# TRAINING MANUAL

## SERVICE AND BUSINESS MODELS FOR SUSTAINABLE FSM IN MUNICIPALITIES

ITN-BUET

BILL & MELINDA GATES foundation

CWIS-FSM Support Cell

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# Foreword

I am delighted that the "Training Manual on Service and Business Models for Sustainable FSM in Municipalities" has been developed with great anticipation. This comprehensive guide is the result of a collaborative initiative between the CWIS-FSM Support Cell of the Department of Public Health Engineering (DPHE) and the International Training Network of Bangladesh University of Engineering and Technology (ITN-BUET). The document can be a vital resource for municipal personnel and private operators involved in Fecal Sludge Management (FSM) services throughout Bangladesh, this manual addresses the crucial requirement for sustainable and inclusive service operations in the field.

Covering business propositions, existing service delivery frameworks, financial considerations, revenue-generating strategies, and international service models, this module is tailored to enhance the efficiency of FSM in municipalities. It aims to contribute to Integrated Waste Management initiatives across Bangladesh. The collaboration between the CWIS-FSM Support Cell of the DPHE and ITN-BUET has brought together a wealth of expertise and perspectives in inclusive Fecal Waste Management, presenting a holistic and multidisciplinary approach to the opportunities and propositions associated with promoting Fecal Sludge Management and business inclusion within broader WASH services.

Within the manual, municipal personnel will not only find practical guidance but also understand actionable frameworks, steps, and case studies to assist them in their on-the-groundwork. It is my hope that this manual will empower the respective personnel to instigate positive change within their municipalities, fostering sustainable waste management that aligns with the diverse needs of our communities. We are confident that this training manual will significantly contribute to the ongoing initiatives aimed at improving the quality and sustainability of FSM services in municipalities.

I extend my sincere gratitude to the dedicated teams at the CWIS-FSM Support Cell, DPHE, and ITN-BUET for their collaborative efforts in developing this invaluable resource. Your commitment to advancing the practice and propositions related to fecal waste, solid waste and sustainable revenue generation in the FSM service delivery mechanism is commendable. I am confident that this manual will act as a catalyst for transformative action on the financial aspects of FSM under the CWIS (City Wide Inclusive Sanitation) concept in the WASH sector.

**Md. Sarwar Hossain**
**Chief Engineer**
Department of Public Health Engineering (DPHE)
Government of the People's Republic of Bangladesh

# Preface

Fecal Sludge Management (FSM) plays a significant role in preserving public health, safeguarding environment and promoting sustainable sanitation practices. In Bangladesh, the local Government Institutions (LGIs) are mandated to ensure the provision of safe sanitation services, with the technical support from Department of Public Health Engineering (DPHE). Acknowledging the need for a structured approach, the Government of Bangladesh has introduced the "Institutional Regulatory Framework for Fecal Sludge Management (IRF-FSM)" which meticulously delineates the roles and responsibilities associated with FSM within the urban landscape. However, sustainable fecal sludge management still remain as a complex terrain due to limited knowledge of municipal authorities to adopt FSM as “Business as usual” and not practicing appropriate financial models. These challenges pose significant hurdles for municipal authorities to devise and implement sustainable service and business approach for FSM within their areas of governance.

To contribute in this domain and augment the capacity of the municipal authority in planning and adopting viable financial framework for FSM service delivery, ITN-BUET, in collaboration with the CWIS-FSM Support Cell of DPHE, has developed the Training Manual on “Service and Business Models for Sustainable FSM in Municipalities”. This manual serves as a comprehensive guide for the decision-makers and field level implementers to design an efficient and sustainable financial model for FSM service delivery. Encompassing a range of topics, spanning from comprehending different service approaches with financial aspects to the exploration of innovative business modalities, the manual is crafted not only to address immediate challenges but also to foster long-term sustainability.

I express my gratitude to the contributors who have used their expertise and experiences to draft the module, particularly Mr. Md. Saiful Islam (Consultant, ITN-BUET) and Mr. Monzur Morshed (Business Expert, CWIS-FSM Support Cell). The grant from the Bill and Melinda Gates Foundation to ITN-BUET is also deeply acknowledged.

As we embark on this journey towards improved fecal sludge management, I am optimistic that this manual will spark innovation and aid municipal officials in making informed decisions to identify gaps and opportunities in various FSM businesses, ultimately leading to the adoption of a sustainable service model.

**Professor Dr. Tanvir Ahmed**
**Director**
International Training Network of
Bangladesh University of Engineering and Technology (ITN-BUET)

# Acknowledgement

I extend my heartfelt gratitude to the ITN-BUET and CWIS-FSM Support Cell for their invaluable contributions to the development of the **'Service and Business Models for Sustainable FSM in Municipalities'** training manual. This manual will serve as a vital resource for municipalities, practitioners, and policymakers dedicated to enhancing Faecal Sludge Management (FSM) services in urban areas, thereby significantly advancing the establishment of resilient and sustainable sanitation including FSM and waste management systems across Bangladesh.

Special thanks are due to WaterAid Bangladesh, Practical Action Bangladesh, and SNV for their support in the development of the training manual, which integrates the field-level experiences of these organizations. I am extending my gratitude to all other I/NGOs, Private Sectors and Development Partners who were rigorously discussed, received feedback while developing this manual. Special acknowledgement to Bill & Melinda Gates Foundation for supporting citywide inclusive sanitation (CWIS) scaling up in Bangladesh where this training manual will be meaningfully used by different partners who work in sanitation.

I also express my appreciation to my colleagues at the Department of Public Health Engineering, including the esteemed Project Directors, whose knowledge and experiences have enriched the manual and ensured its relevance to the urban context in Bangladesh, despite remaining unnamed.

Furthermore, I extend my thanks to Mr. Saiful Islam, Consultant from ITN-BUET, and Mr. Monzur Morshed from CWIS-FSM Support Cell, Department of Public Health Engineering, for their significant contributions.

I am confident that this training module will be effectively utilized in various Integrated Sanitation and Waste Management projects, fostering progress and sustainability in this critical area.

**Abdullah Al-Muyeed, PhD**
**Chief Operating Officer**
CWIS-FSM Support Cell
Department of Public Health Engineering

# Abbreviations

| | |
|---|---|
| BLT | Base Level Tariff |
| CAPEX | Capital Expenditure |
| CCC | Chattogram City Corporation |
| CDC | Community Development Committee |
| C&T | Collection and Transportation |
| CWIS | City-wide Inclusive Sanitation |
| DAE | Department of Agriculture Extension |
| DoE | Department of Environment |
| DPHE | Department of Public Health Engineering |
| E&T | Emptying and Transportation |
| FGD | Focus Group Discussion |
| FSM | Fecal Sludge Management |
| FSTP | Fecal Sludge Treatment Plant |
| FTE | Full Time Equivalent |
| FV | Future Value |
| GIS | Geographic Information System |
| GoB | Government of Bangladesh |
| GPS | Global Positioning System |
| GWMC | Greater Warangal Municipal Corporation |
| HH | Household |
| IEDCR | Institute of Epidemiology, Disease and Research |
| IMIS | Integrated Municipal Information System |
| IRF | Institutional Regulatory Framework |
| IRR | Internal Rate of Return |
| ITN- BUET | International Training Network - Bangladesh University of Engineering and Technology |
| IWMI | International Water Management Institute |
| IWM | Integrated Waste Management |
| KCC | Khulna City Corporation |
| KMC | Kochi Municipal Corporation |
| KTP | Karunguzhi Town Panchayat |
| LIC | Low-Income Communities |
| LGD | Local Government Division |
| LGED | Local Government Engineering Department |
| MCL | Municipal Committee Leh |
| MoU | Memorandum of Understanding |
| NAP | National Action Plan |
| NGO | Non-Governmental Organization |
| NPV | Net Present Value |
| O & M | Operation and Maintenance |
| OPEX | Operational Expenditure |
| OSS | Onsite Sanitation System |
| OWSSB | Odisha Water Supply and Sewerage Board |
| PHED | Public Health Engineering Department |
| PE | Private Enterprise |
| PPE | Personal Protection Equipment |
| PPP | Public-Private Partnership |
| PV | Present Value |
| RUIDP | Rajasthan Urban Infrastructure Development Project |
| SeTP | Septage Treatment Plant |
| SDC | Society Development Committee |
| SDG | Sustainable Development Goal |
| SWM | Solid Waste Management |
| UNGA | United Nations General Assembly |
| VT | Vacuum Truck |
| WMC | Wai Municipal Council |

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# ABOUT THE TRAINING

## Training Objectives

To support municipality officials to increase their knowledge about Sustainable FSM Service and Business Models.

## Training Module

The training Modules includes the following modules-

- Module 1: Introduction and Overview.
- Module 2: National and International FSM Service & Business Models.
- Module 3: User's Experience Sharing about Existing FSM Service Models & Tariff structures.
- Module 4: FSM Business Analysis.

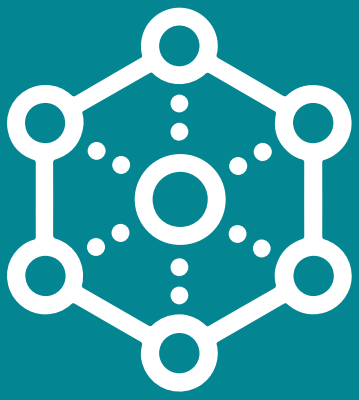
## Training Materials

Each Participant will be provided with a workbook to note down their reflections on the slide contents. The participants have to apply their knowledge gained from each session to perform the group activities.

| Module No. | Session No. | For Participants |
|---|---|---|
| 1 | 1.1 | Workbook |
| | 1.2 | Workbook |
| 2 | 2.1 | Workbook |
| | 2.2 | Workbook |
| | 2.3 | Workbook |
| Group Work-1 | | Workbook, different color markers, A3 Size Hard Paper, marking tape, Printed question list provided by trainer, Printed A4 size paper with dotted service models provided by trainer |
| 3 | 3.1 | Workbook |
| | Survey Task -1 | Laptop/Mobile Phone with internet |
| | 3.2 | Workbook |
| | Survey Task-2 | Laptop/Mobile Phone with internet |
| 4 | 4.1 | Workbook |
| | 4.2 | Workbook |
| Group Work-2 | | Workbook, individual/single laptop for a group, A3/A4 paper for rough calculation |

# Training Schedule

| Day | Topic | Session Contents |
|---|---|---|
| 01 | Opening Session | Registration, Tea and Snacks, and Network Building |
| | | Welcome Note |
| | | Self-Introduction |
| | | Overview of Training Goals, Objectives, and Expected Results |
| | | Remarks by Guest |
| | Morning Session (Module 1) | Session 1.1 - Introduction to SDGs, CWIS, and FSM |
| | | Session 1.2 - Institutional and Regulatory Framework (IRF) and National Action Plan (NAP) |
| | 1st Afternoon Session (Module 2) | Session 2.1 - National and International FSM Service & Business Models |
| | | Session 2.2 - Fecal Sludge Business Models |
| | | Session 2.3 - FSM Service and Business Models in India |
| | 2nd Afternoon Session Group Work | Group work 1 - Group work on Existing or Probable Service Model of Participants Municipality. |
| 02 | Review Session | Review of Day-1 Session Contents |
| | 1st Morning Session (Module 3) | Session 3.1 - User's Experience Sharing about Existing FSM Service Models |
| | | Survey Task 1 - Individual Work |
| | | Session 3.2- Integrated Municipal Information System (IMIS) |
| | | Survey Task 2 - Individual Work |
| | 2nd Morning Session (Module 4) | Session 4.1 - FSM Business Analysis of Integrated Waste Management |
| | | Session 4.2 – Day-to-day Financial Analysis of FSM Business |
| | Afternoon Session (Group Work) | Group Work 2 - Financial Calculation of FSM Business Model |
| | | Presentation on Group Work 2 |
| | Closing Session | Closing Remarks and Certificate Distribution |



# 01

## INTRODUCTION AND OVERVIEW

# 1. Introduction and Overview

## Objectives

The objective of the session is to make the participants familiar with Sustainable Development Goal (SDG), Citywide Inclusive Sanitation (CWIS), Fecal Sludge Management (FSM), Institutional and Regulatory Framework for Fecal Sludge Management (IRF-FSM) and National Action Plan (NAP) for IRF-FSM.

## Learning Outcome

**At the end of this session participants will be able to:**

- Learn about the 17 Sustainable Development Goals, and targets of SDG-6.
- Discuss about the system functions and service outcomes of Citywide Inclusive Sanitation (CWIS).
- Know the component of Fecal Sludge Management (FSM).
- Know about the Institutional and Regulatory Framework for Fecal Sludge Management (IRF-FSM) and National Action Plan (NAP).

## Session Timing

**75 minutes**

## Key Contents

### 1.1. The Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) or Global Goals are a collection of seventeen interlinked objectives designed to serve as a shared blueprint for peace and prosperity for people and the planet, now and into the future. In 2015, the United Nations General Assembly (UNGA) created the SDGs as part of the Post-2015 Development Agenda. This agenda sought to design a new global development framework, replacing the Millennium Development Goals, which were completed that same year. These goals were formally articulated and adopted in a UNGA resolution known as the 2030 Agenda, often informally referred to as Agenda 2030.

**Box 01:** *17 SDGs*


### 1.1.1. Sustainable Development Goal 6 - Clean Water and Sanitation

Sustainable Development Goal 6 (SDG 6 or Global Goal 6) is about "clean water and sanitation for all". It is one of the 17 Sustainable Development Goals established by the United Nations General Assembly in 2015. According to the United Nations, the goal is to: "Ensure availability and sustainable management of water and sanitation for all." The goal has 6 outcome targets and 2 means of implementing targets to be achieved by 2030.

**The six outcome targets:**

**Target 6.1: Safe and affordable drinking water**
By 2030, achieve universal and equitable access to safe and affordable drinking water for all.

**Target 6.2: End open defecation and provide access to sanitation and hygiene**
By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.

**Target 6.3: Improve water quality, wastewater treatment, and safe reuse**
By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

**Target 6.4: Increase water-use efficiency and ensure freshwater supplies**

By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

**Target 6.5: Implement Integrated Water Resource Management (IWRM)**

By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.

**Target 6.6: Protect and restore water-related ecosystems**

By 2030, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

**Two means of implementing these targets:**

**Target 6.A:** Expand water and sanitation support to developing countries By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.

**Target 6.B:** Support local engagement in water and sanitation management support and strengthen the participation of local communities in improving water and sanitation management.

## 1.2. Citywide Inclusive Sanitation (CWIS)

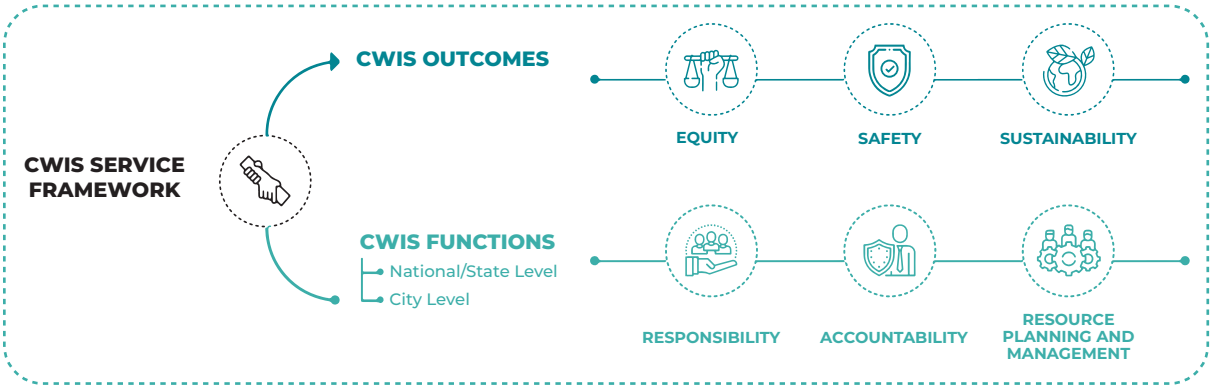
Citywide Inclusive Sanitation (CWIS) is a public service approach to advance Equitable, Safe, and Sustainable outcomes, by strengthening the design and implementation of core public system functions of Responsibility, Accountability, and Resource Planning and Management for sanitation services.

**Seven principles of CWIS:**

- Everyone benefits from safe services and public investment equitably, with a focus on reaching the poorest.
- Gender and social equity are designed into planning, management, and monitoring.
- Human waste is safely managed along the sanitation chain, starting with containment.
- Authorities operate with a clear, inclusive mandate, performance targets, resources, and accountability.
- Authorities deploy range of hardware, funding and business models to meet goals.
- Comprehensive long-term planning fosters innovation, pro-poor financing; informed by analysis of needs, and resources.
- Political will and accountability incentivize improvements in capacity, leadership, outcomes.

### 1.2.1. Service Framework, System Functions and Service Outcomes of CWIS

**Box 02:** *CWIS Service Framework* (Source: https://cwiscities.com/#cwis)




#### System functions of CWIS

There are 3 core system functions of CWIS. These are stated below:

**Responsibility**

National Level Service Authorities have a clear public mandate to ensure safe, equitable, and sustainable sanitation for all. City Level Service Authorities are delivering safe, equitable, and sustainable sanitation services as per their mandate.

**Accountability**

National Level Service Authorities performance against their mandate is monitored and managed with data, transparency and incentives. City Level Service Authorities regularly collect and report data for performance monitoring.

**Resource planning and management**

Resources- human, financial, natural, assets- are effectively managed at the national level to support execution of mandate across time/space. Resources are effectively managed at the city level to deliver safe, equitable and sustainable sanitation for all.

#### Service outcomes of CWIS

There are 3 core outcomes of CWIS. These are stated below:

**Equity**

Services reflect fairness in distribution and prioritization of service quality, prices and deployment of public finance/subsidies.

**Safety**

Services safeguard customers, workers and communities from safety and health risks by reaching everyone with safe sanitation.

**Sustainability**

Services are reliably and continually delivered based on effective management of human, financial and natural resources.

### 1.2.2. Features of Past, Present, and the New CWIS Approach

**Features of past traditional approach**

- Master planning/investment only for centralized systems
- Financed by central govt./loans
- Wealthy/affluent districts prioritized
- Limited coverage
- Sustainability challenges for O&M
- Resource recovery not considered
- No performance management
- On-site, small network not considered

**Features of present approach**

- Often standalone pilots, not mainstream
- NGO / pilot financed
- Poor communities targeted but often missed
- Informal businesses, NGOs independent from service authorities
- Business models often unable to scale
- Limited professional capacity

**CWIS approach**

CWIS focuses on promoting public service delivery approaches to ensure everyone in an urban area is served by safe, equitable, and financially viable sanitation service systems. This means systems are designed to reach the poor and to ensure human waste is safely managed along the whole sanitation service chain.

## 1.3. Introduction of Fecal Sludge Management (FSM)

Fecal sludge management (FSM) is the collection, transportation, treatment, and safe disposal of fecal sludge from pit latrines, septic tanks or other onsite sanitation systems. Fecal sludge is a mixture of human excreta, water and solid wastes (e.g., toilet paper or other anal cleansing materials, menstrual hygiene materials) that are disposed of in pits, tanks or vaults of onsite sanitation systems. Fecal sludge that is removed from septic tanks is called septage.

FSM is necessary in densely populated areas where a proportion of the population is not connected to a sewerage network, and the covering and rebuilding of pit latrines is not possible. This is the case in most urban areas in developing countries, but such services are also used in developed countries where sewerage systems are unavailable.

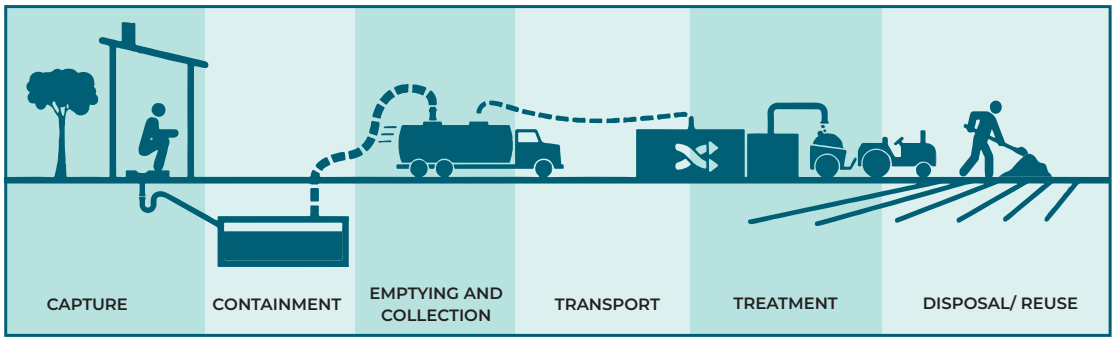
FSM services are usually provided by formal and informal private sector services providers, local governments, water authorities and utilities. However, in many developing countries FSM services are often unavailable, or even if they are available are often informal, unregulated, unhygienic and unsafe. This can lead to surface water and groundwater pollution, the spreading of pathogens into the environment and adverse public health impacts. It can also result in unreliable services with relatively high costs to the households which need them.

A sanitation system deals with human excreta from the time it is generated until it is reused or disposed of safely. Fecal sludge management includes emptying, transportation, treatment, and reuse or disposal of fecal sludge from an on-site sanitation technology (like a pit latrine or septic tank).

## 1.4. FSM Service Chain

### Core Components of FSM Service Chain are as follows:

**Box 03:** *Sanitation Service Chain*




**Containment**

Containment refers to the systems such as septic tanks, pits or other on-site sanitation structures where the excreta discharged from a user interface is temporarily stored. The primary purpose of a proper containment system is to safeguard both users and the surrounding environment from potential contamination. Additionally, it significantly reduces the risk of disease transmission. Serving as a critical function in preserving hygiene and public health, containment is the first step of the effective management of fecal sludge.

**Emptying and transport**

On-site sanitation technologies will fill up sooner or later. There are two types of methods to collect fecal sludge from on-site sanitation technologies and transport it for treatment or safe disposal:

- Manual emptying (using a bucket or hand pump)
- Mechanized emptying (using a motorized pump or vacuum truck)

Once emptied, the fecal sludge must be safely transported to a treatment plant or disposal location. Again, there are various manual and mechanized vehicles ranging from pushcarts to pickup trucks to vacuum trucks. Emptying and transporting fecal sludge is an essential service that is often neglected in sanitation projects. Ideally, on-site sanitation technologies should be emptied in a safe and hygienic manner by well-equipped and protected workers who transport the sludge to a treatment, reuse or disposal site. However, in reality, many on-site technologies are either abandoned or emptied using unsafe and unhygienic methods. Fecal sludge is simply dumped by the owner, in the street, or in nearby water bodies.

**Treatment**

The type and level of treatment depends on the final goal for the fecal sludge (how it is to be used or disposed of). There are four different treatment objectives for fecal sludge: (1) pathogen inactivation, (2) stabilization, (3) dewatering, and (4) nutrient management. Each treatment objective has associated environmental, health, and logistics impacts.

- Established: There is experience in designing and operating the technologies for fecal sludge. For example, drying beds, settling-thickening, and co-composting.
- Transferring: Technologies are being adapted from wastewater treatment or another sector. For example, mechanical dewatering, anaerobic digestion, incineration, and thermal drying.
- Innovative: Technologies are being researched, developed and piloted. For example, alkaline and ammonia treatment, vermicomposting, and black soldier flies for animal protein.

**Reuse or disposal**

The following are some options for using or disposing of fecal sludge in ways that are the least harmful to people and the environment:

- Use treated fecal sludge as a soil amendment in: forestry, sod and turf growing, flower growing, landscaping, parks, golf courses, mine reclamation, landfill cover, or erosion control.
- Use fecal sludge as a source of protein for animal feed (for example, black soldier fly larvae).
- Use fecal sludge as a source of energy (for example, biogas and solid fuel).
- Dispose of fecal sludge by burying in a pit or trench.

## 1.5. Institutional and Regulatory Framework for Fecal Sludge Management (IRF-FSM) – Paurashava

Bangladesh Government published Institutional and Regulatory Framework (IRF) for Fecal Sludge Management for Paurashava in 2017.

**Objectives and scope of FSM framework**

The primary objective of this FSM framework is to facilitate implementation of FSM services in Paurashavas.

It identifies of ways and means of implementing FSM services in Paurashavas; and defines specific roles and responsibilities of various institutions and stakeholders, particularly the Paurashavas, for effective implementation of FSM.

The institutional roles and responsibilities specified in this framework are based primarily on the provisions of the Local Government (Paurashava) Act 2009 (amended in 2010), which guides and regulates the roles and responsibilities of all Paurashavas.

### 1.5.1. Distribution of Institutional Roles and Responsibilities

**Overall responsibility of FSM**

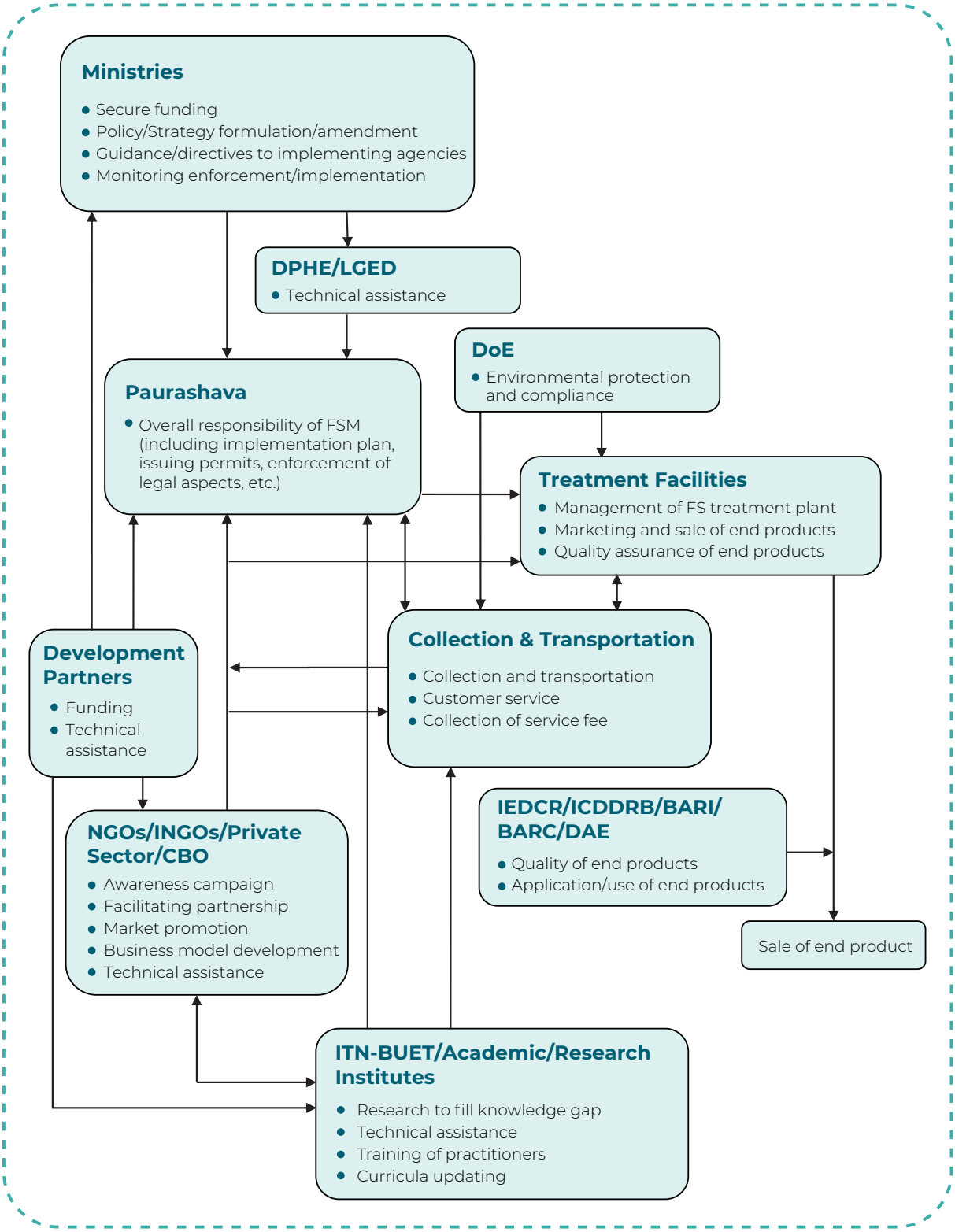
1. In accordance to the provisions of the Paurashava Act 2009, the "Paurashava" shall be responsible for fecal sludge management (FSM) in areas within its jurisdiction, including planning for and implementation of FSM services (including financial/business model for service delivery).

2. The Paurashava shall take steps to include within its "master plan" the provisions of the infrastructure (i.e., treatment facility) for implementation of FSM services.

3. The Paurashava shall from a Standing Committee on "health, water and sanitation" (if it has not been formed already). This Standing Committee shall oversee the activities related to planning and implementation of FSM services.

4. The Paurashava shall initiate inclusive FSM planning and implementation modality among the government agencies, I/NGOs, community groups and the private sector.

**Box 04:** *Institutional Setup for Fecal Sludge Management (FSM) in Paurashavas*
*(Source: IRF-FSM, 2017)*



### 1.5.2. Proper Design and Construction of Sanitation Facilities and Disposal of Fecal Sludge

**New construction and existing/completed buildings**

While approving design of buildings, the Paurashava shall check the design of the sanitation facilities (e.g., septic tank, pit latrine), as well as its location/layout. For pit latrines, where conditions permit, the Paurashava shall promote use of twin off-set pit pour-flush toilets (or other technologies) that provide a long-term solution to the fecal sludge management problem.

While inspecting a building during or after completion of its construction/reconstruction the Paurashava shall check that the sanitation facilities have been sited and constructed according to the approved design. In case of non-compliance, the Paurashava shall instruct the owner to re-construct the sanitation facilities following the approved design.

**Disposal of fecal sludge**

The Paurashava shall carry out inspection and make sure that domestic sewage/ wastewater, and discharge from house-drain are not connected to storm sewer/drain or irrigation canal, and that "refuse" (which included fecal sludge) is not thrown/disposed or stored on street or open place; these activities are treated as punishable offence according to the provisions of Schedule 4 (Clauses 10, 11, 12, 13) of Paurashava Act 2009. The Paurashava shall execute punishment for such offences according to Clauses 108, 109, 110 and 111 of the Paurashava Act 2009.

**Fecal sludge collection and transport**

1. The Paurashava shall be responsible for proper execution of the entire FSM service chain.
2. The Paurashava shall make sure that the collected fecal sludge is transported to the designated site(s) for treatment and disposal, and that the collected fecal sludge is never disposed in open space or water bodies or storm drains or sewers.
3. The Paurashava shall execute punishment for unauthorized disposal of collected fecal sludge (e.g., in open space, water bodies, storm sewers/drains) according to Clauses 108, 109, 110 and 111 of the Paurashava Act 2009.
4. The Paurashava shall introduce and promote mechanical pit emptying (desludging) services for ensuring health and safety of emptiers and protection of the public health and environment. The Paurashava shall make sure that the manual emptier (traditional pit emptier/cleaner) communities are integrated into the modern FSM services through proper training and support, without adversely affecting their income.
5. The process of pit emptying involves significant hazard, and the Paurashava shall follow/ enforce appropriate health and safety guidelines for emptying services.
6. The Paurashava may fix fees/charges for collection and transportation of fecal sludge from sanitation facilities. If fecal sludge treatment facilities are operational in the Paurashava and the collected fecal sludge is transported to such facilities for treatment, the Paurashava may consider the entire service chain (i.e., from collection to treatment) while fixing such fees/charges.
7. In order to ensure proper and timely emptying of onsite sanitation facilities, the Paurashava shall gradually develop a database of all sanitation facilities within areas of its jurisdiction, along with probable emptying frequency of these facilities.

**Fecal Sludge Treatment, Disposal and End-use**

1. Until treatment facility for fecal sludge is built, fecal sludge (e.g., those desludged from onsite sanitation facilities) shall be disposed in a land/area designated by the Paurashava by digging pits/trenches in the ground, and burying the pits/trenches with soil after it is filled with sludge.
2. The Paurashava may collaborate with the Department of Public Health Engineering (DPHE) and the Local Government Engineering Department (LGED) in development and O&M of fecal sludge treatment facilities.
3. The Paurashava may engage the private sector/non-government organization for treatment and disposal of fecal sludge, and use/marketing of end-products, as service procurement.
4. The Paurashava shall seek assistance of the Department of Environment (DOE), and the Institute of Epidemiology, Disease and Research (IEDCR) in fulfilling compliance with the existing rules and regulations with regard to installation and operation of fecal sludge treatment facilities.
5. The Paurashava shall seek assistance of the Department of Agriculture Extension (DAE) under the Ministry of Agriculture with regard to simplifying the procedure for securing license for using/ marketing of compost/organic fertilizer produced (if any) at fecal sludge treatment facilities.
6. The Paurashava shall work with the Ministry of Agriculture to ensure safe use of treatment end products (compost/organic fertilizer) in agriculture, landscaping and other purposes.

## 1.5.3. Financial Aspects of FSM Service Chain

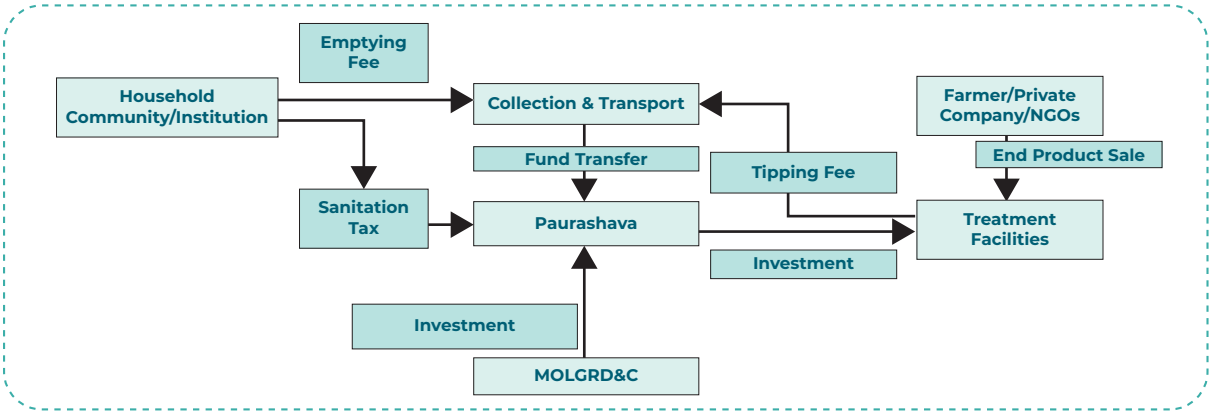
**Cost of FSM Services**

Fecal sludge management system involves different activities and therefore there is cost involvement at each step of activities. Some FSM infrastructure, such as treatment plant and vacutugs require considerable investment; therefore, support from the Government would be required for these facilities. Other expenses, including emptying and transportation of fecal sludge, and regular operation and maintenance should be supported from fees/charges from service recipients. Paurashavas shall collaborate with the LGD for establishment of major FSM infrastructure (e.g., treatment plant, vacutugs), and develop appropriate "business models" for delivery of FSM services with contribution/fees/ charges from service recipients in due course.

**A Proposition of Fund Flow for FSM Services**

Flow of funds from one step to another has to be considered carefully so that the FSM services are sustained. Considering the existing situation of fecal sludge management in Paurashava, and the level of awareness among different stakeholders of the importance of FSM, a financial flow approach for the FSM service chain can be considered as suggested below in the Figure:

**Figure 01:** *Flow of Fund (Source: IRF-FSM, 2017)*




In the above approach the fund flow starts from HH/Community/Institution (both public and private), the collection points of fecal sludge. Payment by HH/Community/Institution is divided into two channels to collection and transportation service provider as septic tank/pit emptying fee, and to the Paurashava as sanitation tax/charge along with holding tax to cover all other expenses including FS treatment.

The emptying fee will be determined based on volumetric pumping rate, and other considerations as may be determined by the Paurashava; sanitation tax/charge can be determined based on water use or more conveniently on flat rate proportionate to holding tax. This two-channel payment mode will help support the low-income people in slums, as in most cases sanitation tax/charge will be subsidized or fully waived and will be covered by government funds to Paurashava to cover FS treatment and other expenses.

An important feature of the above fund flow approach is the direction of the fund transfer to the treatment facilities. Treatment facilities will pay the collection and transportation service provider a discharge incentive to dump collected sludge at the FS treatment plant. The financial incentive here is used to encourage socially desirable behavior i.e., to encourage sludge collection and discharge at the treatment plant and reduce illegal discharge. With this approach the collection and transportation service provider would only have to recover a portion of the total operating costs from the emptying fee and the remaining portion would be made up by the discharge incentive from the treatment facility. As a result, the collection service would be more affordable for poorer households, more sludge would be collected, less sludge would be discharged to the environment and the community as a whole would benefit.

Treatment facilities will receive funds from the Paurashava, part of the sanitation taxes/charges collected, to cover treatment plant operation and management expenses. The Paurashava will charge fee for permits/ licenses for collection and transportation. Treatment facilities may also receive price of end products from private enterprises or NGOs engaged in marketing and selling of the end product. However, substantial government support will be needed to fill the budget gaps of the Paurashava, particularly to cover some of the major capital expenditures.

## 1.6. National Action Plan for IRF-FSM

The National Action Plan (NAP) for implementation of the IRF-FSM specifies the roles and responsibilities of stakeholders at different levels for specific actions with set milestones to be achieved within a given period of time for the safe management of fecal sludge in the country. The NAPs have been developed with the objective of rapid implementation of FSM services throughout the country by 2030.

The NAP for Paurashavas has been developed with an objective of rapid implementation of FSM in all Paurashavas, which covers the entire service chain and will be implemented by 2030. The Paurashavas are divided into four clusters, namely Cluster A, Cluster B, Cluster C and Cluster D, based on following criteria:

- Cluster A: Paurashavas with operational FSM services (10 Paurashava)
- Cluster B: Paurashavas that have been selected for GoB or other Development Bank funded sanitation projects (115 paurashavas)
- Cluster C: Paurashavas having land for construction of FSTP in future (excluding Paurashavas in cluster A and B) (26 Paurashavas)
- Cluster D: Rest of the Paurashavas requiring land procurement for construction of FSTP in future excluding Paurashavas in cluster A and B) (184 Paurashava)

**Box 05:** *Target Milestone for Different Types (Clusters) of Paurashavas (Source: NAP for IRF-FSM, 2020)*

| Cluster | Type of Paurashava | Milestones (2019-2021) | (2022-2024) | (2025-2027) | (2028-2030) |
|---|---|---|---|---|---|
| A | Paurashavas with operational FSM services (10 Paurashavas) | • Plan and implement citywide FSM<br>• Capacity building<br>• Ensure mechanical desludging confirming OHS | • Citywide FSM service achieved | • FSM Service continued & continually updated | • FSM Service continued & continually updated |
| B | Paurashavas selected for GoB or other development partner funded projects (115 Paurashavas) | • Capacity building<br>• Awareness campaign<br>• Plan for citywide FSM impleentation<br>• Ensure mechanical desludging confirming OHS<br>• Land procurement for FS treatment facility | • Citywide FSM service implementation | • City-wide FSM service achieved | • FSM Service continued & continually updated |
| C | Paurashavas having land for construction of FSTP (26 Paurashava) | • Capacity building<br>• Awareness campaign<br>• Plan for citywide FSM implementation<br>• Introduce mechanical desludging confirming OHS<br>• Appropriate and safe burial of emptied sludge until FSTP is constructed<br>• Confirm land procurement/availability for FS treatment facility | • Ensure mechanical desludging confirming OHS<br>• Ensure adequate treatment and safe disposal<br>• Gradual FSM service Implementation | • City-wide FSM service Implementation | • City-wide FSM service achieved<br>• Ensure safe treatment |
| D | Paurashavas requiring land procurement for construction of FSTP (184 Paurashava) | • Capacity building<br>• Awareness campaign<br>• Plan for citywide FSM implementation<br>• Introduce mechanical desludging and safe burial confirming OHS<br>• Land procurement for FS treatment facility | • Ensure mechanical desludging confirming OHS<br>• Ensure adequate treatment and safe disposal<br>• Confirm land availability/procurement for FS treatment<br>• Gradual FSM service Implementation | • Citywide FSM service Implementation | • City-wide FSM service achieved<br>• Ensure safe treatment |

## References and Further Reading

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https://www.fsmtoolbox.com/assets/pdf/35.Sanitation_TB_Intro_to_FSM_2016-07_en.pdf

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5. Sustainable Development Goals

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6. The Global Goals

https://www.globalgoals.org/goals/6-clean-water-and-sanitation/

# 02

# NATIONAL AND INTERNATIONAL FSM SERVICE AND BUSINESS MODELS

# 2. National and International FSM Service and Business Models

## Objectives

The objective of the session is to study different National and International FSM Service Models and FSM Business Models.

## Learning Outcome

**At the end of this session Participants will be able to:**

- Gather knowledge about standards service models and existing service models for FSM in Bangladesh.
- Know about standard FSM business models and existing business models of Bangladesh.
- Know about the different FSM service and business models of India.

## Session Timing

**180 minutes**

## Key Contents

## 2.1. Concepts of FSM Service Model

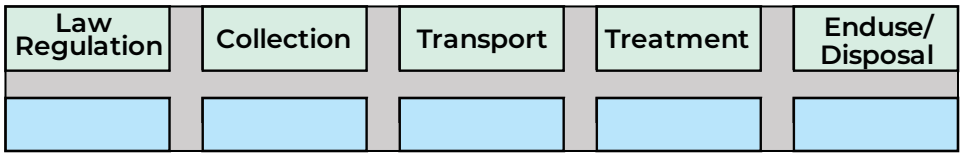
For a successful FSM intervention, strong coordination among the implementing agencies along the value chain is important. There are different ways to organize the value chain. It depends on the local context, the willingness of the private sector or NGOs to invest in FSM, the political influence of the involved stakeholders and the available expertise of the Paurashava.

**Table 01:** *Some Possible FSM Service Model Arrangements*

| | |
|---|---|
| **Option 1** | Each step of the service chain is provided by a different stakeholder. |
| **Option 2** | Collection and transportation services are operated by one stakeholder, and the treatment is carried out by a separate stakeholder. |
| **Option 3** | One type of stakeholder manages all the equipment for the collection and transportation of fecal sludge, while another oversees the infrastructures for the treatment of fecal sludge and resource recovery. |
| **Option 4** | One entity maintains the collection, transportation and treatment, but the disposal or end-use relies on another entity. |
| **Option 5** | A single entity manages the whole service chain. |

### 2.1.1. FSM Service Model Arrangement - Option 1

**Box 06:** *Each Step of the Service Chain is Provided by a Different Stakeholder*




**Pros:**

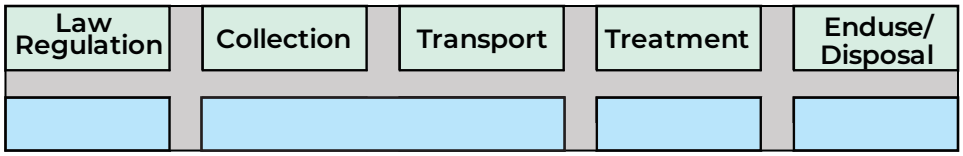
- This allows for organizational flexibility
- The fact that different stakeholders undertake the collection and transport activities creates job opportunity

**Cons:**

- Enforcement, monitoring and coordination are challenging and may result in tension at the many interfaces
- Transfer of fecal sludge is needed after collection to transport it to the FSTP, thus involving more infrastructure and organization (e.g., to operate transfer stations)

### 2.1.2. FSM Service Model Arrangement - Option 2

**Box 07:** *Collection and Transport Services Are Operated by One Stakeholder, and the Treatment is Carried Out by a Separate Stakeholder*




**Pros:**

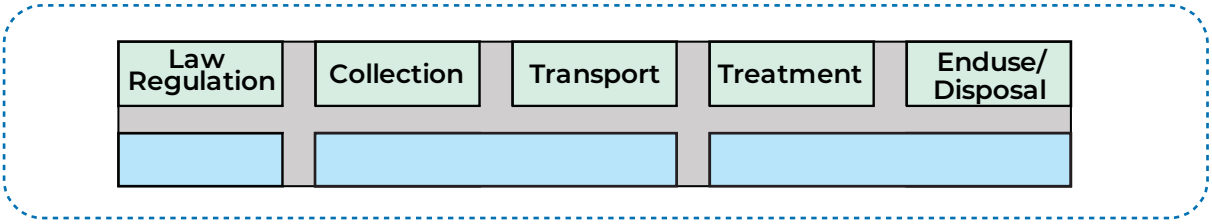
- This option is preferable when mechanical collection and transport services are already available
- It simplifies the financial flow and organization of the transport of fecal sludge to the FSTPs

**Cons:**

- The quality and quantity of collected sludge cannot be controlled at the treatment as a different entity maintains the treatment plant
- Mechanical trucks could face difficulties if roads are narrow or not suitable to access

### 2.1.3. FSM Service Model Arrangement - Option 3

**Box 08:** *One Type of Stakeholder Manages All the Equipment for the Collection and Transport of Fecal Sludge, While Another Oversees the Infrastructures for the Treatment of Fecal Sludge and Resource Recovery*




**Pros:**

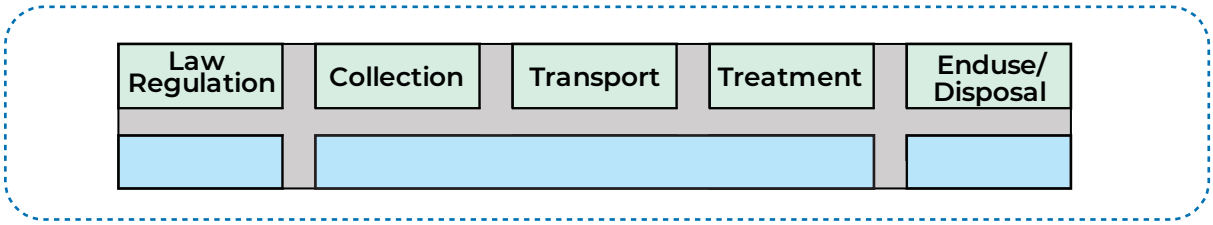
- Two types of stakeholders can develop specific skills for their activity
- Treatment technology can be chosen based on the resource recovery required

**Cons:**

- As transportation and discharge is maintained by a different entity, it is difficult to optimize the process

### 2.1.4. FSM Service Model Arrangement - Option 4

**Box 09:** *One Entity Maintains the Collection, Transportation and Treatment, but the Disposal or End-use Relies on Another Entity*




**Pros:**

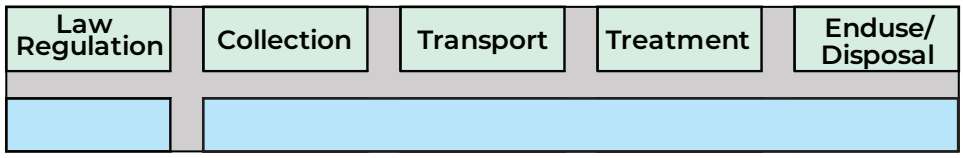
- This option has the advantage of facilitating the management of fecal sludge from the onsite technologies' user to the treatment plant and reducing the risk of unauthorized discharging

**Cons:**

- The management of the collection and transport equipment together with the treatment infrastructures involve highly developed managerial skills
- The financial flow between the end-use step and the rest of the service chain is not optimized as the end-use has the potential to generate revenue

### 2.1.5. FSM Service Model Arrangement - Option 5

**Box 10:** *A Single Entity Manages the Whole Service Chain*




**Pros:**

- Easy coordination
- Optimization of each component of the service chain based on the needs of the other components

**Cons:**

- Requires highly developed managerial skill
- Requires high financial resources

## 2.2. Existing FSM Service Models in Bangladesh

Basic FSM Service Models are operating in Bangladesh.

### 2.2.1. Public Sector-Led Model - Municipality Owned and Operated

Under this model, the LGI/Municipality takes the lead in providing fecal sludge management services. This can involve the establishment of treatment plants, collection services, and operation and maintenance of the entire system. The government may allocate funds for the construction and ongoing operation of the facilities and employ trained personnel to manage the operations.

At the commercial zone, Laxmipur, Teknaf, Mymensingh and Khulna City Corporation is operating the FSM services by themselves. Khulna City Corporation divided its zone into four different sectors. The commercial zone is fully operated by the KCC. For the other three zones, 3 private service operators are engaged through a lease agreement under PPP with KCC.

### 2.2.2. Private Sector/ Community-Led Service Level Agreement Model

In this model, marginalized group of communities take an active role in fecal sludge management. It involves organizing local community groups or cooperatives that are responsible for fecal sludge collection, transportation, and treatment under the service level agreement with LGI's. This model promotes community ownership, social empowerment, and engagement in decision-making processes.

Usually, Horijon Community is responsible for the waste management process. The municipality leases the mechanical trucks to Horijon Community through a lease agreement. Horijon Community Leader provides FSM and waste management services and gives back the lease fee. Faridpur and Meherpur are following this model. This is a combined approach. The Horijon community can also develop their livelihood status through this model.

### 2.2.3. Public-Private Partnership (PPP) Model

PPP models involve collaboration between the LGIs and private sector entities. The government/LGIs provides the policy and regulatory framework, while private companies or entrepreneurs are responsible for implementing and operating the full fecal sludge management services. This model can bring together the strengths of both sectors, including public oversight and private sector efficiency.

A third-party organization is responsible for all the waste management services. A third-party organization may purchase mechanical trucks by taking a loan and operate the whole service. At year-end, the service provider will pay a certain fee to the municipality.

For this model, the municipality does not need any additional manpower for waste management. All things are operated by a third party through PPP. Kushtia, Jhenaidah, and Jessore, Gazipur, Benapole municipalities are operating through this model.

### 2.2.4. Hybrid Model - LGI Owned and Operated by Private Sectors

A hybrid model combines elements of the public and private sectors, as well as community participation. It may involve a mix of public and private service providers working together to deliver fecal sludge management services. For example, the government might establish and operate the treatment plants, while private companies/NGOs/sanitation enterprises handle the collection and transportation of fecal sludge.

Sakhipur, Saidpur, Rangpur and Chattogram municipalities are under this Hybrid model where the private enterprises are operating their FSM business under different lease agreement with LGIs and municipalities are the top level monitoring/overseeing the service delivery mechanism by the service providers in the cities.

**Table 02:** *Business Model Typology in Different Cities of Bangladesh*

| Models | Participating Municipalities |
|---|---|
| Model-A: Public Sector-led Model: LGI Owned and Operated | Lakshmipur, Mymensingh, Teknaf. |
| Model-B: Public-Private Partnership (PPP) Model | Faridpur, Jamalpur, Meherpur. |
| Model-C: Private sector/ Community led Service Level Agreement Model | Benapole, Gazipur, Jassore, Jhenaidah, Khulna, Kushtia. |
| Model-D: Hybrid Model: LGI Owned and Operated by Private Sectors (Commercial) | Chattogram, Rangpur, Saidpur, Sakhipur. |

### 2.2.5. Synopsis of Existing FSM Service Models in Bangladesh

**Table 03:** *Existing FSM Service Model Arrangements in Few Cities (as of April 2023)*

| Location | Collection | Transport | Treatment | Resource Recovery |
|---|---|---|---|---|
| Khulna City Corporation | 3rd Party Entity and KCC -Both | | Done by 3rd party. Partially repairing and maintaining cost provided by KCC | Initially Briquette produced by 3rd Party |
| Faridpur | Private Company through Co-operative Society Kuthibari and Bandhob Palli | | Private Company SDC-Society Development Committee (Vermi compost, Co-Composting) | |
| Meherpur | Co-operative Society | | Municipality | Absent |
| Jhenaidah | 3rd Party Under PPP | | | Dry cake storing for further Co-Composting |
| Kushtia | 3rd Party Under PPP | | Private Company under lease agreement with Municipality | |
| Lakshmipur | Municipality | | | Absent |
| Benapole | Municipality | | | Absent |
| Sakhipur | Municipality (with support from I/NGOs), Co-compost | | | |

## 2.3. Stakeholders Involved in Financial Transfers

1. **Household-level toilet users** are those people who are responsible for removing FS from property that they own or rent. These people have some type of onsite sanitation technology that requires periodic FS removal.
2. **Government authorities** may allocate budgets to utilities and outsource work to private enterprises, but may also plan and manage their own FS programs internally.
3. **Private enterprises** are organizations that operate on a for-profit basis by providing goods or services in exchange for payment.

4. **Non-Governmental organizations (NGOs)** are enterprises that operate on a not-for-profit basis and which are not funded or supported directly by government, although they are often sub-contracted by government for specific tasks.
5. **End-use industries** are those stakeholders that make use of the inherent nutrients and energy potential of treated FS.

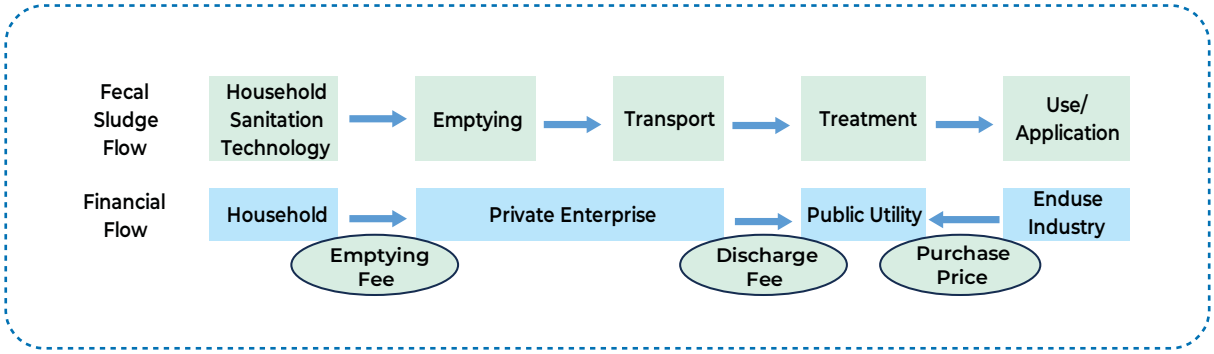
## 2.4. Ways of Financial Transfers

1. **Budget support** is the name given to cash transfers between stakeholders to partly or fully cover one stakeholder's operating budget. Typically, a government authority would provide budget support for a public utility, but foreign governments or agencies (e.g. USAID, Asian Development Bank) also provide budget support to different ministries and/or sectors. The duration of the budget support is usually long-term and non-conditional.
2. **Capital investment** costs are those that are paid once, at the beginning of the project to cover all materials, labor and associated expenses needed to build the facilities and associated infrastructure. Examples of capital investments could include the purchase of land for the construction of FS drying beds, the design and build of a treatment plant, the purchase of a vacuum truck for collection and transport, or the installation of a septic tank at the household level.
3. **Discharge/Tipping Fee** is a fee charged in exchange for permission to discharge FS at some type of facility. The fee is paid with the intention of transferring responsibility to a stakeholder who has the legal and technical ability to safely process of the FS.
4. **Discharge incentive** is the opposite of a discharge fee. It is a payment used to reward the collection and treatment business for discharge the sludge in a designated location. Making payments, rather than collecting fees, means that the FSTP would require other means of meeting their costs, likely in the form of a sanitation tax.
5. **Discharge license** is a financial instrument used to control the number and quality of C&T enterprises that are allowed to discharge FS at the FSTP.
6. **Emptying fee** is the fee that is charged at the household level for removing FS from the onsite sanitation technology where it is collected and stored. The emptying fee can be paid once the service is provided, but this type of payment model does not encourage the household to arrange for the emptying until it is absolutely necessary or long overdue.
7. **Penalties** are tools used by the government, or other legal authorities to control and discourage undesirable behavior. Penalties can be used to prevent the illegal discharge of sludge.
8. **Operation and maintenance (O&M)** costs are expenses that must be paid regularly and continually until the service life of the infrastructure/equipment has been reached. Equipment like pumps, trucks, hoses, etc., will wear down with use and the frequency of replacement will depend on the operating conditions and how often the parts are maintained.
9. **Sanitation tax** is a fee collected either once, or at regular intervals, and which is paid in exchange for environmental services such as a water connection, a sewer connection/removal of FS, or any combination of these services. The benefit of a sanitation tax for the government agency is that it provides a steady source of income allowing treatment and upgrade activities to be more easily planned.

## 2.5. Financial Flow Models

There is no single FSM model that has proven to be effective in all situations; indeed, service delivery models are constantly modified and restructured depending on the economic, legal, and environmental conditions. Furthermore, the responsibilities within the system are constantly changing and as such, the financial transfers between stakeholders can take several forms.

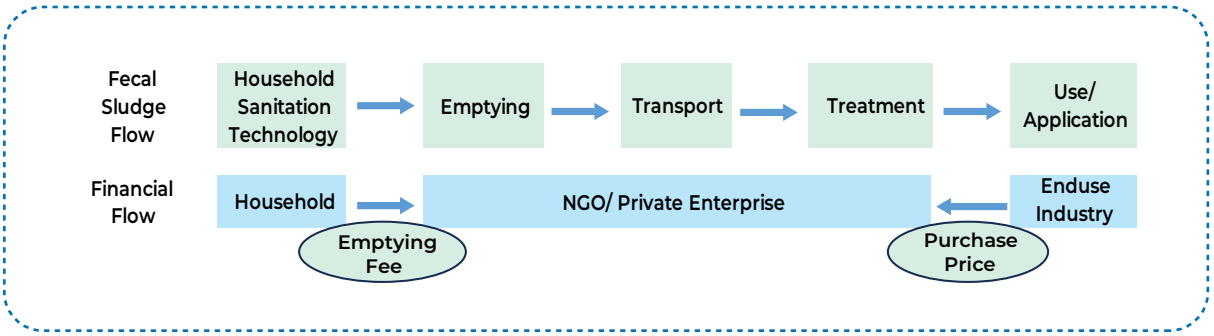
**Figure 02:** *Model 1 - Discrete Collection and Treatment Model*




Above figure illustrates a simple model of financial transfers. In this example, each of the stakeholders is responsible for a single technology in the FSM chain, and consequently, money is exchanged each time responsibility is handed over (emptying and transport are identified here as a single technology). The household-level toilet user pays a private enterprise (PE) an emptying fee to remove the sludge and the PE is responsible for the emptying and transportation of the sludge. The PE is then charged a discharge fee by the public utility for accepting, and treating the sludge. The utility is also paid a purchase price by an end-use industry in exchange for treated FS or sludge-grown products.

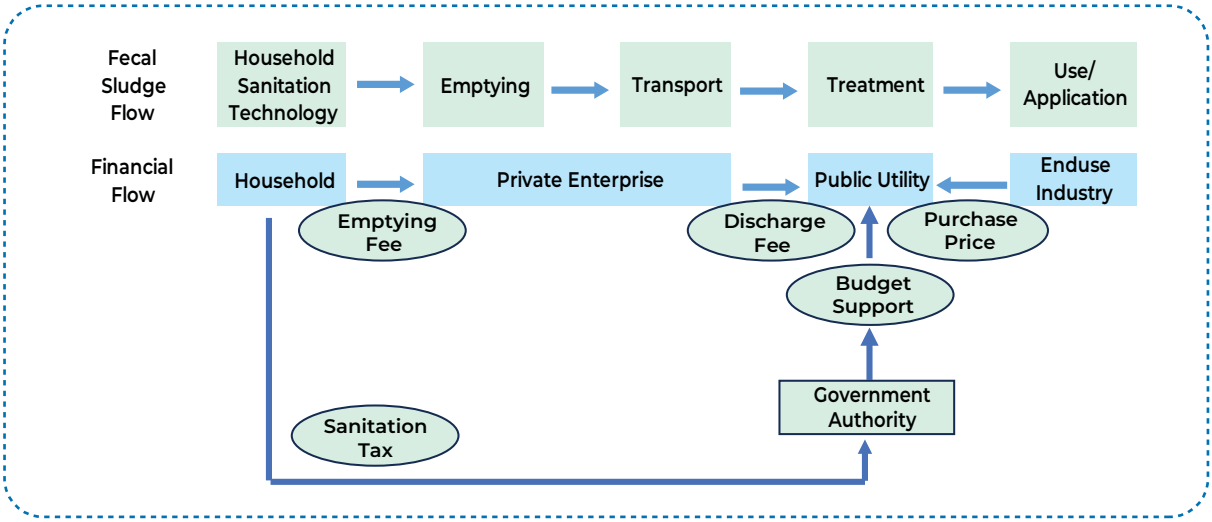
This type of model has two potential negative consequences; either, private enterprises are forced to pass the high discharge fee costs on to their customers, and thus exclude the poorest; or, the PE avoids paying the high discharge fee by illegally discharge, free of charge, on land that is not designated for FS discharge or treatment.

**Figure 03:** *Model 2 - Integrated Collection, Transport and Treatment Model*



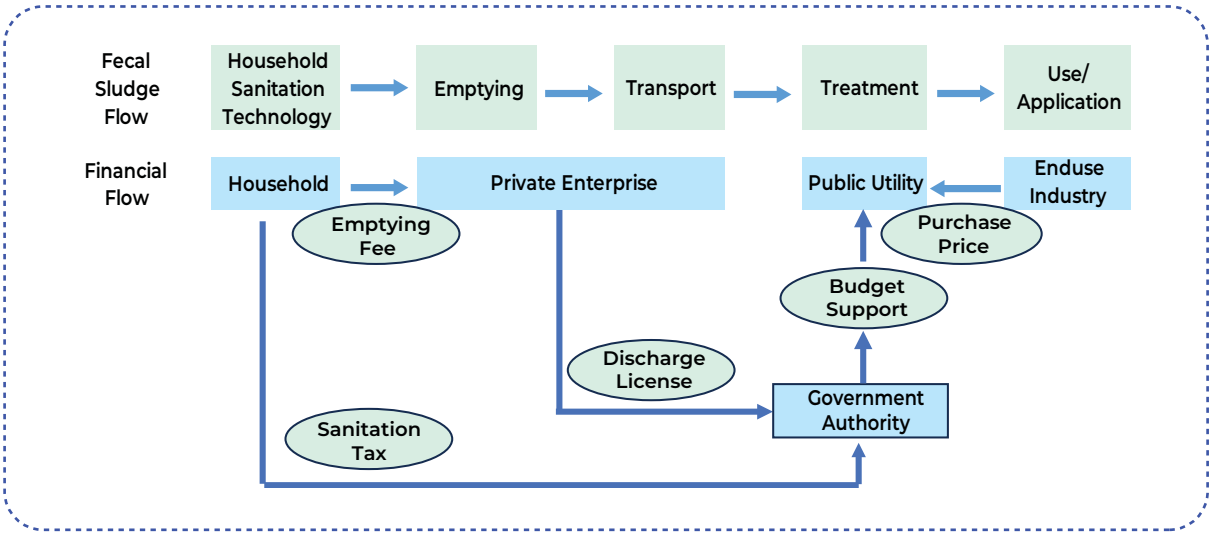

A single private enterprise or non-governmental organization (NGO) is responsible for the emptying, transport and treatment, thus eliminating the need for a discharge fee between the stakeholder responsible for Collection and Transport (C&T) and the stakeholder responsible for treatment. The private enterprise is responsible for collecting fees directly from the household-level toilet users. The emptying fees required to cover the cost of transport and treatment can be too high for many households and more cost recovery strategies will be needed to ensure the financial sustainability of the system.

**Figure 04:** *Model 3 - Parallel Tax and Discharge Fee Model*



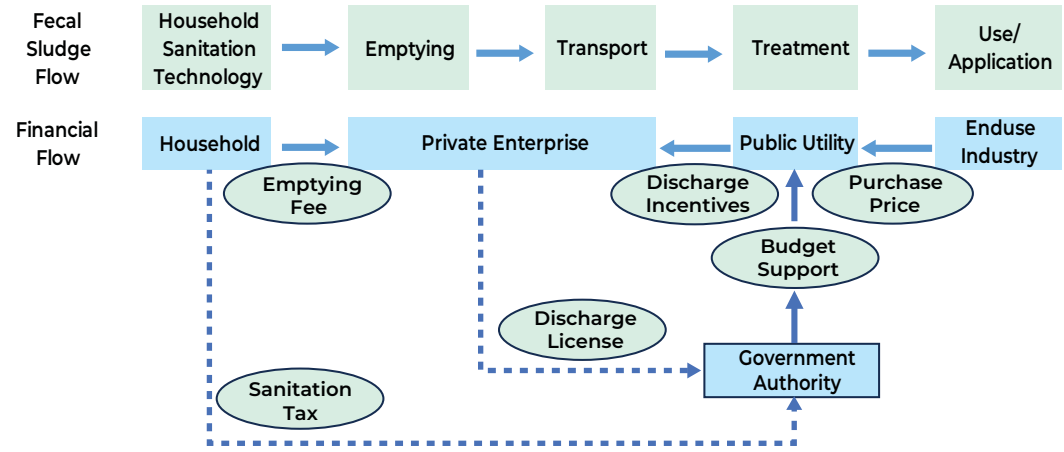

In the model a sanitation tax is paid directly to the government authority by the toilet user, either through water, sewer, or property taxes. The utility is given budget support from the government authority that collects the sanitation tax. The utility therefore does not need to rely entirely on the discharge fee, and could lower it (in comparison to Model 1) thus reducing the total costs of the private enterprise. This system is prone to corruption and under-servicing if the government authority is not competent or transparent in how it allocates it money. Furthermore, the financial balance is very much dependent on the consistent collection of the sanitation tax.

**Figure 05:** *Model 4 - Licensing and Sanitation Tax Model*




In the licensing and sanitation tax model the private entrepreneur who is responsible for C&T is not penalized with a discharge fee for each discharge at the FSTP, but instead is granted unlimited (or semi-limited) access to dump through a discharge license, thus reducing illegal discharge. Having to pay a discharge license, no matter how nominal, ensures that the government has more administrative control over the industry.

**Figure 06:** *Model 5 - Incentivized Discharge Model*




In this model, the FSTP operator pays the stakeholder responsible for C&T a discharge incentive to dump sludge at the FSTP. The discharge license and sanitation tax flows in the above figure are left as dashed lines to indicate that they may or may not exist in this model, depending on the context. In the case of discharge incentives, the payment is used to encourage sludge collection and reduce illegal discharge.

This model is built on the theory that C&T stakeholders cannot afford the discharge fees charged by FSTP operators and so dump indiscriminately, causing damage to public and environmental health. Working under this scheme, the C&T operator would only have to recover a portion of the total operating costs from the emptying fee (the other portion would be made up by the discharge incentive). As a result, the collection service would be more affordable for poorer households, more sludge would be collected, less sludge would be discharged to the environment and the community as a whole would benefit.

## 2.6. Revenue Generation Models based on Existing FSM Operation in Bangladesh

For existing FSM financial models in Bangladesh, most of the revenue generation comes from the septic tank cleaning fee. Sanitation taxes also applied to some extent. Usually, sanitation tax varies from 7 to 12% of the yearly holding tax. Kushtia, Jhenaidah, and Faridpur are practicing this way. Almost every FSM treatment plant sells bi-products. In summary, the existing revenue generation chart can be found below:

**Table 04:** *The Existing Revenue Generation Chart (as of April 2023)*

| Location | Revenue Generation | | |
|---|---|---|---|
| Meherpur and Laksmipur | Emptying Fee | | |
| Khulna and Sakhipur | Emptying Fee | | Briquette and Co-compost Sale |
| Kushtia, Jhenaidah, and Faridpur | Emptying Fee | Sanitation Tax | Co-compost Sale |

Graphical representation of FSM service Chain and Financial Flow Diagram for several municipalities is given below:

**Figure 07:** *FSM Service Chain and Financial Flow Diagram for Kushtia*

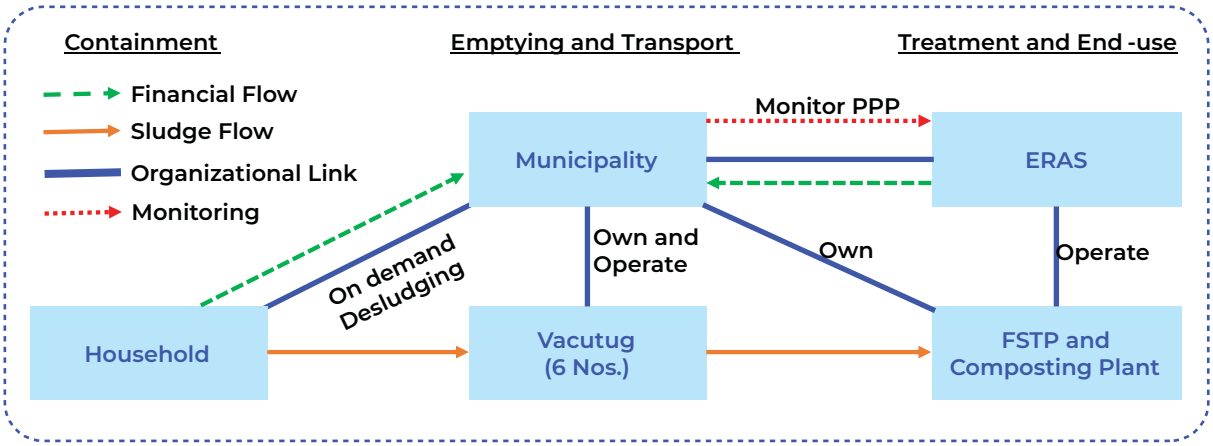



**Figure 08:** *FSM Service Chain and Financial Flow Diagram for Jhenaidah*

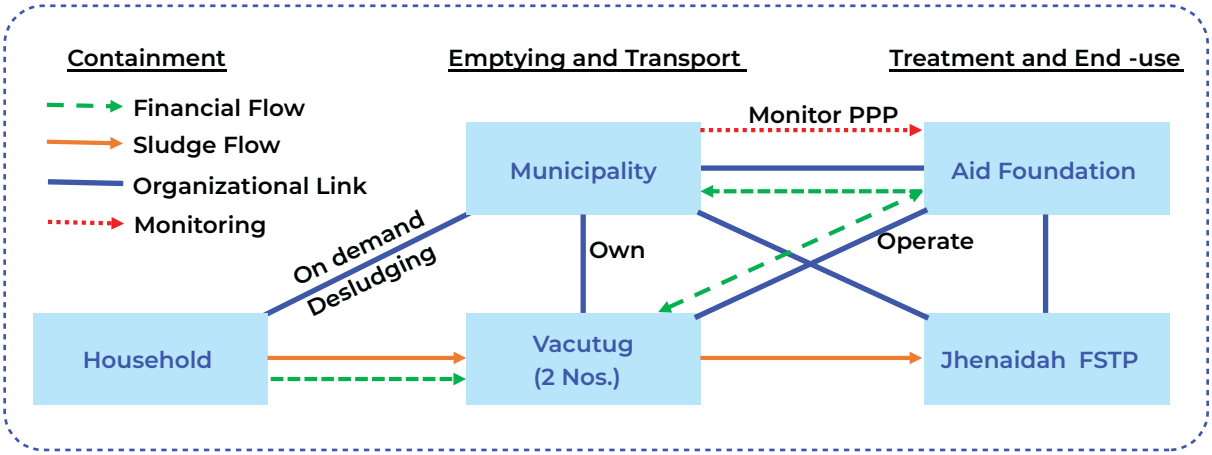
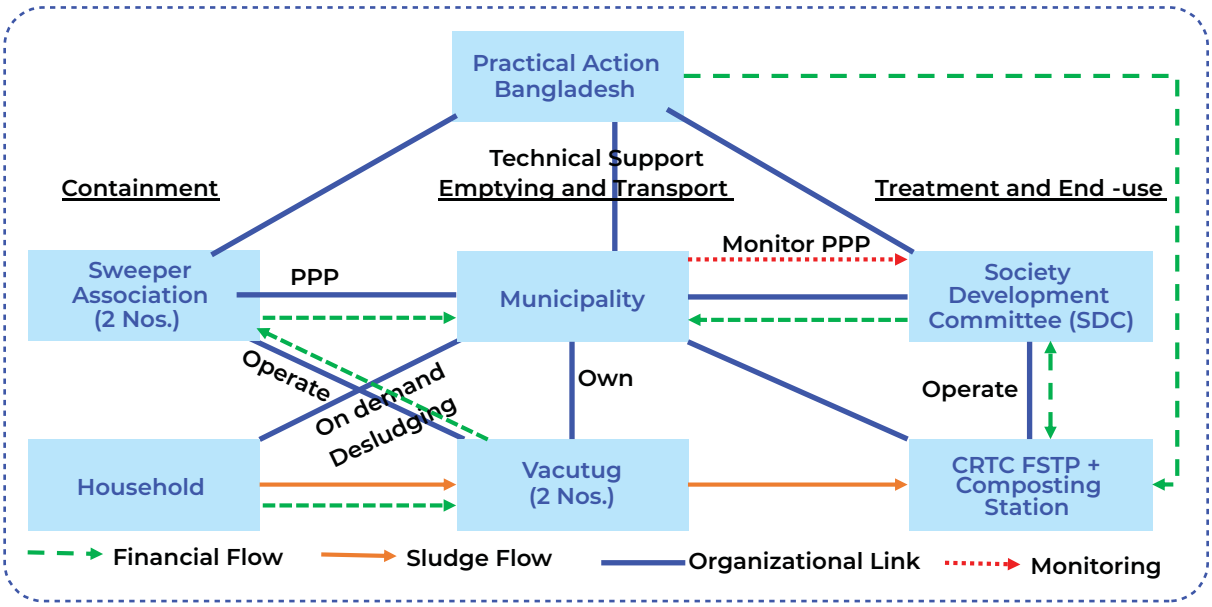



**Figure 09:** *FSM Service Chain and Financial Flow Diagram for Faridpur*



# 2.7. FSM Service and Business Models in India

## 2.7.1. Government Managed FSM Service

**Bhubaneswar Government Managed FSM Service, Odisha**

The municipalities have a mandate from the Government of Odisha to contract desludging operations to private entities, but due to lack of participation in the bids, many municipalities are operating the vehicles.

An On-site Sanitation Systems user requiring desludging submits a request at the municipal office and pays for the desludging fee in advance. Based on this request, the municipality provides the desludging service, and the FS is transported to a Septage Treatment Plant (SeTP) or designated disposal point.

In municipalities where desludging operations are contracted to a private entity, the municipality and service provider sign a service contract. The private entity must provide service for 28 days per month and carry out a minimum number of daily trips (six trips per vehicle) or number of applications received whichever is lower. The private entity is required to maintain the truck.

The municipality fixes desludging rates, coordinates with the private operator regarding desludging scheduling, and monitors the operations. On-site Sanitation Systems users must go to the municipal office to submit desludging requests. Some municipalities have also started accepting requests via telephone. Desludging services are provided during working hours; hence, it typically takes 2 to 3 days to provide the service once the request is submitted.

In most cases, the municipality collects desludging fees, transfers the fees to an escrow account, and makes monthly payments to the private operator based on the number of trips completed. Alternately, the private operator directly collects desludging fees from the customers.

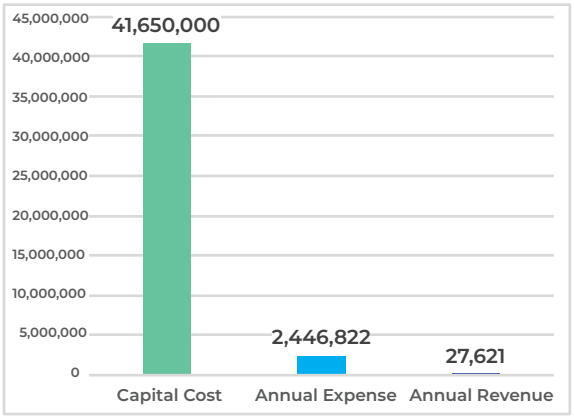
The Odisha Water Supply and Sewerage Board designed the SeTP and supervised the plant's construction. The SeTP was co-located at a proposed STP site in Bhubaneswar. The Bhubaneswar Municipal Corporation owns four desludging vehicles and transports FS to the SeTP.

The Odisha Water Supply and Sewerage Board allocates funds from its budget to cover the O&M cost. The SeTP generates revenue from surplus power produced by the onsite solar photovoltaic system.

**Table 05:** *Key Features of Bhubaneswar Fecal Sludge Treatment Plant (as of April 2019)*

| | |
|---|---|
| Installed capacity | 75 $m^3$/day |
| Allocated land area | 2.5 acres |
| Labor requirements | 8 persons (FTE-Full Time Equivalent) |
| Inputs Raw septage | 35-45 $m^3$/day, up to 75 $m^3$/day |
| Outputs | Dried sludge and treated water (not valorized) |
| Capital Cost | GoI-Government of India Program |
| Operating Cost | OWSSB-Odisha Water Supply and Sewerage Board and revenue from surplus power generated by solar photovoltaic system |

**Figure 10:** *Financial Overview of FSM in Bhubaneswar (Adoted from IWMI and WASH Institute, India, 2020)*




Cost-Revenue (1 INR = 1.19 BDT, Oct 2019):
**Capital Cost:** BDT 41,650,000
**Total Annual Expense:** BDT 2,446,822
Labor: BDT 1,402,553
SeTP O&M: BDT 1,012,139
Solar Power Maintenance: BDT 11,900
Hospitality Cost, maintenance RO system in the office: BDT 20,230
**Annual Revenue/Surplus Power:** BDT 27,621

**Box 11:** *Risk-Benefit of FSM Financial Model of Bhubaneswar*

| | |
|---|---|
| Risk | ▸ Unable to provide desludging services in a timely manner, especially if the end beneficiary has to make the payment first<br>▸ In small towns with low demand for desludging, asset utilization can be low |
| Benefits | ▸ Preventing manual E&T where private sector desludging is absent<br>▸ The government can ensure equity in terms of service provision and fees charged, especially to poor households |

## 2.7.2. Privately-Owned and Operated FSM Service

### Emptying and Treatment Licensing: Warangal Desludging Licensing, Telangana

This is a market-driven business model. On-site Sanitation Systems users engage the services of the private entity, which markets its services through word of mouth, local plumbers funneling orders for a commission, and bills/stickers on electric poles with telephone numbers. FS collected from On-site Sanitation Systems is transported to a disposal point – a municipality-designated point, vacant or agricultural land, or the nearest canal or waterbody.

The private entity charges desludging fees to the customer, which are based on market pricing and the containment system (type, number of trips required to empty it, length of pipe required to desludge it and distance from the disposal point). Typically, the municipality's monitoring function is weak or entirely lacking.

The private desludging operators, who largely operate without any regulations and on an informal basis, are formalized through provision of licenses by the municipality or parastatal agency to operate their businesses.

The municipality/parastatal agency prescribes criteria such as a valid driving license, vehicle fitness certification, GPS installation, use of PPE, and so forth for the private desludging operator to be eligible to receive the license. The private operator is required to pay a stipulated amount as license fees to obtain the permit. Typically, the license requires periodic renewal. The operator may be required to obtain the license to operate the business and/or to drive the desludging vehicle. The operator is required to display the E&T license number on the vehicle.

The municipality/parastatal agency can regulate desludging tariffs, especially for poor families, and advise OSS users to only avail of desludging services from licensed operators.

As a key step to operationalize the regulations, the Greater Warangal Municipal Corporation (GWMC) initiated licensing of private operators, with annual renewal required. To obtain the license, private operators must ensure the following:

- Vehicles meet the approved standards
- Workers are equipped with uniforms and required PPE and tools
- GPS devices are installed on their vehicles

GWMC maintains a list of licensed operators on its website to provide customers ease of access to information and has a toll-free number for sanitation queries from citizens. Any desludging request submitted to the GWMC is passed on to licensed operators.

**Table 06:** *Key Features of Warangal Fecal Sludge Treatment Plant (as of March 2019)*

| | |
|---|---|
| Installed capacity | 15 $m^3$/day |
| Allocated land area | 1 acre; FSTP land area: 0.6 acres |
| Labor requirements | 4-10 persons (FTE) - two 12-hour shifts of 1-3 security guards/gardeners, 1-3 operators, 1-3 assistant operators, and 1 supervisor |
| Inputs Raw septage | Raw FS – 9-15 $m^3$/day |
| Outputs | 1.8 to 2.5 kg biochar per 0.1 $m^3$ septage treated |

**Box 12:** *Risk-Benefit of FSM Financial Model of Warangal*

| | |
|---|---|
| Risk | ▸ In the absence of effective monitoring, the health and safety of workers and disposal of FS at designated sites may not be ensured<br>▸ Licensing norms and fee can become barriers to entry for small or new entrepreneurs if not designed judiciously |
| Benefits | ▸ Provides a legal umbrella for desludging operators and hence prevents harassment from police and society<br>▸ Ensures equipment and service standards<br>▸ The municipality can regulate pricing to ensure services reach every household |

### Desludging Association: Kochi Associations of Desludging Operators, Kerala

A well-known practice of individuals or enterprises engaged in a common profession is to come together to promote and/or safeguard their activities/business interests. This is typically done through the formation of either unions or associations.

Similarly, private desludging operators can come together to form desludging or emptying associations for the following purposes:

- Advocacy with government agencies to improve the business environment
- Demarcation of geographical boundaries for business operations
- Agreement on a set of informal rules for plying vacuum truck operations, including setting tariffs
- The associations were initially formed to shield members from police harassment and facilitate advocacy with the government to recognize their business.

The two oldest associations, All Kerala Cleaning Contractors' Welfare Association and All Kerala Sewage and Septic Cleaning Vehicle Owners' Association, are issued six disposal passes each from the Kochi Municipal Corporation (KMC) daily to dispose of FS at the FSTP.

It is the responsibility of the associations to issue the passes to 12 members with active service requests for the day. The selected private operators pay the disposal pass fees to the municipality at the FSTP. Since the FSTP only accepts FS from 12 trucks, the remaining FS collected by the operators is disposed of in the open.

**Box 13:** *Risk-Benefit of FSM Financial Model of Kochi*

| | |
|---|---|
| Risk | ▸ Can lead to price gouging for end-users if left unregulated<br>▸ New entrants can find it challenging to enter a market dominated by a closed association |
| Benefits | ▸ Enables collective bargaining for an improved business environment, and the municipality can hold one entity accountable |

## 2.7.3. Public-Private Partnership FSTP and Service Chain

### Leh Public-Private Partnership in FSM, Jammu and Kashmir

Bremen Overseas Research and Development Association identified Leh municipality in Jammu and Kashmir as a city in need of an FSM solution. Leh is a high-altitude, cold desert municipality with a high dependence on groundwater.

A private operator is responsible for managing FSTP operations, along with provision of scheduled and demand-based desludging services.

The Municipal Committee Leh (MCL) provided one existing desludging vehicle. The private operator prepares the schedule for desludging, which is shared with the MCL, who notifies customers of the desludging dates. Scheduled desludging is undertaken twice a week. The remaining days in the week are reserved for on-demand desludging.

The MCL collects desludging fees from the hotels and home stays at the time of renewal of the yearly license to operate. Once the desludging service has been provided, the private operator is paid 90% of the revenue upon submission of documentary evidence of service provision. The municipality monitors desludging and FSTP operations.

Even though operations are only carried out for eight months in a year, there are eight full-time operational staff from the private operator who are paid for the entire year, including one driver and two operators for each desludging vehicle and two FSTP workers. The private operator finances the operating cost with 90% of the desludging fees collected by the MCL. The MCL is promoting scheduled desludging to prevent groundwater pollution from OSS.

**Table 07:** *Key Features of Leh Fecal Sludge Treatment Plant (as of March 2019)*

| | |
|---|---|
| Installed capacity | 12 $m^3$/day |
| Allocated land area | 0.18 acres |
| Labor requirements | 8 persons (FTE) |
| Inputs Raw septage | Raw FS – 12 $m^3$/day |
| Outputs | Treated water + dried sludge |

**Box 14:** *Risk-Benefit of Public-private Partnership Model of Leh*

| | |
|---|---|
| Risk | ▸ PPP projects for FSTP construction and O&M are typically small in size in comparison with other infrastructure projects and hence may not attract suitable private entities |
| Benefits | ▸ The municipality can leverage technical expertise and finance for the investment and operations |

**Figure 11:** *Value Chain of the Leh PPP for FSM Model* *(Source: IWMI and WASH Institute, India, 2020)*

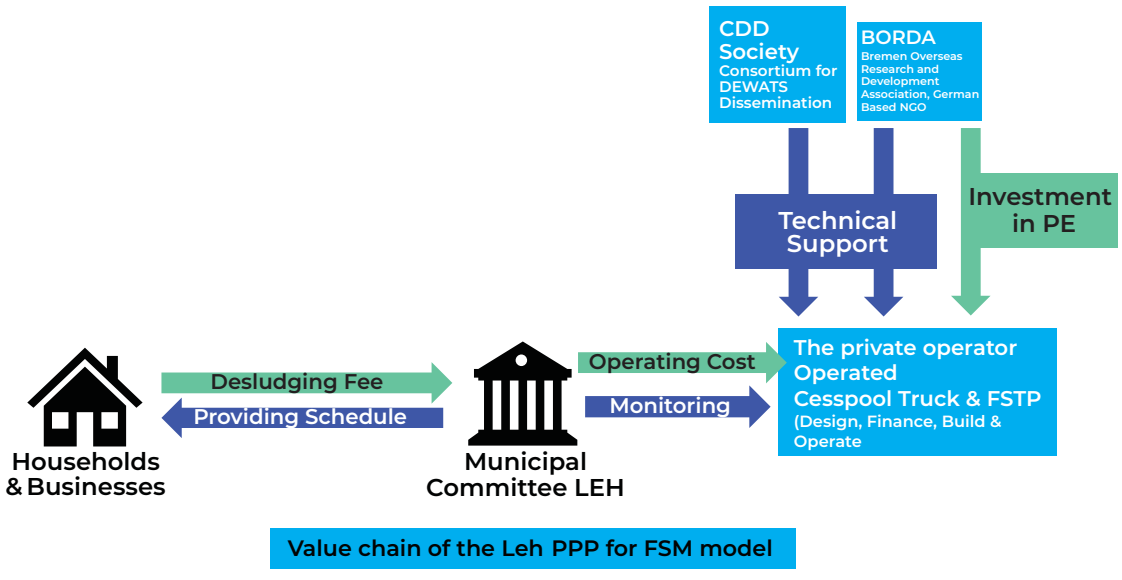
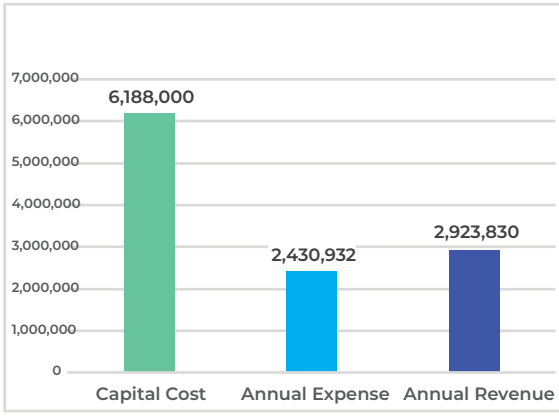


**Figure 12:** *Financial Overview of FSM in Leh (Adoted from IWMI and WASH Institute, India, 2020)*




Cost in BDT (1 INR = 1.19 BDT Oct 2019)
**Annual Desludging Expense: 1,130,500**
Labor: 514,080; Licensing: 30,940
PPE & Tools: 173,740; Fuel: 185,640
Annual Maintenance: 35,700
Periodic Maintenance: 190,400
**Annual FSTP Expense: 1,300,432**
Labor: 999,600; Electricity: 28,560
PPE & Tools: 23,800;
Miscellaneous Expense: 5,712
Office Rent + Supplies: 214,200
**Annual Revenue (90% of desludging fees – 780 trips/year @ 4,165 BDT): 2,923,830**

**Box 15:** *Risk-Benefit of FSM Financial Model of Leh*

| | |
|---|---|
| Risk | ▸ Unable to provide desludging services in a timely manner, especially if the end beneficiary has to make the payment first<br>▸ In small towns with low demand for desludging, asset utilization can be low |
| Benefits | ▸ Preventing manual E&T where private sector desludging is absent<br>▸ The government can ensure equity in terms of service provision and fees charged, especially to poor households |

## 2.7.4. Scheduled Desludging and Sanitation Tax

### Wai Scheduled Desludging and Sanitation Tax, Maharashtra

A tender was issued by the Wai Municipal Council (WMC), and a 36-month performance-based contract was given to a private desludging operator. They were required to cover the capital cost of the desludging trucks and desludge a fixed number of septic tanks over the contract period.

The WMC is responsible for collection of sanitation tax from OSS users as part of the property tax. The payment to the private operator is made on a monthly basis based on the number of septic tanks desludged. A tripartite agreement was made amongst the WMC, the private operator and the Bank of Maharashtra for an escrow account, which would maintain three times the monthly contractual fees and thus provide security and safeguards against delays in payments to the private operator.

To implement scheduled desludging, the city was divided into three zones, with one zone targeted to be covered every year.

The private operator also provides on-demand desludging services on an emergency basis, which is first approved by the WMC sanitary inspector post-inspection. OSS users must pay separately for this service. The private operator transports the FS to the FSTP. WMC staff undertake random checks to verify that desludging services are provided.

**Box 16:** *Risk-Benefit of FSM Financial Model of Wai*

| | |
|---|---|
| Risk | ▸ Lack of collection of sanitation tax from end-users poses risk to operational viability |
| Benefits | ▸ Reduces the cost of the desludging service due to improved logistics in comparison to demand-based desludging, resulting in benefits to end-users and private operators<br>▸ Ensures proper maintenance of septic tanks and hence reduces public health and environmental risks<br>▸ Assured FS disposal at designated sites due to performance-based payment<br>▸ Sizing of FSTP and its operational efficiency can be better planned in comparison to demand based desludging |

## 2.7.5. Cluster FSTP

### Sambhar-Phulera Cluster FSTP, Rajasthan

Rajasthan Urban Infrastructure Development Project (RUIDP) and Phulera municipality tendered FSTP construction and five years' O&M to a private operator. RUIDP provided funds for the capital cost and O&M for the first 2 years of operations, after which it is the responsibility of Phulera municipality.

To cover this cost, Phulera municipality plans to collect sanitation tax, either through a sanitation surcharge on water bills collected by the Public Health Engineering Department (PHED) or sanitation tax on Solid Waste Management (SWM) fees collected by Phulera municipality. Phulera municipality plans to cover the annual O&M cost of E&T and FSTP through collection of sanitation tax from every property. FSM plant is in Phulera Municipality.

Sambhar municipality is not required to collect additional taxes and does not have to pay towards FSTP O&M. Both municipalities have municipal desludging vehicles and must ensure that FS is transported to the FSTP.

Phulera has private desludging operators who will register with the municipality and will be required to dispose of FS at the FSTP. Both towns have plans to implement scheduled desludging to ensure a regular supply of FS to the FSTP.

Treated effluent from the FSTP will be used for gardening and irrigation, and there are plans to mix dried sludge with organic waste to make co-compost, which would then be given to farmers.

**Figure 13:** *Value Chain of the Cluster FSTP Business Model (Source: IWMI and WASH Institute, India, 2020)*

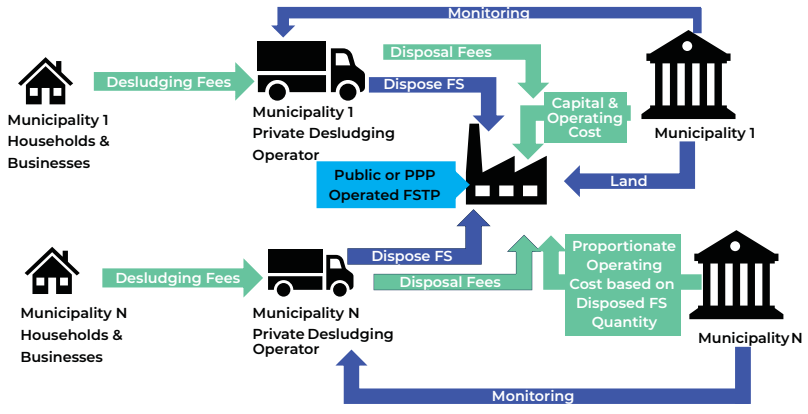


**Table 08:** *Key Features of Sambhar-Phulera Fecal Sludge Treatment Plant (as of March 2019)*

| | |
|---|---|
| Installed capacity | 20 $m^3$/day |
| Allocated land area | 1.31 acres |
| Labor requirements | 4 persons (FTE) – 1 operator and 3 additional workers |
| Capital Cost | ADB Grant |
| Operating Cost | User fees and/or Municipality |

### Karunguzhi-Maduranthagam Cluster FSTP, Tamil Nadu

The model entails treatment of FS from two or more municipalities in a single FSTP. The cluster FSTP should be strategically located within a 10 to 15 km radius of each municipality so that E&T operators dispose of FS at the FSTP. In a cluster FSTP model, one of the municipalities provides land for the FSTP and finances FSTP operations. The lead municipality signs a memorandum of understanding (MoU) with one or more nearby municipalities.

The Karunguzhi Town Panchayat (KTP) handles FSTP operations and ensures that the private desludging operator in Karunguzhi disposes of FS in the FSTP. The KTP provides a license to a private desludging operator.

The KTP receives customer requests for desludging and passes on the requests to the operator. The customer can also directly contact the desludging operator. The KTP collects fees from the households and pays the desludging operator on a monthly basis based on the number of trips made to the FSTP to dispose of FS, which the FSTP operator tracks.

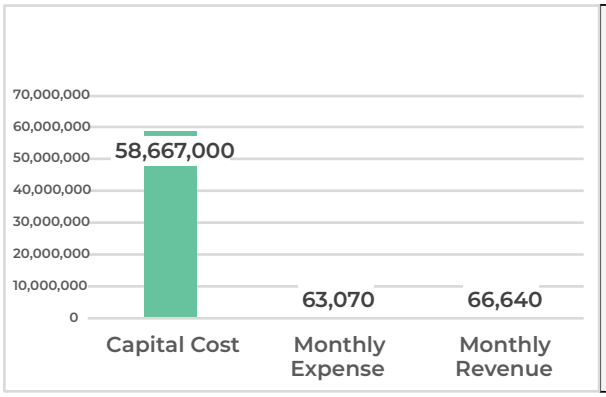
The KTP charges disposal fees to the operator, which are deducted by the KTP from collected desludging fees based on the number of trips.

Under the cluster operations, Maduranthagam municipality is responsible for issuing licenses and ensuring private desludging operators dispose of FS at the Karunguzhi FSTP.

**Table 09:** *Key Features of Karunguzhi-maduranthagam Fecal Sludge Treatment Plant (as of April 2019)*

| | |
|---|---|
| Installed capacity | 23 $m^3$/day |
| Allocated land area | 2 acres |
| Labor requirements | 4 persons (FTE) – 2 plant operators, 1 supervisor, and 1 gardener |
| Inputs | Raw FS: 11-13 $m^3$/day; organic waste: 100 kg/day co-composted with dried sludge |
| Outputs | 300 kg co-compost (first batch, monthly production) |

**Figure 14:** *Financial Overview of FSM in Karunguzhi (Adoted from IWMI and WASH Institute, India, 2020)*




Cost in BDT (1 INR = 1.19 BDT Oct 2019)
**Capital Cost: BDT 58,667,000**
**Monthly Expense: BDT 63,070**
FSTP Labor and O&M: BDT 59,500
Utilities: BDT 3,570
**Monthly Revenue: BDT 66,640**
FSTP O&M fee from GoTN: 63,700
Disposal fees from private desludging operator: BDT 7140

**Box 17:** *Risk-Benefit of FSM Financial Model of Karunguzhi-Maduranthagam (Source: IWMI and WASH Institute, India, 2020)*

| | |
|---|---|
| Risk | ▸ The institutional mechanism for ownership of shared assets amongst multiple municipalities is unclear; therefore, responsibility of sustaining FSTP operations largely falls on one municipality |
| Benefits | ▸ Clustering enables achievement of economies of scale, hence, lowering costs |

## References and Further Reading

1. Business Models for Fecal Sludge Management in India, International Water Management Institute.
https://www.iwmi.cgiar.org/Publications/wle/rrr/resource_recovery_and_reuse-series_18-special_issue.pdf

2. System approach for Implementation and Operation of FSM, IWA
https://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/3591#

# 03

## USER'S EXPERIENCE SHARING ABOUT EXISTING FSM SERVICE MODELS AND IMIS

# 3. User's Experience Sharing about Existing FSM Service Models and IMIS

## Objectives

The objective of the session is to share experience on FSM Service Chain, Tariff Structures and Payment Modality of Different Municipalities.

## Learning Outcome

**At the end of this session participants will be able to:**

- Know about the user experience about FSM service model of different municipalities.
- Provide municipality perspective about different component of probable FSM service models by individual quiz/survey session.
- Know about the user perception about the payment modality of different municipality.

## Session Timing

**60 minutes**

## Key Contents

A survey was done in 2017 for Khulna City Corporation, Kushtia Municipality, and Jhenaidah Municipality. Some good results were achieved, and the users' experiences were reflected in the survey. Before designing an FSM service or business model, the user's experience can be helpful.

## 3.1. Emptying Behavior of Households

It was seen that there is a general tendency of not cleaning/emptying pits or septic tanks proactively, rather households (HHs) usually wait till the last moment, or only conduct emptying activities when faced with an overflow.

## 3.2. Preferred Time of Emptying

Most of the HHs prefered night-time for the 'dirty work' to avoid being castigated by the neighbors. Majority of the manual emptying customers prefered to do it at night, because they felt that there is no other option and they did not want to irritate the neighbors.

For Kushtia Municipality, above 50% of users of vacutug preferred emptying at daytime since vacutug service could contain the bad smell and kept the sludge out of sight while cleaning. Surprisingly most of the non-users of vacutug preferred daytime as well. This is because during the day the owners can supervise the cleaning process properly.

So, it is required to know about the perception of probable users about fixing the timing. Some might prefer day time some might prefer night. Sometime large sized vacutug operation is crucial during day time.

## 3.3. Application Process

**Municipality**

For vacutug service, interested users needed to apply in municipality office for availing the service. After filling up a form, they had the option to submit their application with the required amount of down payment in cash/pay order. Sometimes the application process was inconvenient since some had to take a day off from work just to apply and had to waste half of a productive working day to just drop an application.

**CDC-Community Development Committee**

CDC-Community Development Committee in Khulna operated vacutug service for a long time. During their service, users were satisfied about the application process. Users did not show any noticeable inconvenience. Community Development Committee (CDC) actually provided the service much faster and conveniently. Customers could easily avail the service by calling the local CDC cluster leader near to their residing area.

**Manual Emptier**

Customers who availed manual service for emptying also expressed satisfaction about the process of reaching these manual emptiers. HHs usually contacted the manual emptiers through several methods, such as direct phone call to the emptier, physically going to the emptiers' ghetto, or to their common gathering place.

So, it is required to make the application process as easy as possible.

## 3.4. Time-lag between Service Application and Receipt

For municipality, usually users were getting the service within 24-48 hours. Sometimes it took upto 3-4 days if the vacutug machines needed repair or if there was a queue of requests.

During CDC-run vacutug scheme at Khulna, they could provide the service withing 8-24 hours. Bureaucracy could be avoided while taking the service through CDC.

For manual emptying usually it required 8-24 hours to provide the service. Service providing time can play a big role for successful FSM operation.

## 3.5. Reliance on the Service Provision

Vacutugs, though efficient and clean, had one major flaw. The suction pipes failed to pull out the hardened sludge. HHs often had to employ a mix method of emptying, i. e., sucking up the liquid sludge and then calling up manual emptiers to get into the pit and clear up the hardened sludge. This is not only cumbersome but also costly as both mechanical and manual services are required in the end. The total cost in this case however depended on situation, including bargaining with manual emptiers. This problem usually arised when HHs did not clean up sludge regularly, giving the sludge ample time to harden and solidify.

Users would prefer manual emptying in emergency situation as it is a tested service. Majority of the non-user respondents would choose manual in an emergency because according to them, mechanical emptying service takes considerably more time.

## 3.6. Scope of Integration from Manual Emptier

Based on the survey, manual emptier showed strong willingness to move into mechanical system. They were also enthusiastic about becoming entrepreneurs themselves if given ample startup support such as soft loans and training to handle the vacutug machine. They were also positive about wearing protective gears if they got the chance to operate the vacutug. They would much prefer to be integrated with such services that ensure their health and wellbeing and also provide them with a steady source of income.

According to the manual emptiers, shifting to mechanical emptying service would increase their social status since they could claim that they do not touch sludge directly.

## 3.7. Perception of Payment Method and Modality

Both users and non-users overwhelmingly preferred one-shot payments and in cash. They found paying in cash is the most convenient as many disliked going to the bank as it was a hassle and consumed time from their working day. For a small amount, it would not be a good use of time if they had to visit a bank and issue a pay order.

Furthermore, users also opined that they do not prefer payment in installments as it is a small amount. Many found paying regular installment every month as an unwanted burden on their income.

## 3.8. Problems in Service Delivery

- Muslim employees do not want to work as drivers or emptiers for the fear of being ostracized in the society.
- Lack of experienced and trained drivers to operate all their vehicle fleet.
- Trucks do not have access to some areas firstly due to congested roads and secondly due to the location of some pits/tanks, which are quite far from the roads.
- Vacutug can only suck out the liquid and semi-liquid sludge. In case of hardened sludge at the bottom, it is impossible to clear it with the vacutug.
- There is no dedicated wing for FSM in municipality organogram.
- Unavailability of protective gears. Operational staff and emptiers attached with the vehicles expose themselves to health risks.
- Lack of knowledge about the functional use of the vacutug machine.

## 3.9. Recommendations for Service Quality Improvement

- Reduction of time-lag in service delivery and bring it down to 24 hours.
- Accept cash payment along with bank draft to ease the application process.
- Establish system of online payment and payment through mobile banking to make the payment process easier. One shot payment preferred.
- Include FSM tax with regular tax that households pay.
- Establishment of dedicated wing for FSM in the organogram of municipality.
- Establish one-stop call center to process customer calls promptly.
- Provide training and proper gear for the operational staff involved with FSM.
- Increasing smaller trucks.
- One of the main reasons for the failure of FSM systems is the vague delegation of responsibilities. Overlapping in roles and lack of incentives for efficient operation also contributed to this. This situation frequently occurs where an incomplete institutional framework exists. It results into a lack of accountability and disagreements between stakeholders.

The Integrated Municipal Information System (IMIS) is a web-based geographic information system (GIS) designed to support local governments' management of municipal services for accountability, management, and planning of FSM services.

In 2019, the IMIS was officially launched in Jhenaidah. The municipality uses IMIS to monitor service status. During 2020, IMIS adoption is likely to be completed in Khulna and replicated in Jashore and Gazipur.

**The IMIS provides three key functions to city authorities:**

1. It is a reporting tool that displays information in services by ward, type or date, and monitors operational, financial or stakeholder mandate indicators.
2. It is a service management tool, currently for FSM, that, combined with the mobile app, enables real-time service reporting through the convenience of easy and immediate data recording, emptying from customer premises, transport, or emptying at FSTP.
3. It is a data integration platform with the capability to hold and generate diverse spatial based analysis data; from status of tax payments per holding or wards, to potential waterlogging areas, or simply knowing in advance the width of a road to access for an emptying service to decide which vacutug type to send.

## 3.10. FSM Monitoring – Integrated Municipal Information System (IMIS)

**Components of IMIS:**

1. **Building Information Management System:** IMIS can be used to maintain building data. Utilizing a mobile app, MIS facilitates the addition of new buildings with location data.
2. **Property Tax Collection Support System:** IMIS can locate integrated property tax payment status, spatial visualization of structures with their tax status, containments, and many other features in Tax Zone.
3. **Urban Management Decision Support System:** IMIS offers a dashboard, simple navigation tools, tools, and many more features that aid in planning and decision-making.
4. **Utility Information Management System:** IMIS can update data on drains and roadways.
5. **SWM Information Support System:** Users of IMIS can see the areas that Solid Waste Management (SWM) services and beneficiary buildings serve.
6. **Water Supply Information Support System:** Through IMIS, it is possible to check the geographical visualization of buildings and the integration of water supply bill payment status data.
7. **Septic Tank Inspection Support System:** Containment assessment for emptying is made possible by IMIS (Supervisor Mobile App).
8. **Fecal Sludge Information Management System:** IMIS offers information on transfer stations, treatment plants, service providers, and compost sales in addition to application/customer information management and containment information management facilities.
9. **FSM Monitoring & Evaluation System:** IMIS assists the Vacutug operator with the gathering of emptying service details, customer feedback, and a chart displaying the containments that will be emptied in the upcoming month or on a chosen date. a graph displaying applications by wards, Service of chart emptying / Comments, Service of chart emptying by year.

Through IMIS, the municipal GIS database for the town can be identified. The location of buildings, drains, containments, tax zones, water bodies, and roads can be identified.

**Figure 15:** *Municipal GIS and CWIS Database*


IMIS is a tool for sanitation planning, infrastructure investment planning, and decision-making. Through IMIS, a number of containments can be identified within a given range or location.

**Figure 16:** *Containment Location Finding within Given Range in the IMIS*

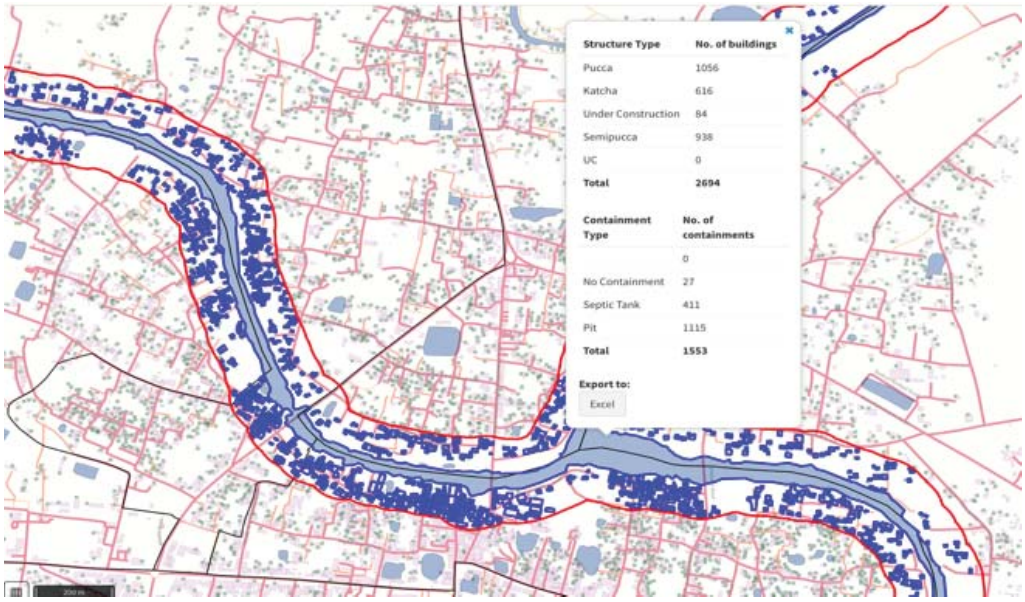
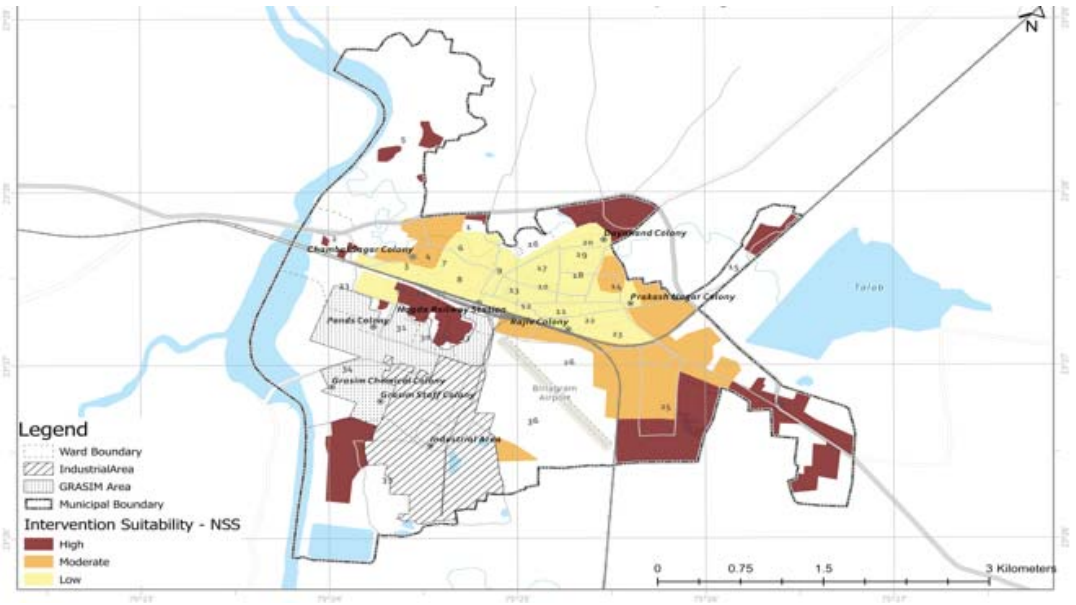


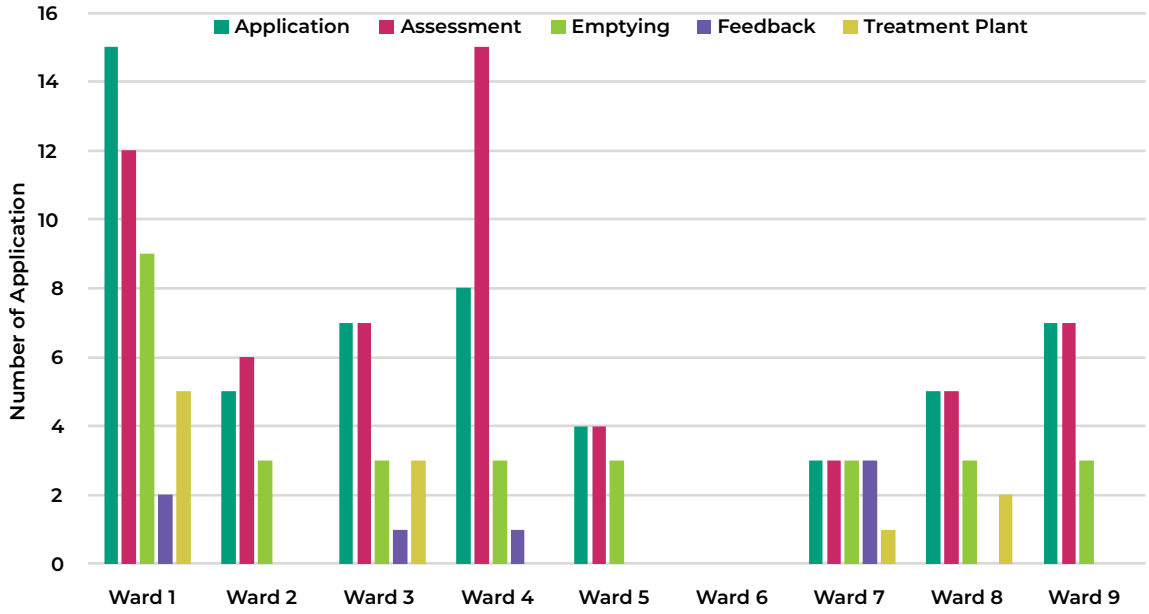
**Figure 17:** *Sanitation Intervention Feasibility Analysis*




The IMIS Dashboard shows real-time data for better monitoring of service. Though dashboard service provider numbers, total containment emptied, total application number, total volume of sludge emptied, and total volume of sludge on the treatment plant can be found for a given timeframe, ward-by-ward application status can also be monitored.

**Figure 18:** *FSM Service Dashboard*

**Figure 19:** *Application Status by Wards*




Tax payment status and water bill payment status can also be checked through IMIS.

**Figure 20:** *Tax Payment Status*

**Figure 21:** *Water Payment Status*


Through IMIS, total revenue collection by ward, service quality, service efficiency, and the number of total containments emitted for a given period can be determined.

**Figure 22:** *Total Revenue Collected by Ward*

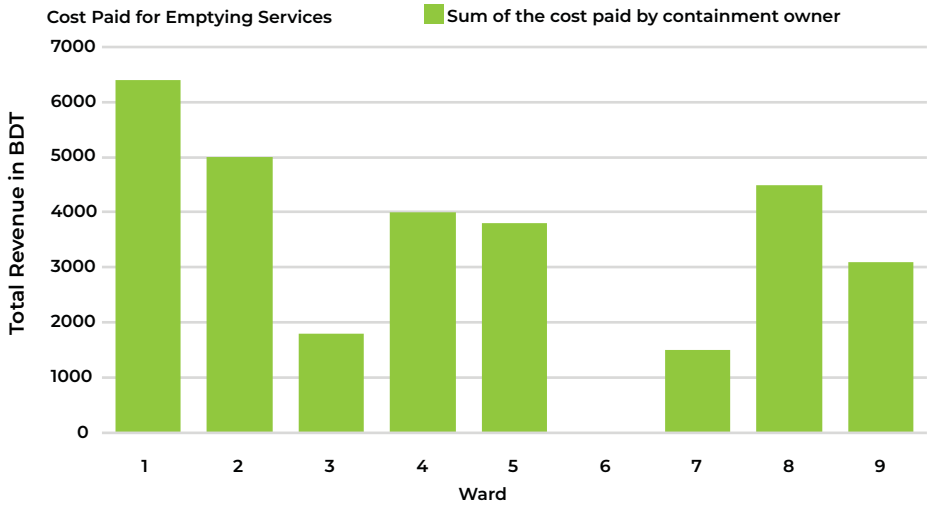


**Figure 23:** *Total Containments Emptied in the Year*

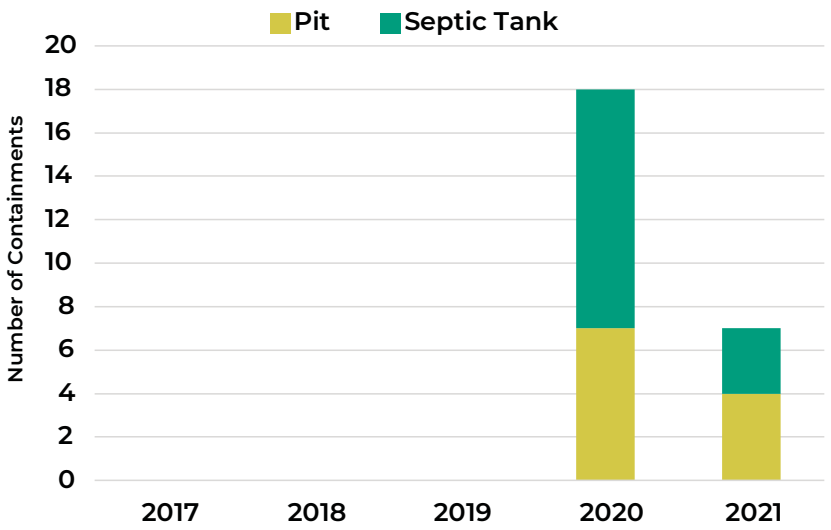



**Figure 24:** *Quality of Service*

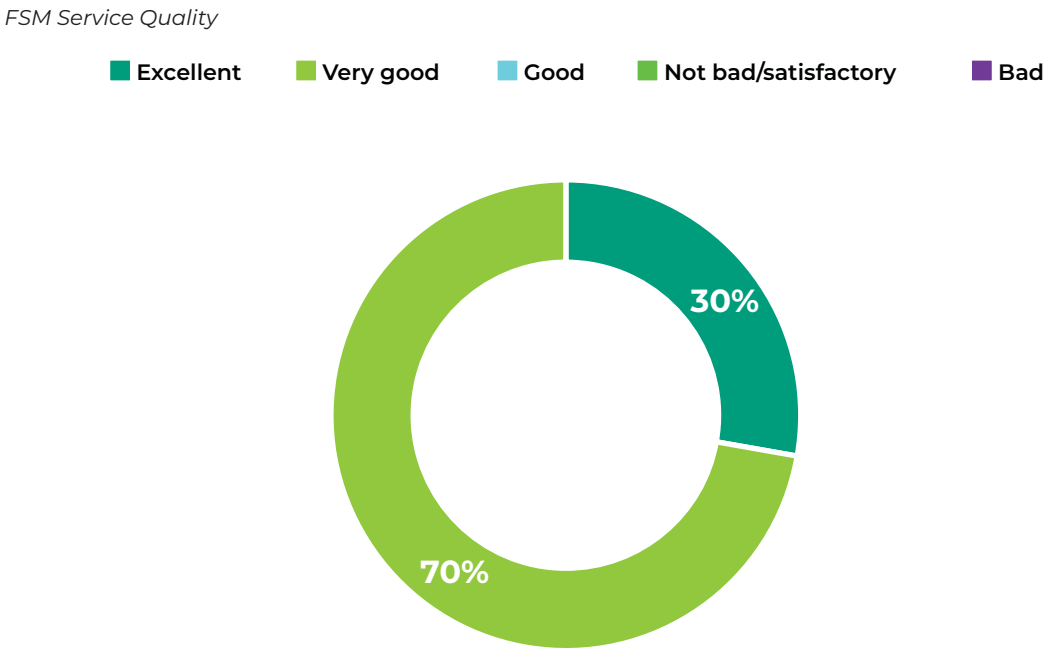
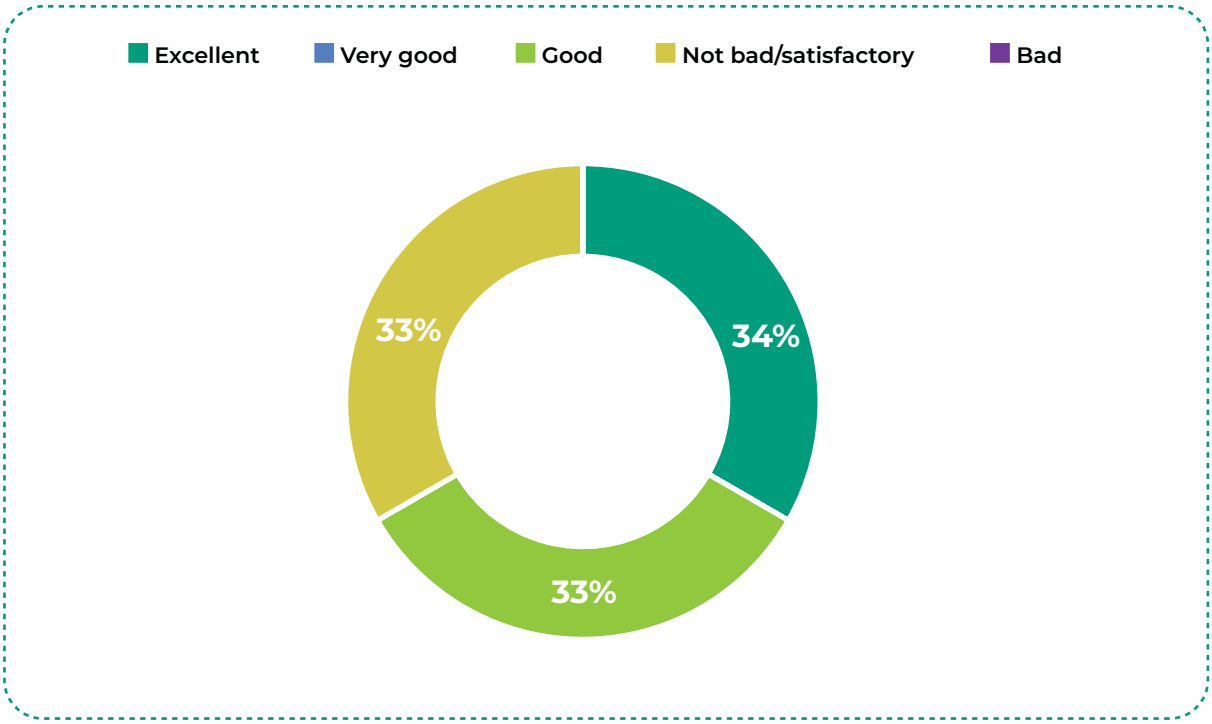


**Figure 25:** *Service Efficiency*




**Steps to Implement IMIS:**

1. **GIS data creation:** Gathering the GIS data that is already accessible, Gap analysis, digitizing the missing data layers using high quality satellite images, Field validation and the creation of a fundamental GIS database.

   Timeframe: 2-3 Months (20,000 Buildings).

2. **Census survey & creation of attribute data:** Obtaining data on the attributes of structures, containments, utilities, etc., gathering it, combining it with GIS data, and analyzing gaps. build an attribute database.

   Timeframe: 3-4 Months.

3. **IMIS customization & setup:** Examining the functional requirements of the system, paying close attention to value-added features. Analyzing the system optimization, SOP optimization, operational processes and policy directives.

   Timeframe: 1-2 Months.

4. **Data migration:** Data migration in the server and system preparation for training.

   Timeframe: 0.5 Months.

5. **Training & launching:** Conducting hands-on operational training for relevant departments, obtaining trainee input, making necessary system updates, creating a sustainability plan for the implementation of the system and launching the system.

   Timeframe: 0.5 Months.

## References and Further Reading

1. Report on Study on Willingness to Pay for Fecal Sludge Management Service, SNV https://a.storyblok.com/f/191310/44a2cbb55b/faecal_sludge_management_service.pdf

2. IMIS: improving municipal-led FSM service efficiency and accountability

https://www.snv.org/update/imis-improving-municipal-led-fsm-service-efficiency-and-accountability

# 04

## FSM BUSINESS ANALYSIS

# 4. FSM Business Analysis

## Objectives

The objective of the session is to analyse Cost-Revenue of FSM Business Models and design Business Model for Participants of Municipality.

## Learning Outcome

**At the end of this session participants will be able to:**

- Know about different financial terms (inflation, NPV, market discount rate, cost of fund, IRR).
- Understand the financial analysis of integrated FSM and solid waste management.
- Understanding NPV calculation with general example and based on IWM.
- Calculate FS Generation, trip numbers and cost-revenue analysis of day-to-day FSM business analysis.

## Session Timing

**150 minutes**

## Key Contents

### 4.1. Cost-Revenue Analysis of Integrated Waste Management (FSM and Solid Waste Management)

In this section, financial analysis will be done for FSM including with Solid Waste Management since in coming days municipalities are planning for integrated waste management system. For every project, costs arise from capital investment and operational expenses. Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) detailing of a probable Integrated Waste Management (IWM) Treatment Plant can be found here. This is a conceptual project detailing which is close to the real one. Here core components (purchasing components and site preparation cost) for CAPEX can be found. In addition, for Solid Waste Collection system major purchasing components also discussed. There are three types of operational maintenance. One is annual, another is bi-annual, and others need to change every 5 years. Here staffing cost of OPEX also discussed.

Revenue generation scopes are also discussed here. Revenue can come from septic tank cleaning fees, solid waste collection fees, and compost sales revenue. If it is only FSM, then revenue can come in only two ways. The term 'Base Level Tariff (BLT)' is introduced here and for this conceptual project, calculation of Net Present Value (NPV) and concept of Internal Rate of Return (IRR) can be found also.

### 4.1.1. Capital Expenditure

**Table 10:** *Costs for IWM (FSM + SWM) Treatment Plant (A)*

| Sl. | Item | Unit Cost in BDT | Total Cost in BDT |
|---|---|---|---|
| 1 | Boundary wall and gate | 7,475,000 | **7,475,000** |
| 2 | Fecal sludge and wastewater treatment | | **10,280,080** |
| | 2.1 Planted drying bed – 3 Nos | 1,564,000 | *4,692,000* |
| | 2.2 Anaerobic baffled reactor and constructed wetland – 2 Nos | 2,277,000 | *4,554,000* |
| | 2.3 Polishing Pond | | *1,034,080* |
| 3 | Solid waste treatment plant (compost shed and others) | | **15,575,600** |
| | 3.1 Compost zone | | *11,463,200* |
| | 3.2 Waste separation zone | | *1,564,000* |
| | 3.3 Leachate tank | | *754,400* |
| | 3.4 Post maturation chamber | | *1,794,000* |
| 4 | Internal road and surface drainage | 4,513,326 | **4,513,326** |
| 5 | Combustible waste shed | 2,250,507 | **2,250,507** |
| 6 | Garage shed and cleaning zone | 1,771,000 | **1,771,000** |
| 7 | Electrification of plant | 183,259 | **183,259** |
| 8 | Secondary stations - 3 Nos | 873,821 | **2,621,463** |
| 9 | Paint works | 165,581 | **165,581** |
| 10 | Pipe network | 263,444 | **263,444** |
| 11 | Site office | 166,628 | **166,628** |
| 12 | Combustible waste system (2.5T) | 42,000,000 | **42,000,000** |
| | **Total construction cost (A)** | | **87,265,890** |

**Table 11:** *Site Preparation and Land Development Cost (B)*

| Sl. | Items | Unit Cost in BDT/CUM | Quantity (CUM) | Total Cost in BDT |
|---|---|---|---|---|
| 1 | Site improvement/ earth filling with specified soil in/c supplying, carrying, filling (Municipal Area) | 450 | 12,384 | 5,572,800 |
| | Total cost for Site Preparation and Land Development (b) | | | **5,572,800** |
| | **Total Cost (A+B)** | | | **92,838,690** |

**Table 12:** *Procurement Cost for FSM Services (C1)*

| Sl. | Description of Items | Unit Cost In BDT | Total Cost In BDT |
|---|---|---|---|
| 1 | Desludging Trucks (2000 L)-2 $m^3$-1 Nos. | 4,900,000 | 4,900,000 |
| 2 | Desludging Trucks (1000 L)-1 $m^3$-0 Nos. | 3,400,000 | 0 |
| 3 | Sludge Transfer Equipment – 3 Nos. | 50,000.00 | 150,000 |
| | **Sub-total (C1)** | | **5,050,000** |

**Table 13:** *Procurement Cost for Solid Waste Transport Vehicles and Equipment (C2)*

| Sl. | Description of Items | Unit Cost In BDT | Total Cost In BDT |
|---|---|---|---|
| 1 | Dump Truck Tipper (3 Ton capacity) | 4,000,000 | 4,000,000 |
| 2 | Excavator -0 Nos | 5,000,000 | 0 |
| 3 | Rickshaw Van (Manual) – 6 Nos | 30,000 | 180,000 |
| 4 | Hand Trolly – 12 Nos | 12,000 | 144,000 |
| 5 | Compost Turner | 100,000 | 100,000 |
| 6 | Generator (10 KV) | 500,000 | 500,000 |
| 7 | Sweeping Tools and Misc. | 100,000 | 100,000 |
| | **Sub-total (C2)** | | **5,024,000** |
| **Total Procurement Cost for IWM Services (C1+C2)** | | | **10,074,000** |
| **Total Capital Expenditure (A+B+C1+C2)** | | | **102,912,690** |

**Assumption:**

- The Life-Time of Infrastructure Items including Fecal Sludge and Solid waste Transport Equipment for Integrated Waste Management Treatment Plant is assumed for 15 years generally considering the Depreciation value, Maintenance and Repair Cost and Replacement Cost aspect.
- Assumed total Population 40,000 (5 person in a family), Monthly FS generation 120 $m^3$, monthly solid waste generation 372,948kg, FS treatment capacity 8 $m^3$/day, non-combustible solid waste treatment capacity 4 MT/day, combustible solid waste treatment capacity 2.5 MT/day, land required 1.02 acre.

### 4.1.2. Operational Expenditure

**Table 14:** *Operation and Maintenance Cost Assumptions for Treatment Plant (A)*

| Sl. | Description of items | Unit Cost, BDT | Total Cost, BDT |
|---|---|---|---|
| 1 | **Plant Repair and Maintenance** | | |
| | Regular maintenance for generator | | 50,000 |
| | Land scaping maintenance | | 20,004 |
| | Electricity cost – 12 months | 50,000 | 600,000 |
| | Drinking water– 12 months | 1,000 | 12,000 |
| | Safety Gears for Driver and Operator – 13 sets X 12 months | 1,072 | 167,232 |
| | Vehicle Tools and Equipment (Maintenance-repair) – 12 months | 10,000 | 120,000 |
| | Plant and Vehicle Running Fuel-Lubricant Cost – 12 months | 27,000 | 324,000 |
| | **Total Cost (Annual Item)** | | **1,293,236** |
| 2 | **Bi-annual Item** | | |
| | Tire Replacement (Trucks) – 4 Nos | 20,000 | 80,000 |
| | **Total Cost (Bi-annual item)** | | **80,000** |
| 3 | **Every 5 Year Item** | | |
| | Replacement of Plasma Cracking Chamber (0.30% of cost of Combustible waste system) | | 126,764 |
| | Periodic maintenance of Solar Panel (repairs and replacements) | | 60,000 |
| | Replacement of screens in Screening chamber | | 24,000 |
| | **Total Cost (every 5 Year)** | | **210,764** |
| 4 | **Replacement roof sheets in every 8 years** | | **60,000** |

**Table 15:** *Staffing Costs (B)*

| Sl. | Item | Monthly Salary | Annual Salary in BDT |
|---|---|---|---|
| 1 | Supervisor | 23,000 | 276,000 |
| 2 | Truck/Equipment Operator | 23,000 | 276,000 |
| 3 | Sweeper/Labors (3 Persons) | 16,000 | 576,000 |
| 4 | Helper (3 Persons) | 16,000 | 576,000 |
| 5 | Van Operator (3 Persons) | 16,000 | 576,000 |
| 6 | Office Staff | 16,000 | 192,000 |
| 7 | Vacutug Driver | 16,000 | 192,000 |
| | **Total Staffing Expense** | **126,000** | **2,664,000** |

### 4.1.3. Revenue Generation

**Table 16:** *Revenue Generation*

| Sl. | Item | Revenue In BDT (per trip) | Monthly Units (Trip or HH or KG) | Annual Revenue In BDT |
|---|---|---|---|---|
| 1 | Septic Tank Cleaning Fee | 1,000 | 120 | 1,000 x 120 x 12 = 1,440,000 |
| 2 | Solid waste Collection Fee | 100 | (8,000-800) x 0.5 = 3,600 | 100 x 3,600 x 12 = 4,320,000 |
| 3 | Revenue from Compost sale | 15 | 500 | 12 x 15 x 500 = 90,000 |
| **Total Revenue** | | | | **5,850,000** |

**Boundary Conditions:**

- For 2m³, the VT (FSM Service) charge should be BDT 1,000 per trip, considering demand-based emptying rather than scheduled emptying. In this context, low-income communities (LIC) will be provided free of charge as part of the equitable, safe sanitation service concept. Based on the efficiency calculation of a 2m³ VT for FSM services, 80% efficiency has been assumed, meaning the VT can serve 5 times a day and 24 days a month.
- For solid waste management, 10% of LIC dwellers should be free of charge because of the safe and equitable green service management concept for municipalities. At present, a maximum of 50% collection service can be provided to city dwellers in HH on an average BDT 100.00 fee.
- For the sale of biofertilizer by the co-composting process, on average, 500kg can be produced initially per day, and the selling price is BDT 15.00 per kg.

### 4.1.4. Financial Assumption

**Table 17:** *Financial Assumption*

| Sl. | Item | Rate |
|---|---|---|
| 1 | Cost Inflation and Revenue Inflation.<br>Inflation rate considered for Bangladesh during project planning stage | 8% |
| 2 | Market Discount Rate/Cost of Funds | 10% |

**Inflation:** Inflation is the rate of increase in prices over a given period of time. Inflation is typically a broad measure, such as the overall increase in prices or the increase in the cost of living in a country

**Market discount rate:** Market discount rate also called required rate of return, is the rate of return required by investors based on the risk of the investment.

**The cost of funds:** The cost of funds is the interest rate paid by lenders for the funds they use in their business.

## 4.2. Financial Ratios

### 4.2.1. Net Present Value (NPV)

Net Present Value (NPV) is the value of all future cash flows (positive and negative) over the entire life of an investment discounted to the present. Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project.

**Formula:**

$$NPV = \frac{Cash\ Flow_1}{(1+r)^1} + \frac{Cash\ Flow_2}{(1+r)^2} + \cdots + \frac{Cash\ Flow_n}{(1+r)^n} - Initial\ Investment$$

- Cash Flow is the sum of money spent and earned on the investment or project for a given period of time.
- n is the number of periods of time.
- r is the market discount rate.

**Interpretation of Net Present Value:**

Net present value has three potential outcomes:

- Positive NPV: A positive NPV means the project or investment may be profitable and worth pursuing.
- Negative NPV: A negative NPV means the project or investment is unlikely to be profitable and should probably not be pursued.
- Zero NPV: A zero NPV means the project or investment is neither profitable nor costly.

**Recommendations:**

- It is recommended not to accept a project unless it generates a positive NPV when discounted by the opportunity cost of funds or Market Discount Rate.
- Within the limit of a fixed budget, it is recommended to choose that subset of available project that maximizes NPV.
- Where no budget constraint but a project must be chosen from mutually exclusive alternatives, it is better to always choose the one that generates highest NPV.
- When comparing mutually exclusive projects of different lengths of life, it is recommended to choose the one with highest NPV, after adjusting their project lives to comparable length.

**Example:**

**Question 1:** What will be the 'Present value-PV' of BDT 1,000 (future value-FV) after 1 year where market discount rate is 10%?

**Answer:**

Equitation to calculate Present Value (PV) from Future Value (FV) is:

$$PV = FV \times \frac{1}{(1+r)^n}$$

$$PV = 1000 \times \frac{1}{(1+0.1)^1} = 909.09$$

**Question 2:** Calculate NPV of the project 'A' and 'B' and suggest which project should be accepted assuming market discount rate is 10%. Capital/initial investment for project 'A' is BDT 50,000 and for project 'B' is BDT 70,000.

**Table 18:** *Cash Inflow (All Values in BDT)*

| Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **Project 'A'** | 15,000 | 25,000 | 25,000 | 7,000 | 5,000 |
| **Project 'B'** | 45,000 | 25,000 | 15,000 | 8,000 | 5,000 |

**Table 19:** *Discounting Factor*

| Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **Discounting Factor (DF), $(\frac{1}{(1+r)^n})$** | $\frac{1}{(1+0.1)^1} = 0.909$ | $\frac{1}{(1+0.1)^2} = 0.826$ | 0.751 | 0.683 | 0.621 |

**Answer:**

**Table 20:** *Project 'A' (All Values in BDT)*

| Year | Cash Flow | DF at 10% | Present Value (PV)= Cash Flow x DF |
|---|---|---|---|
| 0 | -50,000 | 1 | -50,000 |
| 1 | 15,000 | 0.909 | 13,635 |
| 2 | 25,000 | 0.826 | 20,650 |
| 3 | 25,000 | 0.751 | 18,775 |
| 4 | 7,000 | 0.683 | 4,781 |
| 5 | 5,000 | 0.621 | 3,105 |
| | | **NPV** | **10,946** |

**Table 21:** *Project 'B' (All Values in BDT)*

| Year | Cash Flow | DF at 10% | Present Value (PV)= Cash Flow x DF |
|---|---|---|---|
| 0 | -70,000 | 1 | -70,000 |
| 1 | 45,000 | 0.909 | 40,905 |
| 2 | 25,000 | 0.826 | 20,650 |
| 3 | 15,000 | 0.751 | 11,265 |
| 4 | 8,000 | 0.683 | 5,464 |
| 5 | 5,000 | 0.621 | 3,105 |
| | | **NPV** | **11,389** |

Since for same period of time, NPV is higher for project 'B' than project 'A' so project 'B' should be selected.

**NPV Calculation for IWM:**

Now NPV for Integrate Waste Management System will be calculated based on previously showed data.

Here, Fecal Sludge and Wastewater Treatment Cost and Site Preparation and land development cost are not considering as capital investment during NPV calculation. Solid waste transport vehicles and equipment cost and procurement cost for FSM services is considered as capital cost for NPV calculation.

**Procurement Cost for the IWM:** 10,074,000 BDT

**Estimated Yearly Revenue** (before starting of operation): 5,850,000 BDT

**Table 22:** *Yearly Operating Cost of IWM (All Values in BDT)*

| Item/ Year | Annual O&M | Bi-Annual Maintenance | Fifth-Annual Maintenance | One Time Maintenance | Staffing | Total |
|---|---|---|---|---|---|---|
| 1 | 0 | | 0 | 0 | 0 | **0** |
| 2 | 1,396,695 | 0 | 0 | 0 | 2,877,120 | **4,273,815** |
| 3 | 1,508,430 | 93,312 | 0 | 0 | 3,107,290 | **4,709,032** |
| 4 | 1,629,105 | 0 | 0 | 0 | 3,355,873 | **4,984,978** |
| 5 | 1,759,433 | 108,839 | 0 | 0 | 3,624,343 | **5,492,615** |
| 6 | 1,900,188 | | 309,682 | 0 | 3,914,290 | **6,124,160** |
| 7 | 2,052,203 | 126,950 | 0 | 0 | 4,227,433 | **6,406,586** |
| 8 | 2,216,379 | | 0 | 0 | 4,565,628 | **6,782,007** |
| 9 | 2,393,690 | 148,074 | 0 | 111,056 | 4,930,878 | **7,583,698** |
| 10 | 2,585,185 | | 0 | 0 | 5,325,348 | **7,910,533** |
| 11 | 2,792,000 | 172,714 | 455,025 | 0 | 5,751,376 | **9,171,114** |
| 12 | 3,015,359 | | 0 | 0 | 6,211,486 | **9,226,846** |
| 13 | 3,256,588 | 201,454 | 0 | 0 | 6,708,405 | **10,166,447** |
| 14 | 3,517,115 | | 0 | 0 | 7,245,078 | **10,762,193** |
| 15 | 3,798,485 | 234,975 | 0 | 0 | 7,824,684 | **11,858,144** |

*8% inflation adjusted for every year.

**Table 23:** *NPV Calculation for IWM (All Values in BDT)*

| Item/ Year | Capital Cost | Revenue (A)* | Operating Cost (B) | Net Cash Flow (A-B) | DF at 10% | Present Value (PV) = Cash Flow x DF |
|---|---|---|---|---|---|---|
| 1 | -10,074,000 | | | -10,074,000 | 1 | -10,074,000 |
| 2 | | 6,318,000 | 4,273,815 | 2,044,185 | 0.909 | 1,858,350 |
| 3 | | 6,823,440 | 4,709,032 | 2,114,408 | 0.826 | 1,747,445 |
| 4 | | 7,369,315 | 4,984,978 | 2,384,338 | 0.751 | 1,791,388 |
| 5 | | 7,958,860 | 5,492,615 | 2,466,245 | 0.683 | 1,684,479 |
| 6 | | 8,595,569 | 6,124,160 | 2,471,409 | 0.621 | 1,534,551 |
| 7 | | 9,283,215 | 6,406,586 | 2,876,629 | 0.564 | 1,623,782 |
| 8 | | 10,025,872 | 6,782,007 | 3,243,865 | 0.513 | 1,664,616 |
| 9 | | 10,827,942 | 7,583,698 | 3,244,244 | 0.467 | 1,513,464 |
| 10 | | 11,694,177 | 7,910,533 | 3,783,644 | 0.424 | 1,604,634 |
| 11 | | 12,629,711 | 9,171,114 | 3,458,597 | 0.386 | 1,333,439 |

| Item/ Year | Capital Cost | Revenue (A)* | Operating Cost (B) | Net Cash Flow (A-B) | DF at 10% | Present Value (PV) = Cash Flow x DF |
|---|---|---|---|---|---|---|
| 12 | | 13,640,088 | 9,226,846 | 4,413,242 | 0.350 | 1,546,815 |
| 13 | | 14,731,295 | 10,166,447 | 4,564,848 | 0.319 | 1,454,501 |
| 14 | | 15,909,799 | 10,762,193 | 5,147,606 | 0.290 | 1,491,078 |
| 15 | | 17,182,583 | 11,858,144 | 5,324,439 | 0.263 | 1,402,091 |
| | | | | | **NPV** | **12,176,631** |

*8% inflation adjusted for every year.

**Since NPV is positive so project can be implemented.**

### 4.2.2. Internal Rate of Return (IRR)

The internal rate of return (IRR) is a financial metric used in financial analysis to estimate the profitability of potential investments. The Internal Rate of Return (IRR) is the discount rate that makes the net present value (NPV) of a project zero. Its root lies in the internal rate of return, which is the return required to break even. IRR calculations rely on the same formula as NPV does. In theory, any project with an IRR greater than its cost of funds should be profitable. During ranking across several projects project with higher IRR should be chosen.

**Formula:**

$$0 = NPV = \frac{Cash\ Flow_1}{(1+IRR)^1} + \frac{Cash\ Flow_2}{(1+IRR)^2} + \cdots + \frac{Cash\ Flow_n}{(1+IRR)^n} - Initial\ Investment$$

- Cash Flow is the sum of money spent and earned on the investment or project for a given period of time.
- n is the number of periods of time.
- IRR is the market discount rate.

Because of the nature of the formula, IRR cannot be easily calculated analytically and instead must be calculated iteratively through trial-and-error method or by using software programmed to calculate IRR (e.g., excel).

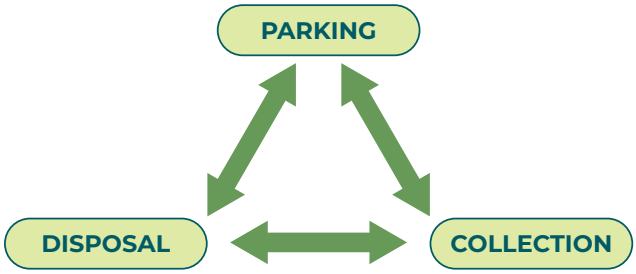
## 4.3. Financial Analysis of day-to-day FSM Business Monitoring

### 4.3.1. Average Trip/day considering Travel Distance

Per day trip calculation for a vacutug is depending on the travel distance. Travel distance is measured from collection point to disposal point. On average a vacutug can provide 8 trips per day if the travel distance is within 2km, per day trip number is 5-6 if the distance is within 6km and 4 tips per day if the travel distance is within 8 km.

**Figure 26:** *Travel Distance - Distance Between Collection and Disposal Point*

| Travel Distance (Kilometer) | Per Day Trips |
|---|---|
| 2 | 7-8 |
| 6 | 5-6 |
| 8 | 3-4 |




### 4.3.2. Household, FS Volume, Number of Trip Calculation

In this section, process of calculating the number of households to be served for FSM service, FS generation calculation, number of trip calculation, FS collection capacity of the municipality, Cost-Revenue and Profit/Loss for FSM operation discussed here. In this section, a small portion of the solid waste business calculation has been given in an easy format with FSM system. The focus is on the FSM day-to-day business plan.

For the below calculation, it is assumed that the municipality already has a certain number of vacutugs and wants to provide FSM service to the household of the municipality by itself. So, CAPEX is not included here and O&M of FSTP is not included. To make it easier sanitation tax, discharge fee, discharge incentives, licensing fee portion not included in the following calculation. The provided data are assumed data.

**Table 24:** *Number of Households (HHs) to Be Served for FSM Service*

| | |
|---|---|
| Total Population in Municipality | 70,000 |
| Average House Hold Size (Person in a family) | 5 |
| Percentage of HH with Septic Tank in the Municipality | 80% |
| Percentage of desludgeable/reachable septic tank in the municipality | 70% |
| Initially convenient population coverage of municipality | 40% |
| **Number of HH** = (Total population x % of HH with Septic Tank x % of Septic Tank which are desludgeable x % of Population covering by FSM facility)/ Average House Hold Size | **3,136** |

**Table 25:** *Trip Calculation*

| | |
|---|---|
| Number of Vacutug | 4 |
| Days operation in a week | 5 |
| Number of weeks in a year | 52 |
| Per day trip number | 4 |
| Years of Operation | 2 |
| **Total trips in year Operation** = Number of VT x Number week in a year x working days in a week x per day trip x years | **8,320*** |

*** Total Number of trips in 2 years (8,320) > Number of HH to be served in 2 years (3,136)**

**Table 26:** *Fecal Sludge Generation Calculation*

| | |
|---|---|
| Typical Volume (Size) of Septic Tanks in the municipality (in $m^3$) | 4 |
| Year for Every Single Desludge of septic tank | 2 |
| **Total Fecal Sludge Generation in Total Years in m^3**=No of HH x Typical Septic Tank Size | **12,544** |

**Table 27:** *Calculation of Collectable FS by Vacutug*

| | |
|---|---|
| Capacity of Vacutug in $m^3$ | 2 |
| Efficiency of Vacutug | 80% |
| **Collectable sludge vol by total trips in total years in $m^3$** = No of trips in total years x capacity of VT x efficiency of VT | **13,312**** |

** **Collectable sludge vol by total trips in total years (13,312 $m^3$)> Fecal Sludge Generation in Total Years in $m^3$**

**Table 28:** *Operation & Maintenance Cost (All Values in BDT)*

| | |
|---|---|
| Monthly Oil cost for per Vacutug | 7,000 |
| VT driver monthly salary (12,000~15,000) | 14,000 |
| VT Operator monthly salary (8,000~12,000) | 11,000 |
| Mobile / communication cost | 500 |
| VT Parking Average Cost | 1,500 |
| Total Monthly Fixed Cost = Oil Cost + VT Driver Salary + VT Operator Salary | 34,000 |
| Monthly VT Maintenance and other cost 8-10% of Fixed Cost | 10% |
| Monthly VT Maintenance and other cost | 3,400 |
| **Total Cumulative Cost Fixed Cost + VT Maintenance Cost** | **37,400** |
| Costing for total years of single VT | 897,600 |
| **Costing for total years for total VT** | **3,590,400** |

**Table 29:** *Revenue*

| | |
|---|---|
| Total Trips | 8,320 |
| Percentage of General Income Category | 50% |
| Percentage of Commercial Category | 20% |
| Percentage of Low-Income Community (LIC) Category | 30% |
| Average Per trip desludging fee (Base Level Tariff) for general income community (BDT) | 1,000 |
| Factor to calculate Commercial-Tariff based on BLT | 1.5 |
| Commercial-Tariff (BDT) | 1,500 |
| Factor to calculate LIC-Tariff based on BLT | 0.5 |
| LIC-Tariff (BDT) | 500 |
| Income generation by taking desludging fee from general income category in total years considering total trips (BDT) | 4,160,000 |
| Income generation by taking desludging fee from commercial Entity in total years considering total trips (BDT) | 2,496,000 |
| Income generation by taking desludging fee from LIC in total years considering total trips (BDT) | 1,248,000 |
| **Revenue from Desludging in total years (BDT)** | **7,904,000** |

**Table 30:** *Profit-Loss (All Values in BDT)*

| | |
|---|---|
| Profit/loss in total years of operation (Revenue-Cost) | 4,313,600 |
| Monthly Profit by Operating total VT | 179,733 |
| **Monthly profit for single VT** | **44,933** |

**Table 31:** *Financial Calculation of Solid Waste Collection System Cost*

| | |
|---|---|
| Number of solid wastes collecting van | 5 |
| Total Years for service | 2 |
| Monthly salary for 1 van operator (BDT) | 8,000 |
| Monthly Salary for 1 van helper (BDT) | 6,000 |
| Fixed Cost or salary (BDT) | 14,000 |
| Percentage of Maintenance Charge based on monthly fixed cost | 5% |
| Monthly Maintenance Cost (BDT) | 700 |
| Monthly Total Operating Cost (BDT) | 14,700 |
| Monthly cost for total vans (BDT) | 73,500 |
| **Cost for total year of operation (BDT)** | **1,764,000** |

**Table 32:** *Revenue*

| | |
|---|---|
| Total HH number | 3,136 |
| Monthly charge for Solid-waste Collection for per HH (BDT) | 60 |
| **Revenue generation in total years (No of HH x Monthly Charge x No of Months) (BDT)** | **4,515,840** |

**Table 33:** *Profit-Loss (All Values in BDT)*

| | |
|---|---|
| Profit or Loss in total years | 2,751,840 |
| **Monthly Profit or Loss** | **114,660** |

**Box 18:** *Different Modes of Financial Transactions*

| |
|---|
| **Sanitation Tax:** Municipality can impose sanitation tax from each HH. Sanitation tax can be 10-12% of total Holding Tax. |
| **Licensing Fee:** Municipality can introduce License charge for private operator. This can be a solid income for municipality. |
| **Discharge Fee:** For per trip discharge fee can be implemented. This will be added as cost in O&M cost on the other hand income for Treatment Plant operation. |
| **Discharge Incentives:** For per trip discharge incentives can be given. This will be added as income in revenue on the other hand cost for Treatment Plant operation. |

## 4.4. Financial Status of Existing FSM Service of Different Municipalities of Bangladesh

### 4.4.1. Financial Management of FSM Service in Lakshmipur Municipality

The FSM service in Lakshmipur Municipality started in 2013-14 with one emptying and transportation vehicle and a planted drying bed for the treatment of collected FS. The sources of capital investment for the components of the FSM service chain in the Lakshmipur Municipality. The Municipality provided 0.5 acres of land for the construction of the treatment plant. Although the Municipality will need more land for expansion of the treatment facility to cater to the demand if city-wide FSM service is to be achieved. The financial affairs in FSM in Lakshmipur Municipality are limited to the operation and maintenance of emptying and transportation service, as the FSTP needs low maintenance and does not produce any compost. The salaries of pit emptiers (including the driver, operator, and helper) are managed from the revenue earned from the emptying service. Capital funding sources status are given in the table.

**Table 34:** *Source of Funding for FSM Service Delivery in Lakshmipur Municipality*

| Item | **Source of Funding** |
|---|---|
| Vacutug | 5 vehicles (3 actives). Providedd by the government project. |
| Land for treatment plant | Municipality acquired 0.5-acre land |
| Construction of the co-compost plant | Supported by government projects. |

The records of yearly income and expenditure from emptying and transportation service in the Lakshmipur Municipality are provided in below Table. It is evident from the table that the Municipality makes profit from the emptying service after paying for all associated service-related costs. However, this is very common in all the Municipalities who run only emptying and transportation service but having no system for making co-compost or any other end-use products. Therefore, the profit from the emptying and transportation service should be interpreted as profit from only a part of the FSM system, as the current system in the Municipality does not cover the end-use component of the service chain.

**Table 35:** *Yearly Income and Expenditure Records of Emptying and Transportation in Lakshmipur Municipality (January 2021)*

| Service Period | Number of Trips | Total Income (A) (BDT) | Total Expenditure (B) (BDT) | Savings (A-B) (BDT) |
|---|---|---|---|---|
| Aug 2016 - Oct 2019 (2 year) | 2,289 | 2,288,700 | 1,830,960 | 457,740 |

### 4.4.2. Financial Management of FSM Service in Sakhipur Municipality

Sakhipur Municipality started providing FSM services in 2016 with support from WaterAid and BASA. It started the service targeting the full sanitation service chain. The sources of capital investment for the components of the full FSM service chain in Sakhipur Municipality are shown in the below Table. Sakhipur Municipality provided land for construction of a co-compost plant but relied on project funding for vacutug, and other equipment and infrastructure.

**Table 36:** *Source of Capital Investment for FSM Service Delivery in Sakhipur Municipality*

| Item | Source of Funding |
|---|---|
| **Vacutug** | 1 vehicle (active), which is project funded. |
| **Land for treatment plant** | The municipality has acquired 22 decimal lands. |
| **Construction of the co-compost plant** | Project funded. |

The yearly income and expenditure records from the FSM service is provided in Table 7-9. The solid waste collection service in Sakhipur Municipality is provided by a separate entity. The figures in the table suggest that a major part of the revenue comes from the collection service. But the system is yet to earn enough revenue from emptying service and sales of co-compost to cover all the costs associated with emptying and transportation, treatment, and making co-compost. One of the promising signs in Sakhipur Municipality is that the Municipality has started allocating some budget from its yearly revenue since 2018-19 that can be used for FSM, which is approximately BDT 200,000.

In the last two fiscal years, the Municipality spent a part of this budget for FSM.

**Table 37:** *Yearly Income and Expenditure Records of the FSM Service in Sakhipur Municipality (January 2021)*

| Service Period | Number of Trips | Total Income from Collection Service (A) (BDT) | Total income from co-compost sales (B) (BDT) | Total Expenditure (C) (BDT) | Savings (A+B-C) (BDT) |
|---|---|---|---|---|---|
| Jan - Dec 2019 | 523 | 523,000 | 292,898 | 942,873 | -126,975 |

### 4.4.3. Financial Management of FSM Service in Faridpur Municipality

Although FSM in Faridpur Municipality started almost a decade ago, the present treatment facility was established in 2017. The sources of capital investment for the current components of the full FSM service chain are shown in the below Table.

**Table 38:** *Source of Capital Investment for FSM Service Delivery in Faridpur Municipality*

| Item | Source of Funding |
|---|---|
| **Vacutug** | 7 vehicles (5 actives). All are project funded. |
| **Land for treatment plant** | Municipality acquired 3 acres of land for co-compost plant |
| **Construction of the co-compost plant** | Project funded. |

The financial model for operation and maintenance in FSM in Faridpur Municipality has two components: financial management of emptying and transportation service, and financial management of treatment and end-use. The Municipality assigned two pits of emptier cooperative groups (one in 2016 and another one in 2018) for operation and maintenance of the two emptying and transportation vehicles. The emptying and transportation fees collected from the customers were

received by pit emptier groups which were used to cover the operational cost, minor repair, and maintenance cost, and salary of pit emptiers and vacutug drivers. The Municipality was responsible for major repair and maintenance of the vehicles. In addition, one of the groups used to pay a monthly fee of BDT 16,500 to the Municipality, while the other group did not pay any fees as the vehicle that they were operating needed regular maintenance which they had to pay for.

The yearly income and expenditure records of emptying and transportation service are provided in the below Table. It is evident from the table that both cooperatives made a profit while they were operating the vehicles for providing an emptying service. During the FGDs, the pit emptiers reported that this has made the Municipality interested in directly providing this service as well, which could be a reason why the Municipality is yet to decide who will operate the new vehicles.

**Table 39:** *Yearly Income and Expenditure Records of Emptying and Transportation in Faridpur Municipality*

| Cooperative Name | Service Period | Number of Trips | Total Income (A) (BDT) | Total Expenditure (B) (BDT) | Lease Money (C) (BDT) | Savings (A-B-C) (BDT) |
|---|---|---|---|---|---|---|
| Kuthibari | Aug 2016 - Oct 2019 (2 year) | 1,603 | 1,788,021 | 1,088,419 | 156,410 | 543,192 |
| Bandhob Palli | May 2018 - Aug 2019 (1.25 year) | 620 | 542,282 | 344,304 | 0 | 197,978 |

The Faridpur Municipality co-compost plant is operated and maintained by SDC, who has been providing this service under a contract agreement with the Municipality since 2017. Under the agreement, the Municipality has given SDC the responsibility of collecting solid waste from households and also operating the treatment plant. It was reported by SDC that they make profit from the solid waste collection service but need to subsidize the cost of running the co-compost plant as the revenue from sales of co-compost is very inadequate, due to low production of co-compost, compared to the operation and maintenance cost of the plant. The overall income of SDC from solid waste collection and co-compost selling, and total expenditure of running solid waste collection and co-compost plants are summarized in the below Table.

**Table 40:** *Income and Expenditure Records of SDC from Solid Waste Collection Service and Co-Compost*

| Service Period | Income from Solid Waste Management (A) (BDT) | Income from co-compost sales (B) (BDT) | Expenditure for Solid Waste Management (C) (BDT) | Expenditure of co-compost plant (D) (BDT) | Savings (A+B-C-D) (BDT) |
|---|---|---|---|---|---|
| Sept. 2017 to Oct. 2019 | 10,791,177 | 146,792 | 10,518,241 | 1,153,579 | -733,851 |

As per Published document of January 2021.

## References and Further Reading

1. Performance assessment of FSM services in Faridpur, Lakshmipur and Sakhipur municipalities, ITN BUET Research Series 14.
https://itn.buet.ac.bd/web/publications/performance-assessment-of-fsm-services-in-faridpur-lakshmipur-and-sakhipur-municipalities/

# ANNEXURES

# ANNEX 01

## Group Work-1 for Module 2: Existing or Probable Service Model of Participants Municipality

Each participant will work as a group member. As a group the participants will receive the following FSM service chain printed in A4 paper:

| Law Regulation | | Collection | | Transport | | Treatment | | Enduse/Disposal |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

[Color Here]

Each group will sketch their proposed FSM service model on the provided A4 paper using colored markers, aligning with the standard service models illustrated in the slides by the facilitators (the models are also presented in section 2.1 in this handbook). They will also write down the features of their chosen service model by answering the questions printed below in bullet points in the supplied A3 paper.

Questions for the municipality having established in Fecal Sludge Management services

1. Who is responsible for fecal sludge collection in your municipality?
2. Who is responsible for the transportation of fecal sludge in your municipality?
3. Who is responsible for the treatment of fecal sludge in your municipality?
4. Draw your proposed FSM service model using color marker along the service chain in the printed A4 paper.
5. Please state 3 challenges associated with the existing service delivery along the service chain.
6. Please outline the potential solutions for the challenges.
7. Is there any scope to integrate SWM and FSM services in the municipality?

Questions for the municipality having no experience in Fecal Sludge Management services

1. Is there any sanitation unit in your municipality?
2. Are you informed about the NAP-IRF?
3. What are the existing practices regarding the FSM service delivery at your municipality?
4. Do you have any plan to introduce FSM service at your municipality?
5. Who will be responsible for collection of fecal sludge?
6. Who will be responsible for transportation of fecal sludge?
7. Who will be responsible for the treatment of fecal sludge?
8. Draw your proposed FSM service model using color markers along the service chain in the printed A4 paper.
9. Please give your reasons for selecting the service model.

# ANNEX 02

## Survey Task-1 for Module 3: Individual Survey Task for General Information

This survey will be conducted via Mentimeter /Google Form. Participants will receive the survey link through their email ID/ the training WhatsApp group/ QR code. The survey will include the following questions:

1. What is the most common type of toilet facility in your area/municipality?
    a. Pit Latrine cover
    b. Septic Tank
2. Is it possible to implement the demand base desludging system in your municipality (5= Strongly agree, 1= Strongly disagree)?

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

3. Municipality Perspective: What will be the preferred time of desludging considering the client's demand?
    a. Day
    b. Night
4. Municipality Perspective: What will be the preferred application process for desludging?
    a. Hard Copy Application
    b. Phone Call
    c. App/online based application
5. How much time municipality will take to provide the desludging service after receiving the application?
    a. Withing 8 Hour
    b. Within 24 Hour
    c. Within 48 Hour
    d. More than 48 Hour

6. Which one is the preferred payment method considering the client and municipality facility?
    a. Cash Payment during the application
    b. Cash Payment during the desludging service
    c. Bank Payment during application submission
    d. Bkash/Online Payment during the application
    e. Bkash/Online Payment during the desludging service

7. Rate the effectiveness of mechanical desludging service in your municipality? (5=very effective, 1=not effective at all)

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

8. Will it be necessary to involve manual emptiers alongside mechanical desludging services in your municipality?
    a. Yes
    b. No

9. Can arrangements be made to deploy a proficient individual to operate and drive the vacutug in your municipality?
    a. Yes
    b. No

10. What percentage of households in your municipality can be accessible by the vacutug?

| | | | | | |
|---|---|---|---|---|---|
| 00 | 20 | 40 | 60 | 80 | 100 |

11. Is it possible to implement sanitation tax to facilitate the provision of scheduled desludging in your municipality?
    a. Yes
    b. No
12. Will it be possible to charge extra for urgent desludging? If yes, then how much?
    a. No
    b. Yes, 1.25 times of regular tariff
    c. Yes, 1.5 times of regular tariff
    d. Yes, 2 times of regular tariff

# ANNEX 03

## Survey Task-2 for Module 3: Individual Survey Task for Financial Calculation

This survey will be conducted via Metimeter /Google Form. Participants will receive the survey link through their email ID/ the training WhatsApp group/ QR code. The survey will include the following questions:

**Survey Questions:**

1. What is the total population of your municipality?
    a. 30,000
    b. 50,000
    c. 70,000
    d. 90,000
    e. More than 100,000

2. What is the average household size in your municipality?
    a. 4
    b. 5
    c. 6
    d. 7
    e. More than 7

3. What is the percentage of HH with septic tank in your municipality?
    a. 30%
    b. 40%
    c. 50%
    d. 60%
    e. 80%
    f. 100%

4. What is the percentage of desludgeable/reachable septic tank in your municipality by vacutug?
    a. 40%
    b. 50%
    c. 60%
    d. 70%
    e. 80%
    f. 100%

5. In the initial phase of a new FSM operation, what is the convenient population coverage for your municipality for service delivery?
    a. 20%
    b. 30%
    c. 40%
    d. 50%

e. 60%
f. 70%

6. What is the typical volume (Size) of septic tanks in your municipality?
   a. 1 $m^3$ (1,000 liter)
   b. 2 $m^3$ (2,000 liter)
   c. 3 $m^3$ (3,000 liter)
   d. 4 $m^3$ (4,000 liter)

7. Considering the size of the septic tank, what could be the appropriate frequency for the desludging?
   a. Every 1 year
   b. Every 2 Year
   c. Every 3 Year
   d. Every 4 Year
   e. Every 5 Year

8. Based on the above assumptions please select the number and size of required Vacutugs-

| Volume of Vacutugs | | No. of Vacutugs |
|---|---|---|
| 1.0 $m^3$ (1,000 liter) | | 2 |
| | | 3 |
| 1.5 $m^3$ (1,500 liter) | | 4 |
| | | 5 |
| 2.0 $m^3$ (2,000 liter) | | 6 |
| | | 7 |

9. How many days in a week vacutugs should be operated?
   a. 4
   b. 5
   c. 6
   d. 7

10. As per assumption, what will be the total number of trips in a day by a vacutug? [Assume HH distance from desludging plant is 5-7km]
    a. 3
    b. 4
    c. 5
    d. 6
    e. 7

# ANNEX-04

## Group Work-2 for Module 4: Financial Calculation of FSM Business Model

The participants will utilize the survey results from module 3 to perform the financial calculation. Each Group will write their group number and their members name in the supplied A4 paper as following:

**Group Number:**

**Members Name:**

**1.**

**2.**

**3.**

**4.**

**5.**

For calculation purposes, two groups will utilize the highest-score from survey responses, while the other two groups will work on the second-highest responses for each question. Subsequently, they will conduct a cost-revenue analysis using the data. The groups will calculate the household numbers, trip count, FS generation, costs, revenue and monthly profit/loss onto either a laptop using Excel or on paper by hand following the below templates provided by the facilitator.

The templates for the calculation are shown here.

## Household Count:

**Total Population in a Municipality** (Survey Result):

**Average HouseHold (HH) Size** (Survey Result):

**% of HH with Septic Tank** (Survey Result):

**% of Septic Tank which are Desludgeable** (Survey Result):

**% of Population covering by FSM facility** (Survey Result):

**Formula of Number of Household**

$$\frac{\text{Total population} \times \%\text{ of HH with Septic Tank} \times \%\text{ of Septic Tank which are desludgeable} \times \%\text{ of Population covering by FSM facility}}{\text{Average House Hold Size}}$$

____ x ____ x ____ x ____ ÷ ____

**Number of Household:** = HH

## Total Trip Count

| | |
|---|---|
| **Frequency of desludging in years** (Survey Result): | |
| **Number of Vacutug** (Survey Result): | |
| **Number of Week in a Year:** | 52 |
| **Per Day Trip by VT** (Survey Result): | |
| **Per Week VT Operational Work Day** (Survey): | |
| **Number of Household** (Calculated): | |

**Formula of Yearly Trip Count**

① Number of VT x Number week in a year x Per day trip x Per week x VT Operational Work Day

[ ] x [ 52 ] x [ ] x [ ]

**Per Year Trip Count** = Nos

**Formula of Trip Count in Total Years**

② Per Year Trip Count x Total Year

[ ] x [ ]

**Trip Count in total Years:** = Nos

**_____trips are required for ___years to desludge FS of _____ nos. HHs.**

*In ideal case total trips in total years should be greater than total ....

## Total FS Volume Count:

**Typical Vol of Septic Tank in $m^3$** (Survey Result)**:**

**Frequency of desludging in years** (Survey Result)**:**

**Capacity of Vacutug in $m^3$** (Survey Result)**:**

**Efficiency of Vacutug** (Survey Result)**:** 80%

**Number of Household** (Calculated)**:**

**Total Trips in total years** (Calculated)**:**

**Formula of FS volume generated in Total Years in HHs**

① No of HHs x Typical Septic Tank Size

[ ] x [ ]

**FS volume generated in Total Years in HHs** = $m^3$

**Formula of Collectable sludge volume by total trips in total years**

② No of trips in total years x Capacity of VT x Efficiency of VT

[ ] x [ ] x 0.80

**Collectable sludge volume by total trips in total years**

*In idle case collectable sludge vol. by VT should be greater than the FS generated in HHs.

= $m^3$

## Cost-Revenue Analysis: Costing

| | |
|---|---|
| **Monthly Oil Cost: 5,000-7,000** (Assume) | |
| **VT Driver monthly salary: 12,000-16,000** (Assume) | |
| **FS/VT Operator monthly salary: 10,000-12,000** (Assume) | |
| **Mobile/Communication Cost: 500-700** (Assume) | |
| **VT Parking Average Cost: 1,000-1,500** (Assume) | |
| **Maintenance & other cost 8-10% of Fixed Cost** (Assume) | **10%** |

**Formula of Total Monthly Fixed Cost**

① **Oil Cost** + **VT Driver Salary** + **VT Operator Salary** + **Communication Cost** + **VT Parking Average Cost**

\+ \+ \+ \+

**Total Monthly Fixed Cost** = BDT

②

| | |
|---|---|
| **Monthly VT Maintenance and other cost is 10% of total Monthly Fixed Cost (BDT)=** | = |
| **Monthly Total Cumulative Cost = Fixed Cost + VT Maintenance Cost** | = |
| **Costing for total years for '1' VT = Cumulative Monthly Cost x Number of months in total years** | = |
| **Costing for total years for total VT = Costing for '1VT' x Number of VT** | = |

## Cost-Revenue Analysis: Revenue

| | |
|---|---|
| **HH Number** (calculated): | |
| **Number of trips in total Years** (calculated): | |
| **% of General Income Group** (Assume): | |
| **% of Commercial Entity** (Assume): | |
| **% of Low-Income Community (LIC)** (Assume): | |
| **Avg. Per Trip Desludging Fee, Base Level Tariff (BLT)** (Assume): | |
| **Avg. Per Trip Desludging Fee for Commercial Entity, (1.5 times of BLT)** (Assume): | |
| **Avg. Per Trip Desludging Fee for LIC, (0.5 times of BLT)** (Assume): | |

| | |
|---|---|
| **Income generation from General income Group** = **Total Trips** x **Group %** x **Fee** | = |
| **Income generation from Commercial income Group** = **Total Trips** x **Group %** x **Fee** | = |
| **Income generation from LIC income Group** = **Total Trips** x **Group %** x **Fee** | = |
| **Total Revenue of Desludging from three Income Groups (sum of 3 groups income)** | = |

**Profit/Loss:**

**Costing for [ ] years for [ ] VT =**

**Revenue from Desludging in [ ] years =**

**Profit/loss in [ ] years operation =** - =

**Monthly Profit by operating [ ] VT =** ÷ Total Month of Operation =

**Monthly Profit for 1 VT =** ÷ No. of VT =

PRESENTATION SLIDES

01
INTRODUCTION AND OVERVIEW

## Learning Outcome

At the end of this session Participants will be able to:

- Learn about the 17 Sustainable Development Goals and targets of SDG-6
- Discuss about the system functions and service outcomes of Citywide Inclusive Sanitation (CWIS)
- Know the components of Fecal Sludge Management (FSM).
- Know about the Institutional and Regulatory Framework for Fecal Sludge Management & National Action Plan (IRF-NAP)

## Sustainable Development Goals (SDGs)

## SDG has 17 Goals

## Sustainable Development Goal 6 - Clean water and sanitation

| | |
|---|---|
| Target 6.1: Safe and affordable drinking water | Target 6.5: Implement Integrated Water Resource Management (IWRM) |
| Target 6.2: End open defecation and provide access to sanitation and hygiene | Target 6.6: Protect and restore water-related ecosystems |
| Target 6.3: Improve water quality, wastewater treatment, and safe reuse | Target 6.A: Expand water and sanitation support to developing countries |
| Target 6.4: Increase water-use efficiency and ensure freshwater supplies | Target 6.B: Support local engagement in water and sanitation management |

## Citywide Inclusive Sanitation (CWIS)

## Citywide Inclusive Sanitation (CWIS)

Past TRADITIONAL APPROACHES

- Master planning/ investment only for centralized systems
- Financed by central govt./loans
- Wealthy/affluent districts prioritized
- Limited coverage
- Sustainability challenges for O&M
- Resource recovery not considered
- No performance management
- On-site, small network not considered

Present APPROACHES

- Often standalone pilots, not mainstreamed
- NGO / pilot financed
- Poor communities targeted but often missed
- Informal businesses, NGOs independent from service authorities
- Business models often unable to scale
- Limited professional capacity

## Citywide Inclusive Sanitation (CWIS)

THE FUTURE CWIS

CWIS focuses on promoting public service approaches ensuring everyone in an urban area is served by safe, equitable, and financially viable sanitation service systems. This means systems are designed to reach the poor and to ensure human waste is safely managed along the whole sanitation service chain.

## Through The Lens: City Wide Inclusive Sanitation

Seven Principles of CWIS:

EVERYONE BENEFITS from safe services and public investment equitably, with a focus on reaching the poorest

GENDER & SOCIAL EQUITY are designed into planning, management, monitoring

Human waste is SAFELY MANAGED ALONG THE SANITATION CHAIN, starting with containment

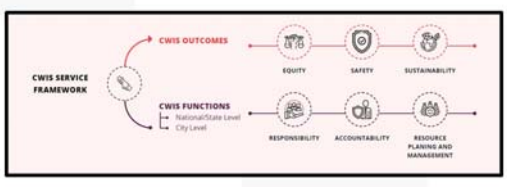
Authorities operate with a CLEAR, INCLUSIVE MANDATE, PERFORMANCE TARGETS, resources, and accountability

Authorities deploy RANGE OF HARDWARE, FUNDING & BUSINESS MODELS to meet goals

Comprehensive long-term planning FOSTERS INNOVATION, PRO-POOR FINANCING; informed by analysis of needs, resources

POLITICAL WILL & accountability incentivizes improvements in capacity, leadership, outcomes

## CWIS Service Framework



INTRODUCTION AND OVERVIEW

## CWIS Framework: Promoting A Public Service

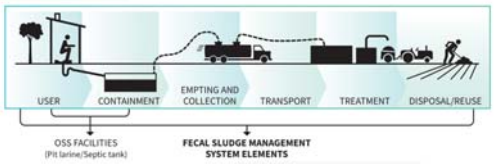
| | | | |
|---|---|---|---|
| CORE CWIS OUTCOMES | EQUITY: Services reflect fairness in distribution and prioritization of service quality, prices, deployment of public finance/subsidies | SAFETY: Services safeguard customers, workers and communities from safety and health risks by reaching everyone with safe sanitation | SUSTAINABILITY: Services are reliably and continually delivered based on effective management of human, financial and natural resources |
| CORE CWIS FUNCTIONS | RESPONSIBILITY: Authority(s) execute a clear public mandate to ensure safe, equitable and sustainable, sanitation services for all | ACCOUNTABILITY: Authority's(ies') performance against mandate is monitored and managed with data, transparency, and incentives | RESOURCE PLANNING & MANAGEMENT: Resources–human, financial, natural, assets–are effectively managed to support execution of mandate across time/space |

INTRODUCTION AND OVERVIEW

## Fecal Sludge Management (FSM)

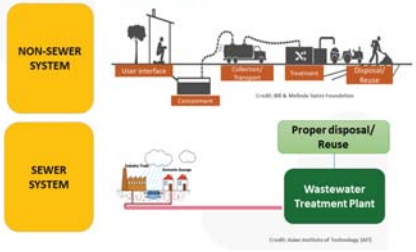
INTRODUCTION AND OVERVIEW

## Sanitation Value Chain




INTRODUCTION AND OVERVIEW

## Sanitation Value Chain




INTRODUCTION AND OVERVIEW

## Terminology

Non-Sewered Sanitation → Fecal Sludge

Sewered Sanitation → Wastewater

INTRODUCTION AND OVERVIEW

## What is Fecal Sludge?

## What is its Management?

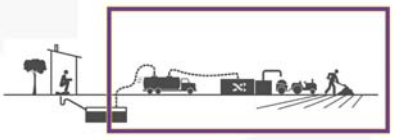
INTRODUCTION AND OVERVIEW

## Fecal Sludge

Excreta from an on-site sanitation technology (like a pit latrine or septic tank) that may also contain used water, anal cleansing materials, and solid waste.


INTRODUCTION AND OVERVIEW

## Fecal Sludge Management



The FSM components are specifically the collection, emptying, transportation, treatment and end-use or disposal of FS.

INTRODUCTION AND OVERVIEW

## Institutional and Regulatory Framework (IRF)

INTRODUCTION AND OVERVIEW

## Institutional and Regulatory Framework (IRF) for Fecal Sludge Management – Paurashava

- The institutional roles and responsibilities specified in this framework are based primarily on the provisions of the Local Government (Paurashava) Act 2009 (amended in 2010), which guides and regulates the roles and responsibilities of all Paurashavas.
- Bangladesh Government published Institutional and Regulatory Framework (IRF) for Fecal Sludge Management for Paurashava in 2017.


http://bdlaws.minlaw.gov.bd/act-details-1024.html

## Objectives and Scope of FSM Framework-IRF

The primary objective of this FSM framework is to facilitate implementation of FSM services in Paurashavas.

Identifies the ways and means of implementing FSM services in Paurashavas.

Defines specific roles and responsibilities of various institutions and stakeholders, particularly the Paurashavas, for effective implementation of FSM.


## Proper Design and Construction of Sanitation Facilities and Disposal of Sewage/Wastewater - IRF

**New Construction & Existing/Completed Buildings**

- Paurashava shall check the design of the sanitation facilities as well as its location/layout
- For pit latrines, the Paurashava shall promote use of twin off-set pit pour-flush toilets
- After completion of building construction the Paurashava shall check that the sanitation facilities have been sited and constructed according to the approved design.

**Disposal of Sewage/Wastewater/ Garbage**

- The Paurashava shall carry out inspection and make sure that domestic sewage/ wastewater, and discharge from house-drain are not connected to storm sewer/drain or irrigation canal, and that "refuse" is not thrown/disposed or stored on street or open place; these activities are treated as punishable offence.

## Fecal Sludge Collection and Transportation - IRF

- Responsible for entire FSM service chain, including collection & transportation
- Collected FS is transported to the designated site(s) for treatment and disposal. FS is never disposed in open space or water bodies, or storm drains or sewers
- Punishment for unauthorized disposal of collected FS
- Fix fees/charges for collection and transportation of fecal sludge
- Introduce and promote mechanical pit emptying services. Integration of manual emptier into the modern FSM services
- Enforce appropriate health and safety guidelines for emptying services
- Development of a database of all sanitation facilities along with probable emptying frequency

## FS Treatment, Disposal and End use - IRF

- Responsible for execution of the entire FSM service chain, including fecal sludge treatment, disposal and end-use
- If treatment plant is unavailable, Collected FS shall be disposed in a designated land/area by digging pits in the ground, and burying the pits with soil after it is filled
- Collaboration with DPHE and LGED in development and O&M of fecal sludge treatment facilities
- Engage the private sector/NGO for treatment and disposal of fecal sludge, and use/marketing of end-products
- Seek assistance of the DOE, and the Institute of Epidemiology, Disease and Research (IEDCR) for installation and operation of FST facilities
- Seek assistance of the Department of Agriculture Extension (DAE) for licensing of using/marketing of compost fertilizer produced at FSTP
- Work with the Ministry of Agriculture to ensure safe use of compost/organic fertilizer in agriculture, landscaping and other purposes

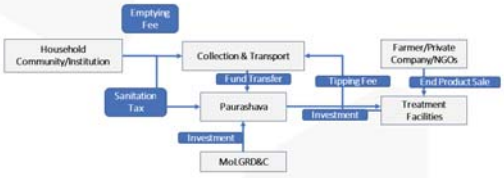
## Financial Aspects of FSM Service Chain - IRF

**Support from the Government**
-FSM infrastructure Development

**Fees/charges from service recipients**
-Emptying and transportation of fecal sludge
-Regular operation and maintenance

**Paurashavas shall collaborate with the LGD**
-Establishment of major FSM infrastructure (treatment plant, vacutugs)
-Develop appropriate "Business Models" for delivery of FSM services

## Proposition of Fund Flow for FSM Services –IRF




## National Action Plan (NAP)

## National Action Plan (NAP)

- A Working Committee was formed in June 2018 by the Local Government Division (LGD), MoLGRD&C, comprising members from relevant government agencies, academia, I/NGOs, development partners and private organizations to develop a "National Action Plan (NAP)" for implementation of the IRF-FSM.
- The NAPs have been developed with the objective of rapid implementation of FSM services throughout the country by 2030.


## National Action Plan (NAP)

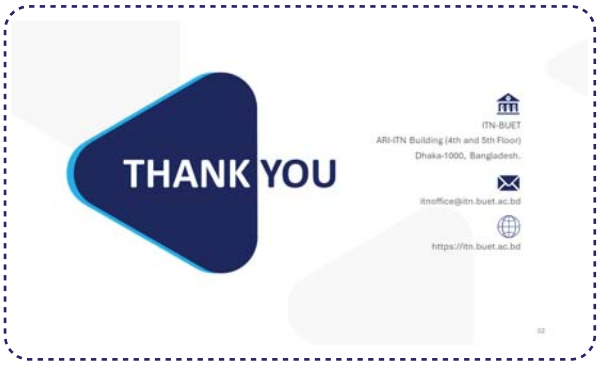
**Paurashavas are divided into four clusters**

- **Cluster A:** Paurashavas with operational FSM services (10 Paurashavas)
- **Cluster B:** Paurashavas that have been selected for GoB or other Development Bank funded sanitation projects (115 paurashavas)
- **Cluster C:** Paurashavas having land for construction of FSTP in future (26 Paurashavas)
- **Cluster D:** Rest of the Paurashavas requiring land procurement for construction of FSTP in future (184 Paurashavas)

## Target milestone for different types (Clusters) of Paurashavas

| Cluster | Type of Paurashava | Milestones (2019-2021) | (2022-2024) | (2025-2027) | (2028-2030) |
|---|---|---|---|---|---|
| A | Paurashavas with operational FSM services (10 Paurashavas) | • Plan and implement citywide FSM<br>• Capacity building<br>• Ensure mechanical desludging confirming O&M | • Citywide FSM service achieved | • FSM Service continued & continually updated | • FSM Service continued & continually updated |
| B | Paurashavas selected for GoB or other development partner funded projects (115 Paurashavas) | • Capacity building<br>• Awareness campaign<br>• Plan for citywide FSM implementation<br>• Ensure mechanical desludging confirming O&M<br>• Land procurement for FS treatment facility | • Citywide FSM service implementation | • Citywide FSM service achieved | • FSM Service continued & continually updated |
| C | Paurashavas having land for construction of FSTP (26 Paurashavas) | • Capacity building<br>• Awareness campaign<br>• Plan for citywide FSM implementation<br>• Introduce mechanical desludging confirming O&M<br>• Appropriate and safe burial of emptied sludge until FSTP is constructed<br>• Confirm land procurement/availability for FS treatment facility | • Ensure mechanical desludging confirming O&M<br>• Ensure adequate treatment and safe disposal<br>• Conduct FSM service implementation | • Citywide FSM service implemented on | • Citywide FSM service achieved<br>• Ensure safe treatment |
| D | Paurashavas requiring land procurement for construction of FSTP (184 Paurashavas) | • Capacity building<br>• Awareness campaign<br>• Plan for citywide FSM implementation<br>• Introduce mechanical desludging and safe burial confirming O&M<br>• Land procurement for FS treatment facility | • Ensure mechanical desludging confirming O&M<br>• Ensure adequate treatment and safe disposal<br>• Confirm land availability/procurement for FS treatment<br>• Conduct FSM service implementation | • Citywide FSM service implemented on | • Citywide FSM service achieved<br>• Ensure safe treatment |


INTRODUCTION AND OVERVIEW
FSM Planning Steps
Making Sanitation a Priority
Context Analysis
Stakeholder Analysis
Social and Gender Inclusion
Enabling Environment Evaluation
Service Delivery and Financial Flow Models
Treatment and End-use Technologies Evaluation
Quantification & Characterization of FS
Collection and Transportation Technologies
Site Optimization
Operation and Maintenance Requirements
Occupational Health and Safety of Operators and Workers
Capacity Building
Social Mobilization


THANK YOU
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02

NATIONAL AND INTERNATIONAL FSM SERVICE AND BUSINESS MODELS

## Learning Outcome

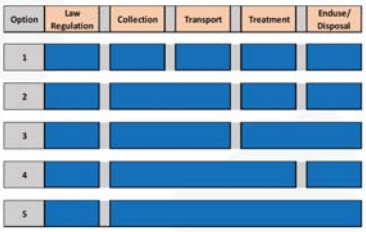
At the end of this session Participants will be able to:

- Gather knowledge about standards service models and existing service models of Bangladesh
- Know about standard FSM business models and existing business models of Bangladesh
- Know about the different FSM service and business models of India

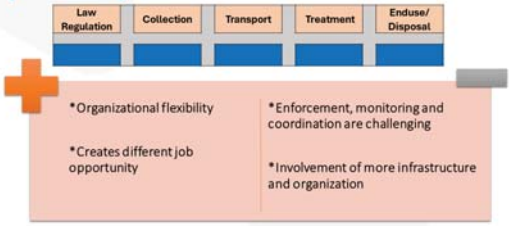
## FSM Service Model

## Concepts of FSM Service Model


## Some possible FSM service model arrangements




## Option 1: Each step of the service chain is provided by a different stakeholder




*Organizational flexibility

*Creates different job opportunity

*Enforcement, monitoring and coordination are challenging

*Involvement of more infrastructure and organization

## Option 2: Collection and transportation services are operated by one stakeholder, and the treatment and Disposal are carried out by separate stakeholders

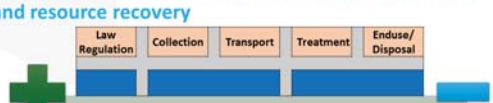

*Preferable when mechanical collection and transport services are available

*Simplifies the financial flow and FS transportation to the FSTPs

*The quality and quantity of collected sludge cannot be controlled at the FSTP

*Mechanical trucks could face difficulties if roads are narrow

## Option 3: One stakeholder manages collection and transportation, while another oversees the treatment and resource recovery

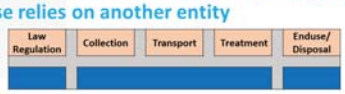



*Two types of stakeholder can develop specific skills for their activity

*Treatment technology can be chosen based on the resource recovery required

*Transportation and discharge is maintained by a different entity; it is difficult to optimize the process

## Option 4: One entity maintains the collection, transportation and treatment, but the disposal or end-use relies on another entity




*Reduce the risk of unauthorized discharging

*Requires highly developed managerial skills

*Financial flow between the end-use step and the rest of the service chain is not optimized

## Option 5: A single entity manages the whole service chain


*Easy coordination

*Optimization of each component with other components

*Requires highly developed managerial skill

*Requires high financial resources

## Existing FSM Service Models in Bangladesh

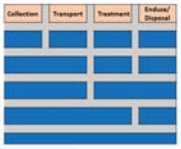
**Municipality Owned Service model**
- Municipality owns the mechanical trucks and provides service
- At commercial Zone, Khulna City Corporation is operating FSM service by themselves

**Municipality Owned but Private Enterprise Operated Service Model**
- Municipality leases the Mechanical Trucks to Private Enterprise (eg. Horizon Community)
- -Private Enterprise provides FSM service and gives back the lease fee
- Faridpur & Meherpur is following this combined approach

**Private Enterprise operated Full-Service Model**
- Through Public Private Partnership (PPP) with 3rd party organization
- -3rd party organization may purchase Mechanical Trucks by taking loan
- -At the year-end service provider will pay certain fee to municipality
- Kushtia, Jhenaidah and Chattogram are operating through this model

## Synopsis of Existing FSM Service Models in Bangladesh

| Sl. | Location | Collection | Transport | Treatment | Resource Recovery | Option Type |
|---|---|---|---|---|---|---|
| 1 | Khulna City Corporation | 3rd Party Entity and KCC -Both | | Done by 3rd party. Partially repairing and maintaining cost provided by KCC | Initially Briquette produced by 3rd Party | Complex Model/ Option 1 |
| 2 | Faridpur | Private Company through Co-operative Society Kuthibari & Bandhob Palli | | Private Company SDC- Society Development Committee (Vermi compost, Co-Composting) | | Option 3 |
| 3 | Meherpur | Co-operative Society | | Municipality | Absent | Option 2 |
| 4 | Jhenaidah | 3rd Party Under PPP | | | Dry cake storing for further Co-Composting | Option 4 |
| 5 | Kushtia | 3rd Party Under PPP | | Private Company under lease agreement with Municipality | | Option 3 |
| 6 | Lakshmipur | Municipality | | | Absent | Option 4 |
| 7 | Benapole | Municipality | | | Absent | Option 4 |
| 8 | Sakhipur | Municipality (with support from (/NGO), Co-compost | | | | Option 5 |




As of April, 2023

## Fecal Sludge Business Models

## Core Stakeholders involved in financial transfers

- Household-level Toilet Users; *FS Generator*
- Government Authorities; *Budget Support for infrastructure, Sanitation Tax etc.*
- Private Enterprise; *Responsible for FS removal & transportation, For-Profit*
- NGO; *Responsible for FS management; Non-Profit*
- End-use Industries; *Treated FS User*

## Ways of Financial transfers

| | |
|---|---|
| Budget Support | • From Government<br>• From Foreign Govt./Agencies/NGO<br>• Usually from Long Term & Unconditional |
| Capital Investment | • Infrastructure Build-up (Land, FSTP, Vacutug etc.)<br>• Septic Tank Installation Support<br>• Usually, investment comes from Budget Support |
| Discharge Fee | • Fee Collected by authorized entity for safely process of FS |

## Ways of Financial transfers

| | |
|---|---|
| Discharge Incentive | • Opposite of Discharge Fee<br>• Reward to discharge the collected FS in designated location |
| Discharge License | • To control the Number and Quality of C&T enterprise to discharge at FSTP<br>• License will be given on proven quality record |
| Emptying Fee | • Household will pay for removing FS from their septic tank |

## Ways of Financial transfers

| | |
|---|---|
| Penalties | • This tool uses by Govt./Legal Entity<br>• Penalties can be used to prevent the illegal discharge of sludge |
| Sanitation Tax | • Can be collected at once or in regular interval<br>• Can be collected through different services (water connection, sewer connection)<br>• Steady Income |
| O&M Costs | • Infrastructure and equipment maintenance cost until the service life of infrastructures/equipment |

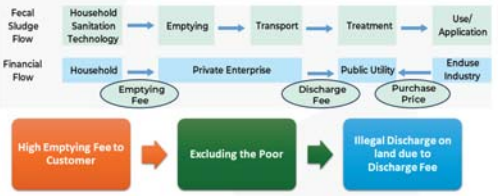
## Financial Flow Models

## Financial Flow Models

There is no single FSM business model that has proven to be effective in all situations; indeed, models are constantly modified and restructured depending on the economic, legal, and environmental conditions.

## Some possible FSM Business Model arrangements

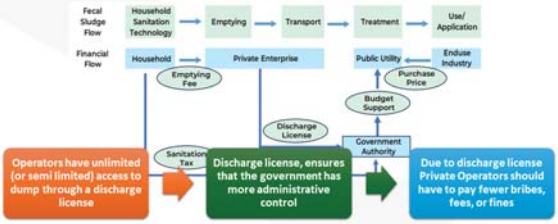
## Model 1: Discrete Collection and Treatment (C&T) model showing the responsibility of each stakeholder and the related financial transfers



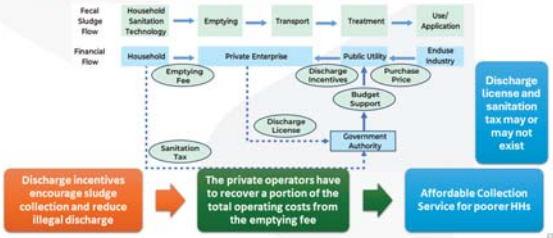

## Model 2: Integrated collection, transport and treatment model


## Model 3: Parallel tax and discharge fee model


## Model 4: Licensing and sanitation tax model




## Model 5: Incentivized discharge model




## Revenue Generation Models based on Existing FSM Operation in Bangladesh

| No. | Location | Revenue Generation | | |
|---|---|---|---|---|
| 1 | Meherpur and Laksmipur | Emptying Fee | | |
| 2 | Khulna and Sakhipur | Emptying Fee | | Briquette and Co-compost Sale |
| 3 | Kushtia, Jhenaidah and Faridpur | Emptying Fee | Sanitation Tax | Co-compost Sale |

- For existing FSM financial models of Bangladesh most of the revenue generation comes from FS Collection Fee.
- Usually, sanitation tax varies from 7 to 12% of yearly holding tax.

## FSM Service Chain and Financial Flow diagram

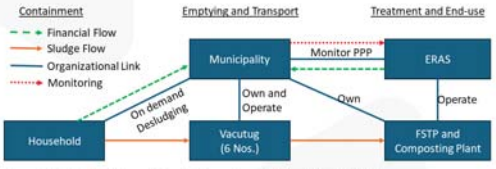



Figure: FSM Service Chain and Financial Flow diagram for **Kushtia Municipality**

ERAS: Environmental Resource Advancement Service

## FSM Service Chain and Financial Flow diagram

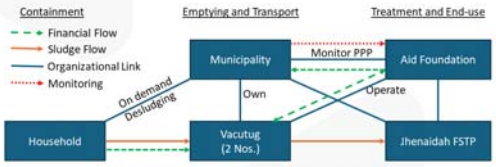



Figure: FSM Service Chain and Financial Flow diagram for **Jhenaidah Municipality**

## FSM Service Chain and Financial Flow diagram

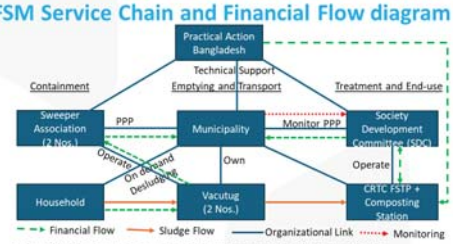



Figure: FSM Service Chain and Financial Flow diagram for **Faridpur Municipality**

CRTC: Compost Research and Training Centre

## FSM Service & Business Models in India

## FSM Service & Business Models in India

| | Model Type | Location |
|---|---|---|
| 1 | Government Managed FSM Service | • Bhubaneswar Government Managed FSM Service, Odisha |
| 2 | Privately-owned and Operated FSM Service | • Warangal Desludging Licensing, Telangana<br>• Kochi Associations of Desludging Operators, Kerala |
| 3 | Public-Private Partnership FSTP & Service Chain | • Leh Public-Private Partnership in FSM, Jammu and Kashmir |
| 4 | Scheduled Desludging and Sanitation Tax | • Wai Scheduled Desludging and Sanitation Tax, Maharashtra |
| 5 | Cluster FSTP | • Sambhar-Phulera Cluster FSTP, Rajasthan<br>• Karunguzhi-Maduranthagam Cluster FSTP, Tamil Nadu |

## Government Managed FSM Service

• Bhubaneswar Government Managed FSM Service, Odisha

- Lack of participation of private companies in the bids
- User Submits a request at the municipal office and pays for the desludging fee in advance
- Where Private operator is available, municipality and service provider sign a service contract
- Private entity must provide service for 28 days/month and minimum 6 trips per vehicle per day
- Desludging services are provided during working hours
- It typically takes 2~3 days to provide the service once the request is submitted
- The private entity is required to maintain the truck.
- Municipality helps the private operator regarding desludging scheduling, and monitors the operations

## Government Managed FSM Service

• Bhubaneswar Government Managed FSM Service, Odisha

- The municipality fixes desludging rates
- Municipality collects desludging fees, and makes payment to the operator based on the number of trips
- The Odisha Water Supply and Sewerage Board designed & supervised the SeTP construction
- The Odisha Water Supply and Sewerage Board allocates funds from its budget to cover the O&M cost

| Risk | Benefit |
|---|---|
| Unable to provide desludging services in a timely manner | Preventing manual E&T where private sector desludging is absent |
| In small towns with low demand for desludging, asset utilization can be low | The government can ensure equity in terms of service provision and fees charged, especially to poor households |

## Government Managed FSM Service

• Bhubaneswar Government Managed FSM Service, Odisha


Cost-Revenue (1 INR = 1.19 BDT, Oct 2019):
**Capital Cost:** BDT 41,650,000
**Total Annual Expense:** BDT 2,446,822
Labor: BDT 1,402,553
STP O&M: BDT 1,012,139
Solar Power System Maintenance: BDT 11,900
Hospitality Cost, including maintenance
Reverse Osmosis system in the office: BDT 20,230
**Annual Revenue/Surplus Power:** BDT 27,621

| | |
|---|---|
| Capital Cost | Government of India Program |
| Operating Cost | OWSSB-Odisha Water Supply and Sewerage Board and revenue from surplus power generated by solar photovoltaic system |

## Privately-owned and Operated FSM Service

• Emptying &Treatment Licensing- Warangal Desludging Licensing, Telangana

- This is a market-driven business model
- Marketing done by word of mouth, local plumbers by orders commission and stickers on electric poles
- To obtain the license, private operators must ensure Vehicle Fitness; GPS Installation; Use of PPE
- The operator is required to display the license number on the vehicle
- Sanitation cell tracks the GPS data to make sure desludged FS is disposed of at the FSTP
- Private desludging operators are formalized through licenses by the municipality
- Municipality maintains a list of licensed operators on its website
- Desludging request submitted to the Municipality is passed to licensed operators

## Emptying &Treatment Licensing- Warangal Desludging Licensing, Telangana

- Private operator requires to pay a license fees. The license requires periodic renewal
- Private entity charges desludging fees to based on market pricing and the containment system
- Municipality can regulate desludging tariffs, especially for poor families
- Municipality advise customers to only avail of desludging services from licensed operators

| Risk | Benefit |
|---|---|
| Without effective monitoring: health and safety of workers and disposal of FS at designated sites may not be ensured | Provides a legal umbrella for desludging operators and hence prevents harassment from police and society |
| Licensing norms and fee can become barriers to entry for new entrepreneurs if not designed judiciously | -Ensures equipment, service standards<br>-Municipality can regulate pricing |

## Privately-owned and Operated FSM Service

• Kochi Associations of Desludging Operators, Kerala

Individuals/enterprises engaged to promote and safeguard their business

*All Kerala Cleaning Contractors' Welfare Association* and *All Kerala Sewage and Septic Cleaning Vehicle Owners' Association* are part of Kochi Association of Desludging Operators

Purpose

- Advocacy with government agencies to improve the business environment
- Demarcation of geographical boundaries for business operations
- To set of rules for plying vacuum truck operations, including setting tariffs
- Associations were formed to shield from police harassment and to get authorized recognition

## Kochi Associations of Desludging Operators, Kerala

- Kochi Municipal Corporation (KMC) issues daily 6 disposal passes for each of two associations to dispose of FS at the FSTP
- Associations to issue the passes to 12 members with active service requests for the day
- Since the FSTP only accepts FS from 12 trucks, the remaining FS collected by the operators is disposed of in the open
- The selected private operators pay the disposal pass fees to the municipality at the FSTP Capital cost covers by association

## Kochi Associations of Desludging Operators, Kerala

| Risk | Benefit |
|---|---|
| Can lead to over pricing for end-users if left unregulated | Enables collective bargaining for an improved business environment |
| New entrants can find it challenging to enter a market dominated by a closed association | The municipality can hold one entity accountable |

## Public-Private Partnership FSTP & Service Chain

• Leh Public-Private Partnership in FSM, Jammu and Kashmir

- A private company is responsible for managing FSTP operations, along with scheduled and demand-based desludging services
- The Municipal Committee Leh (MCL) provided existing desludging vehicle
- Private operator prepares the schedule for desludging, which is shared with the MCL, who notifies customers of the desludging dates
- Scheduled desludging is undertaken twice a week. The remaining days are reserved for on-demand desludging

## Public-Private Partnership FSTP & Service Chain

• Leh Public-Private Partnership in FSM, Jammu and Kashmir

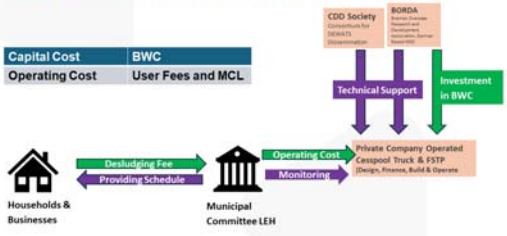
- The MCL collects desludging fees from the hotels and home stays at the time of renewal of the yearly license to operate
- After providing desludging service, the private operator is paid 90% of the revenue upon submission of documentary evidence of service
- The private operator finances the operating cost with 90% of the desludging fees collected by the MCL
- The MCL is promoting scheduled desludging to prevent groundwater pollution from OSS

## Public-Private Partnership FSTP & Service Chain

• Leh Public-Private Partnership in FSM, Jammu and Kashmir

| Risk | Benefit |
|---|---|
| FSTP construction and O&M are typically small in size, hence may not attract suitable private entities | Municipality can leverage technical expertise and finance for the investment and operations |

## Value chain of the Leh PPP for FSM model




## Public-Private Partnership FSTP & Service Chain

• Leh Public-Private Partnership in FSM, Jammu and Kashmir


Cost in BDT (1 INR = 1.19 BDT Oct 2019)
**Annual Desludging Expense: 1,130,500**
Labor: 514,080; Licensing: 30,940
PPE & Tools: 173,740; Fuel: 185,640
Annual Maintenance: 35,700
Periodic Maintenance: 190,400
**Annual FSTP Expense: 1,300,432**
Labor: 999,600; Electricity: 28,560
PPE & Tools: 23,800;
Miscellaneous Expense: 5,712
Office Rent + Supplies: 214,200
**Annual Revenue (90% of desludging fees – 780 trips/year @ 4,165 BDT): 2,923,830**

## Scheduled Desludging and Sanitation Tax

• Wai Scheduled Desludging and Sanitation Tax, Maharashtra

- Wai Municipal Council (WMC) given a 36-month performance-based contract to a private operator by Tender
- Operator is required to cover the capital cost of the desludging trucks and desludge a fixed number of septic tanks over the contract period
- To implement scheduled desludging, the city was divided into 3 zones, with 1 zone targeted to be covered every year
- WMC staff undertake random checks to verify that desludging services are provided

## Scheduled Desludging and Sanitation Tax

• Wai Scheduled Desludging and Sanitation Tax, Maharashtra

- WMC is responsible for collection of sanitation tax from OSS users as part of the property tax
- Payment to the private operator is made on a monthly basis based on the number of septic tanks desludged
- Private Operator also provides on-demand desludging services on an emergency basis, which is first approved by the WMC sanitary inspector
- OSS users must pay separately for on demand emergency service

## Scheduled Desludging and Sanitation Tax

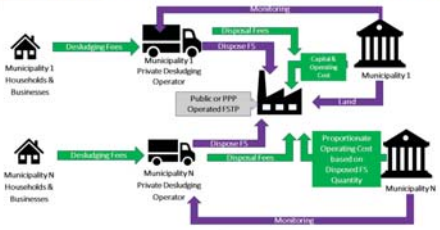
• Wai Scheduled Desludging and Sanitation Tax, Maharashtra

| Risk | Benefit |
|---|---|
| Lack of collection of sanitation tax from end-users poses risk to operational viability | Reduces the cost of the desludging service due to improved logistics in comparison to demand-based desludging |
| | Ensures proper maintenance of septic tanks and hence reduces public health and environmental risks |
| | Assured FS disposal at designated sites due to performance-based payment |
| | Sizing of FSTP and its operational efficiency can be better planned in comparison to demand based desludging |

## Cluster FSTP (Sambhar-Phulera, Rajasthan and Karunguzhi-Maduranthagam, Tamil Nadu)

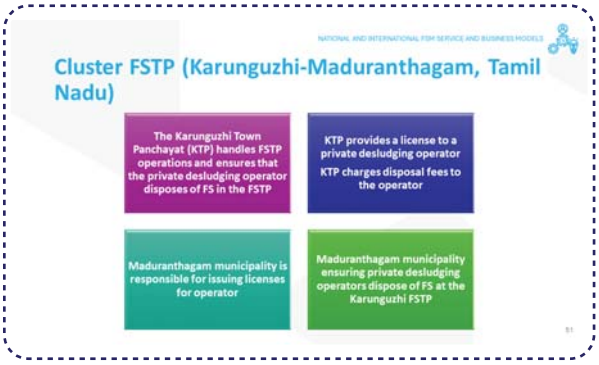
- The model entails treatment of FS from two or more municipalities in a single FSTP
- FSTP should be strategically located within a 10 to 15 km radius of each municipality so that E&T operators dispose of FS at the FSTP
- In a cluster FSTP model, one of the municipalities provides land for the FSTP and finances FSTP operations
- The lead municipality signs a memorandum of understanding (MoU) with one or more nearby municipalities

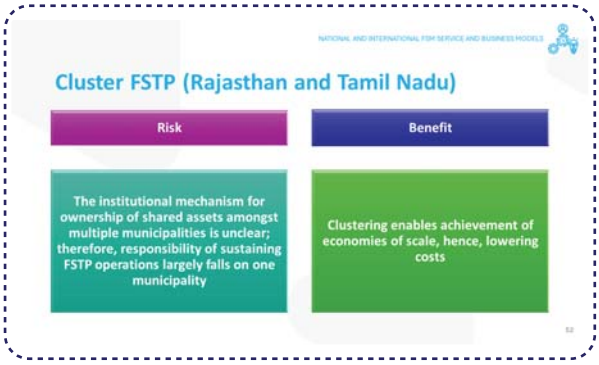
## Value Chain Of The Cluster FSTP Business Model

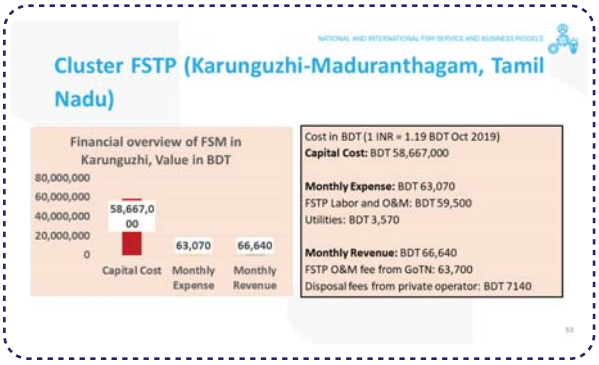



## Cluster FSTP (Sambhar-Phulera, Rajasthan)

- Rajasthan Urban Infrastructure Development Project (RUIDP) provided funds for the capital cost and O&M for the first 2 years of operations
- After 2 years of operation, it is the responsibility of Phulera municipality for O&M
- Phulera municipality plans to collect sanitation tax, through surcharge on water bills or on Solid Waste Management Fee
- Both municipalities have municipal desludging vehicles and must ensure that FS is transported to the FSTP


Cluster FSTP (Karunguzhi-Maduranthagam, Tamil Nadu)
The Karunguzhi Town Panchayat (KTP) handles FSTP operations and ensures that the private desludging operator disposes of FS in the FSTP
KTP provides a license to a private desludging operator
KTP charges disposal fees to the operator
Maduranthagam municipality is responsible for issuing licenses for operator
Maduranthagam municipality ensuring private desludging operators dispose of FS at the Karunguzhi FSTP


Cluster FSTP (Rajasthan and Tamil Nadu)
Risk
Benefit
The institutional mechanism for ownership of shared assets amongst multiple municipalities is unclear; therefore, responsibility of sustaining FSTP operations largely falls on one municipality
Clustering enables achievement of economies of scale, hence, lowering costs


Cluster FSTP (Karunguzhi-Maduranthagam, Tamil Nadu)
Financial overview of FSM in Karunguzhi, Value in BDT
80,000,000
60,000,000
40,000,000
20,000,000
0
58,667,000
63,070
66,640
Capital Cost
Monthly Expense
Monthly Revenue
Cost in BDT (1 INR = 1.19 BDT Oct 2019)
Capital Cost: BDT 58,667,000
Monthly Expense: BDT 63,070
FSTP Labor and O&M: BDT 59,500
Utilities: BDT 3,570
Monthly Revenue: BDT 66,640
FSTP O&M fee from GoTN: 63,700
Disposal fees from private operator: BDT 7140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03

USER'S EXPERIENCE SHARING ABOUT EXISTING FSM SERVICE MODELS AND IMIS

## Learning Outcome

At the end of this session Participants will be able to:

- Know about the user experience about FSM service model of different municipality
- Provide municipality perspective about different component of probable FSM service models by individual quiz/survey session.
- Know about the user experience about FSM service model's tariff structures of different municipality
- Know about the user perception about the payment modality of different municipality

## Emptying Behavior of Households

House Holds usually wait till last moment/overflow

## Preferred Time of Emptying

- Most of the HHs prefer 'Night Time' for the Dirty Work
- Most of the Vacutug Users and Non Users of Kushtia Municipality Preferred Day Time Cleaning

## Application Process

- For Municipality
  - Need to Fill up the form
  - Need to make payment by Cash/Payorder
- Cash Payment
  - By calling the local Community Development Committee (CDC) Cluster Leader for Mechanical Service at KCC during their service
  - By Calling to Manual Emptier


## Time-lag between Service Application and Receipt

For Municipality, Usually Users are getting the Service within 24-48 hours.
Sometimes it takes up to 96 hours

During the CDC Operation at KCC, they could provide the service within 8-24 hours

Manual Emptying service it required 8-24 hours only

## Reliance on the Service Provision

Mix Method (Mechanical & Manual) of Emptying requires for Harden Sludge


On Emergency Manual Emptier Preferred

## Scope of Integration from Manual Emptier

- Manual Emptier wants to be Entrepreneur with support (loans & training to handle vacutug)
- Integration/Recruitment process should be transparent Manual Emptier of KM prefer to work with a private organization or NGO
- Mechanical emptying service will increase their social status and financial too
- Manual Emptier Shows Strong Willingness to Move into Mechanical System

## Perception of Payment Method and Modality

- One-shot Cash Payment
- Going to the bank is a hassle and consumes time
- Paying regular instalment every month is an unwanted Burden

## Identified Problems in Service Delivery

- Problems in finding/retaining well-trained drivers
- Limited access of Trucks due to width of road
- Muslim employees do not want to work as drivers or emptiers
- There is no dedicated wing for FSM in organogram
- Unavailability of Required Protective Gears

## Recommendations for Service Quality Improvement

- Increase Smaller Trucks
- Cash/Online Payment/Mobile Banking, Single Shot
- Including FSM Tax with regular annual Tax
- Establish Dedicate Wing for FSM in the Municipality
- One-stop Call Center to receive Customer Query
- Training arrangements for FSM Operational Staffs

## Recommendations for Service Quality Improvement

- One of the main reasons for the failure of FSM systems is the Vague Delegation of Responsibilities
- This situation frequently occurs where an incomplete institutional framework exists
- It results into a lack of accountability and disagreements between stakeholders

## Survey Task

## Integrated Municipal Information System (IMIS)

## FSM Monitoring - Integrated Municipal Information System (IMIS)

- A web-based geographic information system (GIS) designed to support local governments' management of municipal services for accountability, management and planning FSM services.
- In 2019, the IMIS was officially launched in Jhenaidah.
- It is a reporting tool
- It is a service management tool
- It is a data integration platform

## IMIS

- IMIS is an Information System developed to catalyze CWIS approach, and achieve SDG 6.2 Outcomes
- It is a convergence of web, mobile and GIS technologies developed on open-source software platform
- It brings Innovation in overall city's sanitation system and services fostering good Governance.


## IMIS Components

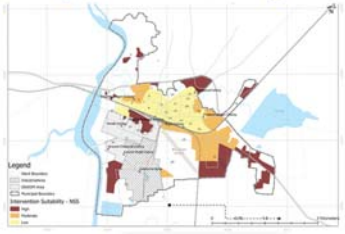

## IMIS (Municipal GIS database of the town)


## Tools for sanitation planning, infrastructure investment planning and decision-making

**How many containments are there within 100 m around a river ?**

## Tools for sanitation planning, infrastructure investment planning and decision-making

**Sanitation Intervention Feasibility Analysis**

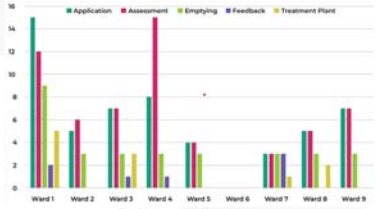


## Business process mainstreaming Sanitation Value Chain with municipality's regular business process


## Dashboard for real-time monitoring and evaluation of CWIS system and service


FSM service dashboard

## Dashboard for real-time monitoring and evaluation of CWIS system and service




Application status by wards

## Interoperability system to integrate with external data sources – tax payments, and other spatial data source

Tax Payment Status

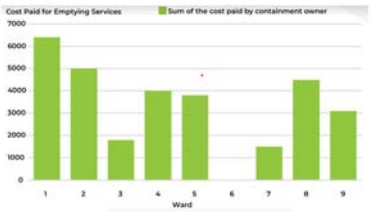
## Interoperability system to integrate with external data sources – tax payments, and other spatial data source

Water Payment Status

## IMIS-Monitoring and Evaluation of Infrastructure & Service Delivery

1

Total Revenue Collected by Ward




## IMIS-Monitoring and Evaluation of Infrastructure & Service Delivery

FSM Service Quality

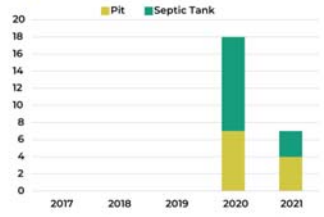
2

Quality of Service


## IMIS-Monitoring and Evaluation of Infrastructure & Service Delivery

3

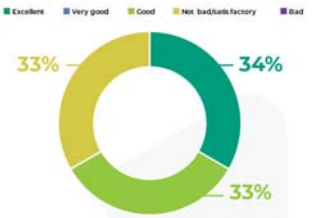
Total Containments Emptied in the Year




## IMIS-Monitoring and Evaluation of Infrastructure & Service Delivery

4

Service Efficiency




## IMIS-Steps to Implement

04

FSM BUSINESS ANALYSIS

## Learning Outcome

At the end of this session Participants will be able to:

- Know about different financial terms (inflation, NPV, market discount rate, cost of fund, IRR)
- Understand the financial analysis of integrated FSM and solid waste management
- Understanding NPV calculation with general example and based on IWM
- Calculate FS generation, trip numbers and cost-revenue analysis of day-to-day FSM business analysis

## Capital Expenditure (CAPEX) of Integrated Waste Management (IWM)


## Capital Expenditure (CAPEX) of Integrated Waste Management (IWM)


## CAPEX

Costs for IWM (FSM + SWM) Treatment Plant (A)

| Sl. | Item | Unit Cost, BDT | Total Cost, BDT |
|---|---|---|---|
| 1 | Boundary wall and gate | 7,475,000 | 7,475,000 |
| 2 | Fecal sludge and wastewater treatment | | 10,280,680 |
| | 2.1 Planted drying bed – 3 Nos | 1,564,000 | 4,692,000 |
| | 2.2 Anaerobic baffled reactor & constructed wetland – 2 Nos | 2,277,000 | 4,554,000 |
| | 2.3 Polishing Pond | | 1,034,680 |
| 3 | Solid waste treatment plant (compost shed & others) | | 19,575,600 |
| | 3.1 Compost zone | | 11,463,200 |
| | 3.2 Waste separation zone | | 1,564,000 |
| | 3.3 Leachate tank | | 754,400 |
| | 3.4 Post maturation chamber | | 1,794,000 |
| 4 | Internal road and surface drainage | 4,513,325.72 | 4,513,326 |
| 5 | Combustible waste shed | 2,250,507.05 | 2,250,507 |
| 6 | Garage shed and cleaning zone | 1,771,000.25 | 1,771,000 |
| 7 | Electrification of plant | 183,259.4 | 183,259 |
| 8 | Secondary stations – 3 Nos | 873,821.26 | 2,621,463 |
| 9 | Paint works | 165,381.34 | 165,381 |
| 10 | Pipe network | 263,444.3 | 263,444 |
| 11 | Site office | 166,828.1 | 166,828 |
| 12 | Combustible waste system (2.5T) | 42,000,000 | 42,000,000 |
| | Total construction cost (A) | | 87,265,890 |

## CAPEX

Site Preparation & Land Development Cost (B)

| Sl. | Items | Unit Cost in BDT/CUM | Quantity (CUM) | Total Cost in BDT |
|---|---|---|---|---|
| 1 | Site improvement/ earth filling with specified soil in/c supplying, carrying, filling (Municipal Area) | 450 | 12,384 | 5,572,800 |
| | Total cost for Site Preparation & Land Development (b) | | | 5,572,800 |
| | Total Cost (A+B) | | | 92,838,690 |

Procurement Cost for FSM Services (C1)

| Sl. | Description of Items | Unit Cost in BDT | Total Cost in BDT |
|---|---|---|---|
| 1 | Desludging Trucks (2000 L)-2m3-1 Nos | 4,900,000 | 4,900,000 |
| 2 | Desludging Trucks (1000 L)-1m3-0 Nos. | 3,400,000 | 0 |
| 3 | Sludge Transfer Equipment – 1 Nos. | 50,000.00 | 150,000 |
| | Sub-total (C1) | | 5,050,000 |

Procurement Cost for Solid Waste Transport Vehicles and Equipment (C2)

| Sl. | Description of Items | Unit Cost in BDT | Total Cost in BDT |
|---|---|---|---|
| 1 | Dump Truck Tipper (3 Ton capacity) | 4,000,000 | 4,000,000 |
| 2 | Excavator -0 Nos | 5,000,000 | 0 |
| 3 | Rickshaw Van (Manual) – 6 Nos | 30,000 | 180,000 |
| 4 | Hand Trolly – 12 Nos | 12,000 | 144,000 |
| 5 | Compost Turner | 100,000 | 100,000 |
| 6 | Generator (10 KV) | 500,000 | 500,000 |
| 7 | Sweeping Tools and Misc. | 100,000 | 100,000 |
| | Sub-total (C2) | | 5,024,000 |

| Total Capital Expenditure (A+B+C1+C2) | 102,912,690 |
|---|---|

## Operational Expenditure (OPEX) of Integrated Waste Management (IWM)





## Revenue Generation


## OPEX and Revenue

Operation and Maintenance Cost Assumptions for Treatment Plant (A)

| Sl. | Description of Items | Unit Cost, BDT | Total Cost, BDT |
|---|---|---|---|
| 1 | Plant Repair & Maintenance | | |
| | Regular maintenance for generator | | 50,000 |
| | Land escaping maintenance | | 20,004 |
| | Electricity cost- 12 months | 50000 | 600,000 |
| | Drinking water- 12 months | 1000 | 12,000 |
| | Safety Gears for Driver and Operator- 12 sets | 1672 | 167,232 |
| | Vehicle Tools & Equipment (Maintenance repair) -12 months | 10000 | 120,000 |
| | Plant & Vehicle Running Fuel-Lubricant Cost- 12 months | 27000 | 324,000 |
| | Total Cost (Annual Item) | | 1,293,236 |
| 2 | Bi-annual Item | | |
| | Tire Replacement (Trucks)- 4 sets | 20000 | 80,000 |
| | Total Cost (Bi-annual Item) | | 80,000 |
| 3 | Every 5 Year Item | | |
| | Replacement of Plasma Cracking Chamber (5.30% of cost of Combustible waste system) | 0.30% | 126,764 |
| | Periodic maintenance of Solar Panel (repairs and replacements) | | 60,000 |
| | Replacement of screens in Screening chamber | | 24,000 |
| | Total Cost (every 5 Year) | | 210,764 |
| 4 | Replacement roof sheets in every 8 years | | 60,000 |
| | Total cost (Time Item) 1+2+3+4 | | 1,644,000 |

Staffing Costs (B)

| Sl. | Item | Monthly Salary | Annual Salary in BDT |
|---|---|---|---|
| 1 | Supervisor | 23,000 | 276,000 |
| 2 | Truck/Equipment Operator | 23,000 | 276,000 |
| 3 | Sweeper/Laborer- 3 person | 16,000 x 3 | 576,000 |
| 4 | Helper- 3 person | 16,000 x 3 | 576,000 |
| 5 | Van Operator- 3 person | 16,000 x 3 | 576,000 |
| 6 | Office Staff | 16,000 | 192,000 |
| 7 | Vacutug Driver | 16,000 | 192,000 |
| | Total Staffing Expense | 126,000 | 2,064,000 |
| | Total OPEX (A+B) | | 4308000 |

Revenue Generation

| Sl. | Item | Revenue in BDT (per trip) | Monthly Units (Trip/HH/KG) | Annual Revenue in BDT |
|---|---|---|---|---|
| 1 | Septic Tank Cleaning Fee | 1,000 | 120 | 1,440,000 |
| 2 | Solid waste Collection Fee | 100 | 3,600 | 4,320,000 |
| 3 | Revenue from Compost sale | 15 | 500 | 90,000 |
| | Total Revenue | | | 5,850,000 |

## Boundary Conditions

- Considered Demand based Emptying rather than Scheduled Emptying.
- For 2m³, the VT (FSM Service) charge should be BDT 1,000 per trip.
- The Low-Income Communities (LIC) will be under free of charge as the equitable safe sanitation service concept.
- 80% efficiency has been assumed for VT, which can serve 5 times in day and 24 days in a month.
- For solid waste management, 10% of LIC dwellers should be free of charge because of the safe and equitable green service management concept for municipalities.
- At present, a maximum of 50% collection service can be provided to city dwellers in HH on an average BDT 100.00 fee.
- For the sale of biofertilizer by the co-composting process, on average, 500kg can be produced initially per day, and the selling price is BDT 15.00 per kg.

## Financial Assumption

**Financial Assumption**

| Sl. | Item | Rate |
|---|---|---|
| 1 | Cost Inflation and Revenue Inflation. Inflation rate considered for Bangladesh during project planning stage | 8% |
| 2 | Market Discount Rate/Cost of Funds | 10% |

**Inflation:** Inflation is the rate of increase in prices over a given period of time. Inflation is typically a broad measure, such as the overall increase in prices or the increase in the cost of living in a country

**Market discount rate:** Market discount rate also called required rate of return, is the rate of return required by investors based on the risk of the investment.

**The cost of funds:** The cost of funds is the interest rate paid by lenders for the funds they use in their business.

## Financial Ratios ((Net Present Value (NPV))

**Definition:** Net Present Value (NPV) is the value of all future cash flows (positive and negative) over the entire life of an investment discounted to the present.

**Formula:**

$$NPV = \frac{Cash\ Flow_1}{(1+r)^1} + \frac{Cash\ Flow_2}{(1+r)^2} + \cdots + \frac{Cash\ Flow_n}{(1+r)^n} - Initial\ Investment$$

- ***Cash Flow*** is the sum of money spent and earned on the investment or project for a given period of time
- ***n*** is the number of periods of time
- ***r*** is the market discount rate

## Net Present Value (NPV)

- **Positive NPV:** A positive NPV means the project or investment may be profitable and worth pursuing.
- **Negative NPV:** A negative NPV means the project or investment is unlikely to be profitable and should probably not be pursued.
- **Zero NPV:** A zero NPV means the project or investment is neither profitable nor costly.
- **Recommendation:**
  - Not to accept a project unless it generates a positive NPV
  - Choose a project that maximizes NPV among available projects.
  - Where no budget constraint but a project must be chosen from mutually exclusive alternatives, choose the one that generates highest NPV.
  - When comparing mutually exclusive projects of different lengths of life, choose the one with highest NPV, after adjusting their project lives to comparable length.

## Net Present Value (NPV)

**Example:**

**Question 02:** Calculate NPV of the project 'A' and 'B' and suggest which project should be accepted assuming market discount rate is 10%. Capital/initial investment for project 'A' is BDT 50,000 and for project 'B' is BDT 70,000.

**Cash inflow in BDT:**

| Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Project 'A' | 15,000 | 25,000 | 25,000 | 7,000 | 5,000 |
| Project 'B' | 45,000 | 25,000 | 15,000 | 8,000 | 5,000 |

**Discounting Factor:**

| Year | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Discounting Factor (DF), $(\frac{1}{(1+r)^n})$ | $\frac{1}{(1+0.1)^{1=}} = 0.909$ | $\frac{1}{(1+0.1)^{2=}} = 0.826$ | 0.751 | 0.683 | 0.621 |

## Net Present Value (NPV)

| Project 'A' | | | |
|---|---|---|---|
| **Year** | **Cash Flow** | **DF at 10%** | **Present Value (PV) = Cash Flow x DF** |
| 0 | -50,000 | 1 | -50,000 |
| 1 | 15,000 | 0.909 | 13,635 |
| 2 | 25,000 | 0.826 | 20,650 |
| 3 | 25,000 | 0.751 | 18,775 |
| 4 | 7,000 | 0.683 | 4,781 |
| 5 | 5,000 | 0.621 | 3,105 |
| | | **NPV(BDT)** | **10,946** |

## Calculate NPV for Project 'B'

| Project 'B' | | | |
|---|---|---|---|
| **Year** | **Cash Flow** | **DF at 10%** | **Present Value (PV) = Cash Flow x DF** |
| 0 | -70,000 | 1 | -70,000 |
| 1 | 45,000 | 0.909 | 40,905 |
| 2 | 25,000 | 0.826 | 20,650 |
| 3 | 15,000 | 0.751 | 11,265 |
| 4 | 8,000 | 0.683 | 5,464 |
| 5 | 5,000 | 0.621 | 3,105 |
| | | **NPV(BDT)** | **11,389** |

Which Project should be taken?

Since for same period of time, NPV is higher for project 'B' than project 'A' so project 'B' should be selected.

## NPV Calculation for IWM

| Capital Investment | In BDT |
|---|---|
| Procurement Cost for FSM Services | 5,050,000 |
| Procurement Cost for Solid Waste Transport Vehicles and Equipment | 5,024,000 |
| **Total Procurement Cost for IWM(BDT)** | **10,074,000** |

Fecal Sludge and Wastewater Treatment Cost and Site Preparation and land development cost are not considering as capital investment during NPV calculation.

| Revenue Generation | | | | |
|---|---|---|---|---|
| Sl. | Item | Revenue In BDT (per trip) | Monthly Units (Trip,HH,KG) | Annual Revenue In BDT |
| 1 | Septic Tank Cleaning Fee | 1,000 | 120 | 1,440,000 |
| 2 | Solid waste Collection Fee | 100 | 3,600 | 4,320,000 |
| 3 | Revenue from Compost sale | 15 | 500 | 90,000 |
| | **Total Revenue(BDT)** | | | **5,850,000** |

## NPV Calculation for IWM (Operating Cost)

| Item/ Year | Annual O&M | Bi-Annual Maintenance | Fifth- Annual Maintenance | One Time Maintenance | Staffing | Total |
|---|---|---|---|---|---|---|
| 1 | 0 | - | 0 | 0 | 0 | 0 |
| 2 | 1,396,695 | 0 | 0 | 0 | 2,877,120 | 4,273,815 |
| 3 | 1,508,430 | 93,312 | 0 | 0 | 3,107,290 | 4,709,032 |
| 4 | 1,629,105 | 0 | 0 | 0 | 3,355,873 | 4,984,978 |
| 5 | 1,759,433 | 108,839 | 0 | 0 | 3,624,343 | 5,492,615 |
| 6 | 1,900,188 | | 309,682 | 0 | 3,914,290 | 6,124,160 |
| 7 | 2,052,203 | 126,950 | 0 | 0 | 4,227,433 | 6,406,586 |
| 8 | 2,216,379 | | 0 | 0 | 4,565,628 | 6,782,007 |
| 9 | 2,393,690 | 148,074 | 0 | 111,056 | 4,930,878 | 7,583,698 |
| 10 | 2,585,185 | | 0 | 0 | 5,325,348 | 7,910,533 |
| 11 | 2,792,000 | 172,714 | 455,025 | 0 | 5,751,376 | 9,171,114 |
| 12 | 3,015,359 | | 0 | 0 | 6,211,486 | 9,226,846 |
| 13 | 3,256,588 | 201,454 | 0 | 0 | 6,708,405 | 10,166,447 |
| 14 | 3,517,115 | | 0 | 0 | 7,245,078 | 10,762,193 |
| 15 | 3,798,485 | 234,975 | 0 | 0 | 7,824,684 | 11,858,144 |

*8% inflation adjusted for every year.

## NPV Calculation for IWM

| Item/ Year | Capital Cost | Revenue (A) | Operating Cost (B) | Net Cash Flow (A-B) | DF at 10% | Present Value (PV) = Cash Flow x DF |
|---|---|---|---|---|---|---|
| 1 | -10,074,000 | | | -10,074,000 | 1 | -10,074,000 |
| 2 | | *6,318,000 | 4,273,815 | 2,044,185 | 0.909 | 1,858,350 |
| 3 | | *6,823,440 | 4,709,032 | 2,114,408 | 0.826 | 1,747,445 |
| 4 | | 7,369,315 | 4,984,978 | 2,384,338 | 0.751 | 1,791,388 |
| 5 | | 7,958,860 | 5,492,615 | 2,466,245 | 0.683 | 1,684,479 |
| 6 | | 8,595,569 | 6,124,160 | 2,471,409 | 0.621 | 1,534,551 |
| 7 | | 9,283,215 | 6,406,586 | 2,876,629 | 0.564 | 1,623,782 |
| 8 | | 10,025,872 | 6,782,007 | 3,243,865 | 0.513 | 1,664,616 |
| 9 | | 10,827,942 | 7,583,698 | 3,244,244 | 0.467 | 1,513,464 |
| 10 | | 11,694,177 | 7,910,533 | 3,783,644 | 0.424 | 1,604,634 |
| 11 | | 12,629,711 | 9,171,114 | 3,458,597 | 0.386 | 1,333,439 |
| 12 | | 13,640,088 | 9,226,846 | 4,413,242 | 0.350 | 1,546,815 |
| 13 | | 14,731,295 | 10,166,447 | 4,564,848 | 0.319 | 1,454,501 |
| 14 | | 15,909,799 | 10,762,193 | 5,147,606 | 0.290 | 1,491,078 |
| 15 | | 17,182,583 | 11,858,144 | 5,324,439 | 0.263 | 1,402,091 |
| | | | | | NPV | 12,176,631 |

*8% inflation adjusted for every year (6,318,000=5,850,000 x 1.08; 6,823,440=5,850,000x1.17).

Can we go for the project?

NPV is positive so project can be implemented

## Internal Rate of Return (IRR)

**Definition:** The internal rate of return (IRR) is a financial metric used in financial analysis to estimate the profitability of potential investments. The Internal Rate of Return (IRR) is the discount rate that makes the net present value (NPV) of a project zero. IRR should be greater than the market discount rate/cost of fund for a project. During ranking across several project, it is recommended to choose project with highest IRR.

## Internal Rate of Return (IRR)

**Formula:**

$$0 = NPV = \frac{Cash\ Flow_1}{(1+IRR)^1} + \frac{Cash\ Flow_2}{(1+IRR)^2} + \cdots + \frac{Cash\ Flow_n}{(1+IRR)^n} - Initial\ Investment$$

- ***Cash Flow*** is the sum of money spent and earned on the investment or project for a given period of time
- ***n*** is the number of periods of time
- ***IRR*** is the market discount rate

Because of the nature of the formula, IRR cannot be easily calculated analytically and instead must be calculated iteratively through trial-and-error method or by using software programmed to calculate IRR (e.g., excel).

## Average Trip/day considering Travel Distance

- Per day trip calculation for a vacutug is depending on the travel distance.
- Travel distance is measured from collection point to disposal point.

| Travel Distance (Kilometer) | Per Day Trips |
|---|---|
| 2 | 7-8 |
| 6 | 5-6 |
| 8 | 3-4 |


## Day-to-day Financial Analysis of FSM Business

## Financial Analysis of FSM Business Model

**Household Count:**

| | |
|---|---|
| Total Population in a Municipality: | 70,000 |
| Average Household (HH) Size: | 5 |
| % of HH with Septic Tank: | 80% |
| % of Septic Tank which are Desludgeable: | 70% |
| % of Population covering by FSM facility: | 40% |
| Number of Household = | |

Number of Household = (70,000 x 0.80 x 0.70 x 0.40)/5 = 3,136 HH

Number of Household = (Total population * % of HH with Septic Tank * % of Septic Tank which are desludgeable * % of Population covering by FSM facility) / Average Household Size

## Total Trip Count

| | |
|---|---|
| Years of operation: | 2 |
| Number of Vacutug: | 4 |
| Number of Week in a Year: | 52 |
| Per Day Trip by VT | 4 |
| VT Operational days in a Week | 5 |
| Number of Household: | 3,136 |
| Yearly Trip Count | |

Trip Count in total Years

Total Trips in Desludging Years (2 Year) = 4,160 x 2 = 8,320 Trips in 2 Year>HH
*8,320 trips are required for 2 years to desludge FS of 3,136 HH

Number of VT x Number week in a year x VT Operational days in a Week x Per day trip = 4 x 52 x 5 x 4 = 4,160

## Total FS Volume Count

| | |
|---|---|
| Typical Vol. of Septic Tank in m³ : | 4 |
| Years of Operation: | 2 |
| Capacity of Vacutug in m³: | 2 |
| Efficiency of Vacutug: | 80% |
| Number of Household: | 3,136 |
| Total Trips: | 8,320 |
| Total collectable sludge vol by 8,320 trips in 2 years | |

FS Volume Count

Total volume of FS in 2 years = No of HH x Typical Septic Tank Size = 3,136 x 4 = 12,544 m³

No of trips in 2 years x capacity of VT x efficiency of VT = 8,320 x 2 x 0.80 = 13,312 m³ > 12,544 m³

## Cost-Revenue Analysis: Costing (all values in BDT)

| | |
|---|---|
| Monthly Oil Cost: 5,000-7,000 | 7,000 |
| VT Driver monthly salary: 12,000-15,000 | 14,000 |
| VT Operator monthly salary: 8,000-12,000 | 11,000 |
| Mobile/Communication Cost: 500-700 | 500 |
| VT Parking Average Cost: 1,000-1,500 | 1,500 |
| Maintenance cost 8-10% of Fixed Cost | 10% |
| Total Monthly Fixed Cost | |

Monthly VT Maintenance and other cost = 34,000 x 0.10 = 3,400

Total Cumulative Cost Fixed Cost + VT Maintenance Cost = 34,000 + 3,400 = 37,400

Costing for 2 years for '1' VT = Cumulative Monthly Cost x 24 = 37,400 x 24 = 897,600

Costing for 2 years for '4' VT = 897,600 x 4 = 3,590,400

Oil Cost + VT Driver Salary + VT Operator Salary + Communication Cost + VT Parking Average Cost = 7,000 + 14,000 + 11,000 + 500 + 1,500 = 34,000

## Cost-Revenue Analysis: Revenue

| | |
|---|---|
| HH Number | 3,136 |
| Number of trips in total Years (2 years ) | 8,320 |
| % of General Income Category | 50% |
| % of Commercial Entity | 20% |
| % of Low Income Community (LIC) | 30% |
| Avg. Per Trip Desludging Fee, Base Level Tariff (BLT) | 1,000 |
| Avg. Per Trip Desludging Fee for Commercial Entity, 1.5 times of BLT | 1,500 |
| Avg. Per Trip Desludging Fee for LIC, 0.5 times of BLT | 500 |

Income generation from general income Group = 50% of Total Trips in 2 years x General Fee = 8,320 x 0.50 x 1,000 = 4,160,000

Income generation from commercial Entity = 20% of Total Trips in 2 years x Commercial Fee = 8,320 x 0.20 x 1,500 = 2,496,000

Income generation from LIC = 30% of Total Trips in 2 years x LIC Fee = 8,320 x 0.30 x 500 = 1,248,000

Total Revenue from Desludging in 2 years = 4,160,000 + 2,496,000 + 1,248,000 = 7,904,000

## Profit/Loss

Costing for 2 years for '4' VT: 3,590,400

Revenue from Desludging in 2 years: 7,904,000

Profit in 2 years operation = 7,904,000 – 3,590,400 = 4,313,600

Monthly Profit by operating 4 VT = 4,313,600/24 = 179,733
Monthly Profit for 1 VT = 179,733/4 = 44,933

## Solid Waste Collection System

-HH number is 3,136.
-These households require 6 days in a week Solid Waste Collection.
-They are able to pay 60 taka per month for this service.
-Considering 5 motorized solid waste collecting van for the operation.
-Each van requires 1 Van operator and 1 helper.

Solid Waste Collection Cost (all values in BDT):
Monthly salary for 1 van operator = 8,000
Monthly Salary for 1 van helper = 6,000
For 5 van monthly salary/fixed cost is = 5 x (8,000+6,000) = 70,000
Maintenance Charge is 5% of the monthly fixed cost = 70,000 x 0.05 = 3,500
Total monthly cost for 5 van is = 70,000 + 3,500 = 73,500
For 2 years (24 months) cost is = 73,500 x 24 = 1,764,000

## Solid Waste Collection System

**Solid Waste Collection Revenue:**

Each HH will provide 60 taka per month
So, 2-year revenue generation is

= No of HH x Monthly Charge x No of Months
= 3,136 x 60 x 24 = **4,515,840**

*For 2 years (24 months) cost is 1,764,000

Profit in 2 Years = 4,515,840 – 1,764,000 = 2,751,840
Monthly Profit = 2,751,840/24 = **114,660**

## Financial Status of Existing FSM Service of Different Municipalities of Bangladesh

## Lakshmipur Municipality

| Item | Source of Funding |
|---|---|
| Vacutug | 5 vehicles (3 actives). Providedd by the government project. |
| Land for treatment plant | Municipality acquired 0.5-acre land |
| Construction of the co-compost plant | Supported by government projects. |

| Service Period | Number of Trips | Total Income (A) | Total Expenditure (B) | Savings (A-B) |
|---|---|---|---|---|
| August 2016 to October 2019 (2 year) | 2,289 | 2,288,700 | 1,830,960 | 457,740 |

No Co-composting Facility

## Sakhipur Municipality

| Item | Source of Funding |
|---|---|
| Vacutug | 1 vehicle (active), which is project funded. |
| Land for treatment plant | The municipality has acquired 22 decimal lands. |
| Construction of the co-compost plant | Project funded. |

| Service Period | Number of Trips | Total Income from Collection Service (A) | Total income from co-compost sales (B) | Total Expenditure (C) | Savings (A+B-C) |
|---|---|---|---|---|---|
| Jan - Dec 2019 | 523 | 523,000 | 292,898 | 942,873 | -126,975 |

Total Expenditure including emptying and transportation, treatment, and making co-compost

Has Co-composting Facility

## Faridpur Municipality

| Item | Source of Funding |
|---|---|
| Vacutug | 7 vehicles (5 actives). All are project funded. |
| Land for treatment plant | Municipality acquired 3 acres of land for co-compost plant |
| Co-compost plant Construction | Project funded. |

| Cooperative Name | Service Period | Number of Trips | Total Income (A) | Total Expenditure (B) | Lease Money (C) | Savings (A-B-C) |
|---|---|---|---|---|---|---|
| Kuthibari | Aug 2016 to Oct 2019 (2year) | 1,603 | 1,788,021 | 1,088,419 | 156,410 | 543,192 |
| Bandhob Palli | May 2018 to August 2019 (1.25 year) | 620 | 542,282 | 344,304 | 0 | 197,978 |

Only Service

## Faridpur Municipality

| Service Period | Income from Solid Waste Management (A) | Income from co-compost sales (B) | Expenditure for Solid Waste Management (C) | Expenditure of co-compost plant (D) | Savings (A+B-C-D) |
|---|---|---|---|---|---|
| September 2017 to October 2019 | 10,791,177 | 146,792 | 10,518,241 | 1,153,579 | -733,851 |

Has Co-composting Facility & SWM

## Group Work

## THANK YOU

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