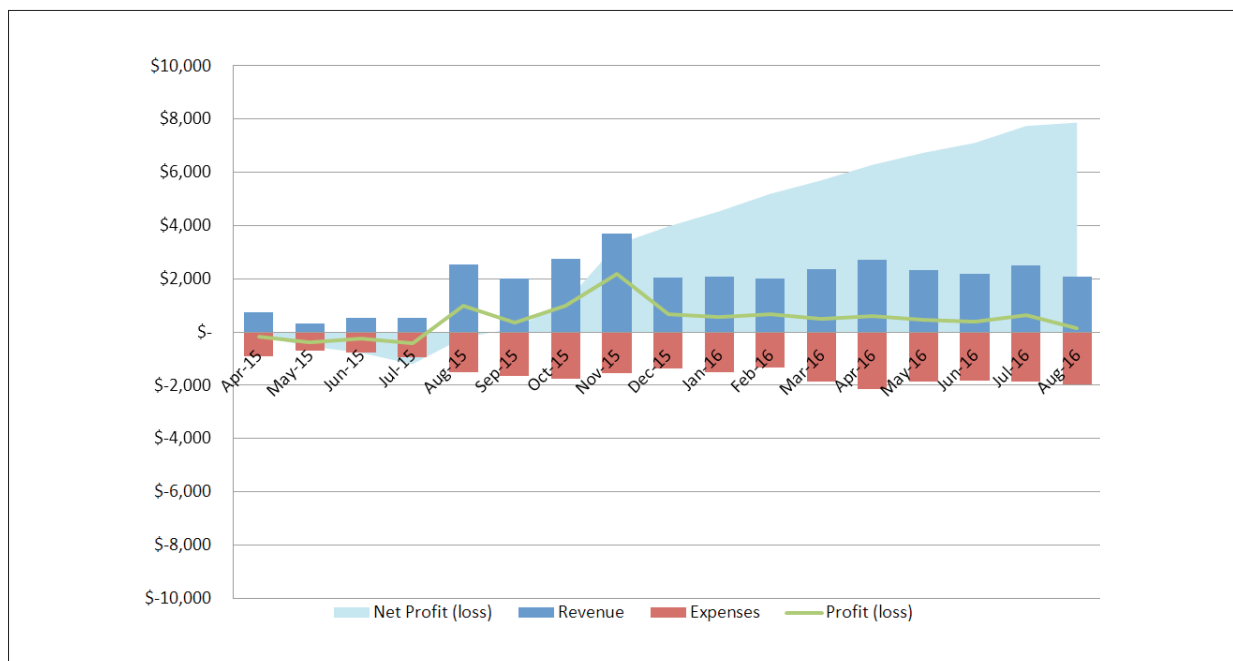


Figure 13: Overview of SWEEP's financial performance, April 2015–August 2016

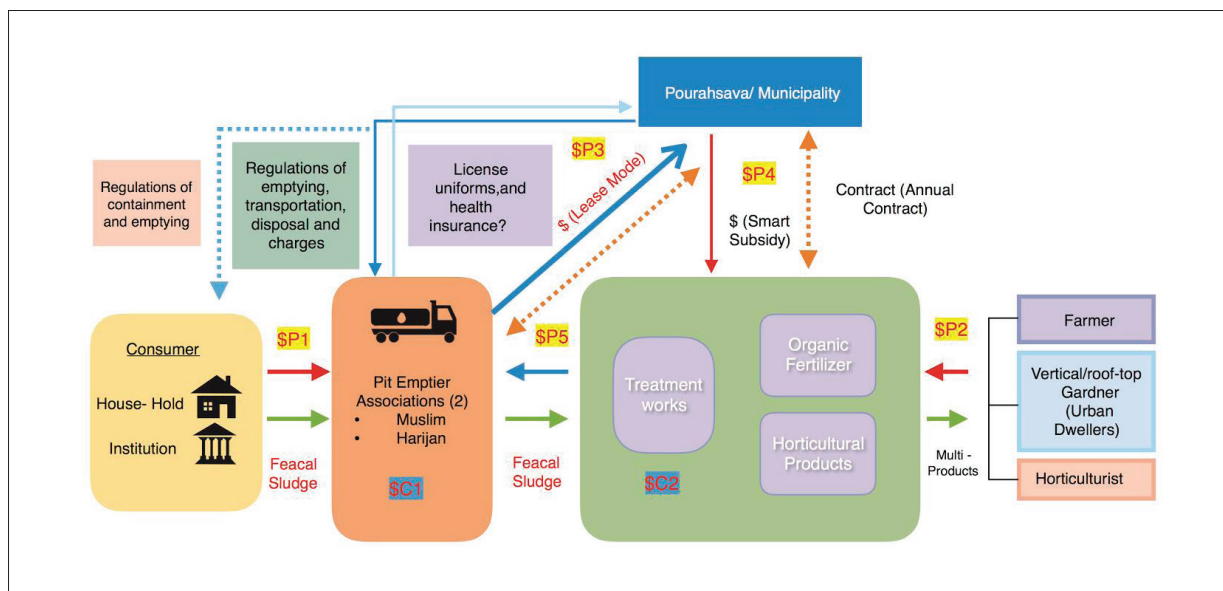


Figure 14: Institutional arrangement and performance based contracts Faridpur

expenses. WaterAid plans to gradually handover the FSM business model, which is yet to reach break-even, to the municipality. In this municipality-led approach, the authorities are the duty bearer, and are responsible for the operation, supervision, regulation, demand management and monitoring of the services. They play a major role in identifying the challenges in the implementation, and the opportunities for business expansion. For example, demand for collection and transport is high during the rainy season, and results in overflowing and flooding of on-site sanitation systems. This also has an impact on composting, as the volume of dry sludge reduces – invaluable information for future planning. The Municipality also has a role to ensure the quality of compost and finally establish interlinks between the components of sanitation service chain.

The uncertainty surrounding innovative FSM business models can be balanced by a smart cross-subsidy system. Revenue earned from emptying services (expected to be USD 4,100 in the first year in Faridpur) subsidises the low revenue expected from compost sales for the treatment plant operator (expected to be USD 1,600). The low revenue from compost sales for the TPO can be compensated by a subsidy from the municipality, covered by revenue from the leasing contract. This cross-subsidy will be in place once the FSM system is operational to help cover the plant's operating costs, estimated at USD 15,000 per year until 2018.

In the start-up phase, a set of smart subsidies and financial and non-financial incentives is often required to cover the shortfall in the budgets of the new businesses. For example, in Dhaka, the business operating under the 'SWEEP' brand reached an

agreement with DWASA on the equipment lease fee, which was invaluable in the start-up stages. Desludging service providers in Faridpur were given a six-month exemption on payments for leasing mechanical and transportation equipment from the municipality. Municipalities can then carefully reduce subsidies to private sector stakeholders over time (without subjecting FSM start-ups to undue financial pressure), thus incentivising businesses to maximize their revenue from sales to cover costs without having to rely so heavily on external financial support.

IN THE START-UP PHASE, A SET OF SMART SUBSIDIES AND FINANCIAL AND NON-FINANCIAL INCENTIVES IS OFTEN REQUIRED

A "safe transfer incentive" is a core part of the business model as it supports desludging service businesses to safely dispose of sludge whilst ensuring rapid profitability. The Faridpur treatment business is projected to become more profitable and have a net cash flow of more than USD 50,000 from its third year of operation. This model is transforming informal emptiers into formal businesses, improving their health and livelihoods, and serving as a pilot model for other municipalities facing the challenge of catalysing a competitive FSM business environment.

Targeting mid- to higher-income residences and commercial institutions can help businesses become profitable early in their start-up phase. In Dhaka, SWEEP's initial targeting of higher income customers

and customers with larger tanks, who are often willing to pay more for desludging services, meant that the SME could fully cover its operational costs and become profitable five months after its launch in April 2015. A price analysis undertaken by WSUP demonstrated that the size of the customer's septic tank indicates profitability, which helped determine pricing (Walcott, 2016a). This information will also be important for scaling up and establishing SWEEP branded vacuum tankers elsewhere.

These customers account for 60 percent of SWEEP's revenue despite being only 15 percent of its customer base. As of October 2016, SWEEP had made a total profit of nearly USD 8,890. The SWEEP experience suggests a combination of institutional and household customers can be highly beneficial to a FSM service in the start-up phase. An initial focus on higher-income customers allows the business to introduce differential pricing for customers with lower incomes; the tariff in Dhaka, for example, is typically USD 6.00–USD 7.50 per cubic metre for low-income customers and USD 10.00–USD 15.00 per cubic metre for middle/high-income and institutional customers (the pricing structure is not fixed, given the widespread practice of negotiation over price for services rendered). Despite this potential barrier, the vast majority of jobs performed by SWEEP technicians generate a profit, with jobs that made a loss mostly confined to the start-up period in 2015. While serving higher income customers and institutions can help a business reach profitability at an early stage, a mix of clients (including those with lower incomes) benefits the business as it ensures plenty of customers. In addition, SWEEP serves lower income customers because they are incentivised to do so by local authorities; a clause in the lease contract stipulates that SWEEP must serve a minimum percentage of customers from low-income areas.

A COMBINATION OF INSTITUTIONAL AND HOUSEHOLD CUSTOMERS CAN BE HIGHLY BENEFICIAL TO A FSM SERVICE IN THE START-UP PHASE

The three different financial and business models presented here show that a pilot period is indispensable for assessing the customer base, the end market for desludging services and establishing compost as a potential source of revenue. Identifying the incentives for SMEs to enter the FSM market is crucial for service delivery beyond piloting. Existing competition can encourage local businesses to

IDENTIFYING THE INCENTIVES FOR SMES TO ENTER THE FSM MARKET IS CRUCIAL FOR SERVICE DELIVERY BEYOND PILOTING

offer FSM services to the widest customer base and ensure successful uptake. International agencies that facilitate the creation of these partnerships and identify an existing market and key local skills (in business planning, for example) can make a significant difference in establishing sustainable businesses (beyond a more traditional focus on health and safety training, and provision of improved equipment).

CAPACITY DEVELOPMENT

The IRF targets specific institutions to provide research support and fill knowledge gaps, technical assistance, training, and quality assurance of process and products (e.g. compost). These institutions include ministries and relevant line agencies, the International Training Network Centre of Bangladesh University of Engineering and Technology (ITN-BUET), universities, national research organisations (e.g. icddr, b , international research/training organisations (e.g. IWMI), DPHE, LGED, development partners, international/local non-governmental organisations (I/NGOs), and the private sector. The Ministry of Local Government, Rural Development and Cooperatives will set up units for FSM in Paurashavas, while national research and training organisations collaborate with their international counterparts, I/NGOs and the private sector to provide capacity building, training and research, supported by national ministries. The LGD of the Ministry will coordinate, develop guidelines for capacity building, research and training initiatives on FSM, and facilitate sharing and dissemination of knowledge amongst Paurashavas.

In Faridpur, building business planning skills for local businesses was a priority, as well as business modelling tools and skills for facilitators of change in the FSM value chain. A participatory workshop attended by organisations including Faridpur Municipality and ITN-BUET used costing tools developed by UK universities to design a business model, which adapted incentives for private service providers and public stakeholders.

In Sakhipur, sharing information about co-composting, marketing, training, and occupational safety messages and best practice with plant operators and other sewerage and waste collection

process stakeholders is key to upscaling the plant and replicating the model elsewhere. WaterAid Bangladesh continues to organise faecal sludge and septage management training for government and NGO officials, engineers, urban planners, academics, and private entrepreneurs. The main objective is to share knowledge on international FSM initiatives so FSM is prioritised across different departments and national bodies. In Sakhipur as well as Faridpur, technical sludge treatment skills were required and the co-composting projects enhanced stakeholders' capacity during the start-up phase.

THE MUNICIPALITY ORGANISED MASS CAMPAIGNS...TO PROMOTE MECHANICAL SLUDGE EMPTYING AND COMPOST USE

In Dhaka, WSUP provided the SWEEP SME with technical and business management training to improve their ability to deliver services safely and profitably, and supported DWASA to develop a promotional and marketing strategy for the SWEEP brand. This marketing drive included an SMS, video, leaflet and poster campaign to raise awareness of the new service. Similarly in Sakhipur, the municipality organised mass campaigns including street shows, student outreach, and an agricultural fair to promote mechanical sludge emptying and compost use. In Faridpur, these interventions were driven by the PPP actors (the municipality and private operators) with support from Practical Action, who organised large campaigns and street drama to increase demand and willingness to pay for these new FSM services.

National partners such as ministries and their line agencies, the Bangladesh Urban Forum, civil society organisations, community-based organisations, researchers and universities are all well-placed to provide this kind of crucial strategic support. In the three case studies, capacity building on community mobilisation, awareness raising campaigns and marketing around FSM service and reuse of human

ONE KEY TRIGGER FOR SYSTEMATIC CHANGE IN FARIDPUR WAS THE MUNICIPALITY'S COMMITMENT TO DELIVERING CITY-WIDE FSM

waste was collaborative and iterative amongst national stakeholders, supported by WSUP, Practical Action and WaterAid Bangladesh.

DRIVERS OF CHANGE AND LESSONS LEARNED

Drivers of change

These experiences **highlight the importance of achieving public sector ownership**. One key trigger for systematic change in Faridpur was the municipality's commitment to delivering city-wide FSM, allocating a large plot of land for a treatment plant and introducing a 30-year City Master Plan. Sakhipur municipality also leased land for the co-composting plant after observing the severity of the FSM problem and identifying possible solutions. In Dhaka, DWASA chose to take part in the PPP as leasing their vehicles to private actors minimises risk, they receive monthly revenue from leasing fees, and the model's scalability meant they could enter the FSM market without internal restructuring. Buy-in is not just important for financial support, land and equipment: working alongside the public sector also lends credence to companies starting to work in FSM.



Figure 15: SWEEP vacuum tanker in operation in Dhaka

The **complexity of the political economy of urban sanitation** provides opportunities and challenges. Political unrest in 2015 delayed implementation of the Faridpur model and treatment plant construction, but the Municipality's political commitment and electoral interest in achieving city-wide FSM overcame this setback. In Dhaka, the Commercial Manager of DWASA was an early 'champion' of the SWEEP model. Stakeholders' willingness to take risks and consider alternative options drive new models, particularly if there is a shared vision of what needs to change. A willingness amongst donors to push for innovation is also valuable.

Successfully engaging the private sector is crucial. In both Dhaka and Faridpur, competitive bidding processes ensured companies that were willing

and able to enter the FSM market were selected. Presenting a business case to entrepreneurs may be necessary to overcome the perception that mechanical emptying businesses operating in low-income areas are not financially viable. Estimating the revenues of existing FSM service providers in Faridpur was difficult, due to the absence of formal structures or track records of income generation; this was overcome through the use of a series of costing tools developed by the University of Leeds. The resulting baseline information obtained allowed for the **creation of a strong business model**. Models should offer clear benefits to the private sector, lessening the risks of entering the FSM market by lowering start-up costs and ensuring that companies see a faster return on their investment.

Main lessons learned so far

Mechanical FSM services that serve the poor can be viable in urban Bangladesh

Providing that institutional support and appropriate differential pricing strategies are established, lower income consumers can be served without jeopardising a company's bottom line. Serving a minimum target of low-income areas can be built into service level agreements between public and private partners, as was the case in Faridpur and Dhaka. Identifying the price points for lower- and higher-income customers allows SMEs to develop an appropriate differentiated pricing strategy, something that WSUP is currently designing in Dhaka. Implementation of a simplified model based on SWEEP's experience in Dhaka so far found that retaining the existing tariff for lower-income customers and raising the tariff for higher-income customers (by 23 percent, a price that customers are still willing to pay) increases the percentage of customers from low-income areas from 16 to 30 percent, and achieves a comparable net profit margin for the SME (Walcott, 2016b).

Awareness raising and demand generation campaigns are strong drivers

The positive impact on demand in Faridpur led to the prioritisation and acceleration of activities that promoted the service, including street drama, cleanliness drives, quiz contests and cycling events. Similarly in Dhaka, WSUP worked with DWASA and the SME to design marketing activities to drive demand and hired 'brand ambassadors' to conduct door-to-door visits in target areas. The high quality of the compost produced by the plant in Sakhipur speaks for itself: positive feedback from farmers has driven demand for the product after it was used to grow a wide variety of plants and crops.

Detailed information about customers, demand, pricing and tariff structure

FSM business models rely on detailed information capture and analysis to provide learning about the market and inform future development, to ensure tariffs are well-structured and to ensure services are equitable and pro-poor. Simple tools to assess all costs and revenues in the whole FSM value chain are helpful to analyse data and support the design of sustainable business models.

PPPs offer a strong framework in which multi-stakeholders can operate

PPPs offer clear advantages for all parties. The private sector benefits from reduced risk from market entry through lower start-up costs, greater flexibility and a faster return on their investment; and the public sector is able to service customers in a scalable manner. Creating a steering committee that sits within the municipality in Faridpur has led to pro-active facilitation of the PPP and business model amongst the major participants – a factor that will be crucial for scaling up the model for citywide service provision. Following the success in Dhaka, SWEEP has now been replicated in Chittagong and has been operating since early 2017. Experiences from Dhaka have been applied; for example, the contract between the private business and the public body in Chittagong includes a fine if the SME does not meet a set target for low-income customers served. The flexibility of PPPs meant that new partnerships could be forged that better suited the Chittagong context; for example, the agreement is between the SME and Chittagong City Corporation rather than the utility.

OUTSTANDING CHALLENGES, NEXT STEPS AND PLANS FOR SCALING UP

Increasing low-income customers' access to FSM services is central to scaling up. To operate at scale, businesses need to operate on the line between reaching the easiest customer base (often the better-off and least marginalised) to maximise revenue, and offering an affordable service to the largest number of people. In Dhaka, WSUP are assessing how to encourage private sanitation entrepreneurs to increase low-income customers' access to their services. This could mean incentivising companies by providing business planning/marketing support to those that achieve pro-poor targets, or ensuring that future contracts include a clause that mandates operators to meet a target of low-income households. The current model works in Dhaka because only leased vehicles operate in the city. In the future, if FSM businesses supply their own vacuum tankers, a new

licensing and leasing model will have to be designed whereby the licence fee contributes towards disposal costs and stipulates a minimum percentage of low-income customers that must be served. Designing business models that include a cross-subsidy pricing structure should be considered a key driver in socially inclusive service provision and demand creation.

The capacity to generate sufficient and sustained demand is a condition for scaling up. A significant number of households in Bangladesh have toilets connected to surface drains or are happy to rely on manual scavenging, and are not necessarily aware of a more hygienic mechanical emptying service and the cost. Moving from the start-up to scale up with supporting investments from the public, non-profit or private sectors means that businesses can further optimise marketing and sales. These investments in advertising, awareness raising and marketing prove helpful in identifying and closing transactions more efficiently with an increased customer satisfaction, whilst ensuring safer, more hygienic disposal of waste. If demand creation steadily increases in Dhaka, and if DWASA continues to support the model and allow for disposal within the sewerage network, more vacuum tankers could be leased under the SWEEP brand.

Engaging the private sector in human waste treatment and compost marketing is new in Bangladesh and has been slow and challenging, but business development is growing. Clearly demonstrating the viability of FSM will generate more business interest. The costs and revenues of a business model have to be regularly updated to orientate the PPP towards more optimal pricing and subsidisation. These can be part of the revenue flows between the municipality and/or utility and the private businesses involved in FSM. Scaling up could require businesses to revisit their initial models and undertake up-to-date analyses of containment conditions. The marketing potential of safe, dried sludge co-composted with kitchen waste lies in simplifying its certification process and generating greater interest from farmers.

The Bangladesh context offers potential for establishing a strong connection between waste management and agriculture through the production of organic fertilisers, linking waste management in urban areas and the need for improved agricultural yields and food security in rural areas. Food security is particularly important in a country with one of the highest population densities in the world and where organic matter in soils is becoming depleted. The case studies show the viability of using treated bio-solids as soil enhancer on a small but growing scale. These

initiatives are valuable and the Agriculture Extension Service has become interested in the work conducted in Faridpur, and other national level organisations and stakeholders may be engaged to expand upon this work. Another question is: could the production of organic fertilisers and soils enhancers drive demand for FSM services, and could this be the missing link to attract private sector investment consistently and at scale?

Finding businesses who are interested in taking on FSM is a key factor for scaling up. In Dhaka, the SME Gulshan Clean and Care was already in operation as a cleaning company, and was a critical asset to build upon and set up SWEEP as a marketing brand. The SWEEP business is profitable and the entrepreneur is considering investing his own capital into the FSM business to ensure its long-term success well beyond the intervention. In Faridpur on the other hand, the lack of business competition in the sanitation and waste management sector initially represented a challenge for attracting businesses with and expertise and who are willing to take the risk engaging in the sector. Selecting locations where active businesses are already present makes development easier. Larger cities often provide a more vibrant environment and interest for entrepreneurship, but as the Faridpur case demonstrates, private sector interest is not limited to large cities.

Addressing the cultural barriers around reusing human waste as compost to improve soil fertility is critical for upscale. As this is a relatively new approach in Bangladesh, the challenge remains to change perceptions and the stigma around faeces, those who manage it, and its reuse. Human waste can be turned into new resources, which Bangladesh needs and towns like Sakhipur provide evidence that such a model can succeed. However, a full-life cycle cost analysis needs to be carried out to ensure sustainability at scale.

Finding an adaptable design for treatment plants is another challenge. Facing intense annual rainfalls, FSM stakeholders and funders should adopt strategies to mitigate risks to safe FSM presented by flooding. The rainy season has significant impact on treatment as the higher moisture content or floods create challenges in drying treatment. The Faridpur case demonstrates that treatment plants on raised land can mitigate this risk. An adaptable and modular design should be considered for expanding treatment facilities as the FSM business grows.

The recent approval of the National Institutional Regulatory Framework for FSM is a significant step towards improving the enabling environment for sanitation, which is key to the long-term success of emerging FSM businesses. Many local governments held back from full engagement in FSM until a clear direction was given by the national government. The IRF provides that guidance and raises new questions about what this really means to local governments. What are the next steps now that the IRF is finalised? Does this framework need to be completed with actual implementing rules and policies? The question of its strict enforcement is still outstanding as the sanitation sector remains under-regulated and existing regulations are often unenforced. Mandates are now recognised at the national and municipal level, and efforts to address them are underway with the development of national framework for FSM. However, it is likely that any resulting wide-scale changes will take a number of years to implement. Finally, the question remains of how innovative programmes such as these can be integrated into the IRF so that other local governments can learn from these models. Opportunities and next steps should be explored to see how the national government might

reach out to local governments, and how might this be conducted effectively, possibly through outreach from stakeholders like ITN-BUET.

The National FSM network is a valuable advocacy tool for FSM initiative start up and scale up. Recently created as a strategic sectorial group for innovation, knowledge and policy influencing, this network of 60 stakeholders from national and local level government agencies, development partners, academia, I/NGO, and private companies will be engaged in regional and international programs. Its first multi-stakeholder convention included the participation of sweepers in workshops on rights and dignity for septic tank emptiers, indicating a strong momentum emerging around not only the business potential of FSM, but also the rights of service users and providers to healthier lives. It brings a valuable support building the nexus between farming and urban sanitation, bolstered by evidence generated by case studies such as the Sakhipur co-composting project. Discussions to extend funding to support the sustainability of the partnerships and services are currently taking place.

REFERENCES

- Ahmed, I. (2014) 'Factors in building resilience in urban slums of Dhaka, Bangladesh', *Procedia Economics and Finance*, 18, pp. 745-753. Available at <http://www.sciencedirect.com/science/article/pii/S2212567114009988> [Accessed 1 May 2017].
- De La Brosse, N., Stevens, L., and Casey, J. (2016) *Technology Justice and Faecal Sludge Management: Tackling the 'second generation' sanitation challenge in South Asia*. Rugby, UK: Practical Action Publishing.
- De La Brosse, N., Stevens, L., Islam, R., (2017) 'Preliminary results of the FSM business model in Faridpur, Bangladesh: Tackling the post-ODF challenge through public-private partnerships' [Presentation], FSM4 Conference, Chennai, India. 19-23 February.
- Jahan, H., Mueeed, A. (2015), 'Faecal Sludge Management in Bangladesh', *The Daily Observer*, 11 June. Available at <http://www.observerbdt.com/2015/06/11/93460.php> [Accessed 1 May 2017].
- Kanti Nath, S., Al-Mueeed, A., Ranjan Sanyal, P., (2017) 'Co-Composting of Faecal Sludge and Municipal Organic Waste in Sakhipur Municipality, Bangladesh' [Presentation], FSM4 Conference, Chennai, India. 19-23 February
- L. Stevens., et al. (2015) 'Faecal sludge management in Faridpur, Bangladesh: scaling up through service level agreements' [Presentation], 38th WEDC International Conference, Loughborough University, UK. 27-31 July.
- Mueeed, A. A., Ali, A, Mahmud, W (2016) *Faecal Sludge Management Perspective of Bangladesh*
- Policy Support Unit, Local Government Division, Ministry of Local Government, Rural Development & Cooperatives (2014) *National Strategy for Water Supply and Sanitation*, August 2014, Dhaka, Bangladesh: Ministry of Local Government, Rural Development & Cooperatives.
- Opel, A., Bashar, M. K., Ahmed, M. F. (2012). 'Faecal sludge management in Bangladesh: an issue that needs urgent attention' [Presentation] Asia Regional Sanitation and Hygiene Practitioners Workshop, Dhaka, Bangladesh. 31 January–2 February.
- Policy Support Unit, Local Government Division (2014) National Strategy for Water Supply and Sanitation. Ministry of Local Government, Rural Development & Cooperatives. Bangladesh, <http://www.psu-wss.org/assets/book/nswss2014.pdf>
- Renouf, R., Rahman, H., Hasan, A., Rahman, N., Mikhael, G., Drabble, S., (2017) 'From Pilot Project to Emerging FSM Service: Scaling up an Innovative PPP Model for Citywide FSM Services in Dhaka, Bangladesh' [Presentation], FSM4 Conference, Chennai, India. 19-23 February.
- Riaz, A. and Rahman, M.S., (eds.) (2016) Routledge Handbook of Contemporary Bangladesh. Routledge.
- Furlong, C (2016) SFD Report – Dhaka, Bangladesh – SFD Promotion Initiative. Water, Engineering and Development Centre (WEDC), <http://www.susana.org/en/resources/library/details/2609>

Bangladesh National Assembly (2010) 'Ordinance issued for the amendment of local government (municipality) ordinance, 2009'. Dhaka, Bangladesh. Bangladesh National Assembly.

United Nations, Department of Economic and Social Affairs, Population Division (2014). 'World Urbanisation Prospects: The 2014 Revision'. Available at <https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Highlights.pdf> (Accessed 1 May 2017).

Walcott, J. (2016a) 'SWEEP Pricing and Financial Analysis'. [Internal Report] WSUP, London.

Walcott, J. (2016b) 'Low-Income Community Ratios and Analysis', [Internal Report] WSUP, London.

WHO/UNICEF. (2015) 'Progress on Sanitation and Drinking Water, 2015 update and MDG assessment' [Report], WHO, Geneva.

Water and Sanitation Program (2015) 'A review of Fecal Sludge Management in 12 cities', [Annex A.7] Dhaka, Bangladesh. World Bank.

Water and Sanitation Program (2016) 'Private sector provision of water and sanitation services in rural areas and small towns: the role of the public sector'. World Bank.

ABBREVIATIONS AND ACRONYMS

BASA	Bangladesh Association for Social Advancement
BMGF	Bill & Melinda Gates Foundation
CLTS	Community Led Total Sanitation
DPHE	Department for Public Health Engineering
(D)WASA	(Dhaka) Water Supply and Sewerage Authority
FSM	Faecal sludge management
GDP	Gross domestic product
ICDDR, B	International Centre for Diarrhoeal Disease Research, Bangladesh
IRF	Institutional Regulatory Framework
ITN-BUET	International Training Network Centre – Bangladesh University of Engineering and Technology
I/NGOs	International/local non-governmental organisations
IWMI	International Water Management Institute
LGD	Local Government Division
LGED	Local Government Engineering Department
MDG	Millennium Development Goal
NFWSS	National Forum for Water Supply and Sanitation
ODF	Open defecation free
OSS	On-site sanitation
PPP	Public private partnership
PSU	Policy Support Unit
RAJUK	Capital Development Authority of the Government of Bangladesh
SDC	Society Development Committee
SME	Small and medium enterprise
TPO	Treatment plant operator
WSUP	Water & Sanitation for the Urban Poor

ACKNOWLEDGEMENTS

The authors would particularly like to extend thanks to their colleagues, partners and funders supporting the FSM work in Bangladesh outlined in this paper, and to David Robbins for his inputs:

WSUP: UK Aid (Department for International Development), UNICEF and the Bill & Melinda Gates Foundation.

Practical Action: Rafiul Islam, Uttam Kumar Saha, and Md. Nazmul Huda, A. Peal and Prof. B. Evans and the Municipality of Faridpur, the Faridpur desludging service cooperatives, our partners ITN-BUET and the Bill and Melinda Gates Foundation, and UK Aid for their funding support.

WaterAid: Dr. Abdullah Al-Muyeed, Sakhipur Municipality, ITN_BUET, and Dr. Feroze Ahmed, Dept. of Agriculture Extension, Soil Research Development Institute

AUTHORS

WSUP: Rosie Renouf (Research Officer (rrenouf@wsup.com), Habibur Rahman (Bangladesh Sanitation Lead, (hrahman@wsup.com), Amirul Hasan (Bangladesh Business Development Specialist, (ahasan@wsup.com), Nirjhor Rahman (Bangladesh Business Development Lead, (nrahman@wsup.com), Georges Mikhael (Head of Sanitation, (gmikhael@wsup.com), and Sam Drabble (Research & Evaluation Manager, (sdrabble@wsup.com))

Practical Action: Noémie de La Brosse (Inclusive Markets Consultant, (noemie.delabrosse@gmail.com), Lucy Stevens (Energy and Urban Services Senior Policy and Practice Advisor, (lucy.stevens@practicalaction.org.uk), Rafiul Islam (Programme Officer, (Rafiul.Islam@practicalaction.org.bd), Uttam Kumar Saha (Head of Energy and Urban Services Programme, (Uttam.Saha@practicalaction.org.bd), and Md. Nazmul Huda (Institutional and Market Development Officer, (Nazmul.Huda@practicalaction.org.bd)) who form the core business modelling team in Practical Action Bangladesh.

WaterAid: Suman Kanti Nath (Programme Officer Engineer, (SumanKantiNath@wateraid.org), Abdullah Al-Muyeed (Technical Adviser WASH, (Abdullahal-Muyeed@wateraid.org), Palash Ranjan Sanyal (Young Professional, (Palashsanyal@wateraid.org))

Published by the Bill & Melinda Gates Foundation

This publication was funded in part by the Bill & Melinda Gates Foundation. The narrative, findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the Bill & Melinda Gates Foundation.

Digital versions of this publication and the complete volume of case studies (ISBN 978-1-5136-2513-3) are available at www.susana.org.

August 2017