Assessment of Fecal Sludge Containment Practices in Urban Areas of Bangladesh and Identifies Improvement Strategies: A Case Study of Savar Paurashava, Bangladesh

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ABSTRACT

Fecal sludge containment management remains a major urban sanitation challenge in Bangladesh, where most municipalities rely on onsite sanitation systems such as septic tanks and pit latrines. This study evaluates the existing fecal sludge (FS) containment status in Savar Paurashava and identifies practical improvement strategies for safe sanitation management. A mixed-methods research design integrating quantitative and qualitative approaches was adopted. Quantitative data were derived from a household survey of 379 holdings conducted by Water and Sanitation for the Urban Poor (WSUP) using stratified random sampling at a 95% confidence level. Qualitative information was obtained through field observations, Key Informant Interviews (KII), stakeholder consultations, and institutional review.

The findings reveal that 20.31% of surveyed households had no containment systems and discharged wastewater directly into drains, while only 30.87% used septic tanks. Among the septic tanks, merely 8.97% were connected to soak wells, whereas most discharged effluent directly into drains or nearby water bodies. The study further identified that the majority of septic tanks were undersized, lacked partition walls, and did not comply with Bangladesh National Building Code (BNBC) standards. Qualitative findings revealed weak institutional enforcement, inadequate technical supervision, low public awareness, and the influential role of informal masons in constructing non-standard containment systems.

The Fecal Waste Flow Diagram (FWFD) (commonly it termed as FSD) shows that the sanitation services in Savar Paurashava are not safely managed. The study recommends strengthening municipal regulatory enforcement, implementing the Paurashava Sanitation Management By-Laws 2021, establishing a Fecal Sludge Containment Management Committee (FSCMC), retrofitting defective systems, and improving technical training and public awareness. These measures are essential for achieving Sustainable Development Goal (SDG) target 6.2 and promoting environmentally sustainable urban sanitation in Bangladesh.

Keywords: fecal sludge management; containment; septic tank; urban sanitation; Bangladesh

INTRODUCTION

Urban sanitation management has become a critical environmental and public health concern in Bangladesh due to rapid urbanization, population growth, and inadequate sanitation infrastructure. Most municipalities outside Dhaka rely almost entirely on onsite sanitation systems, including septic tanks and pit latrines. However, these systems are frequently poorly designed, improperly maintained, and directly connected to municipal drains, resulting in environmental contamination and public health risks.

The Government of Bangladesh introduced the Institutional and Regulatory Framework (IRF) for FSM in 2017 and the Paurashava Sanitation Management By-Laws 2021 to improve urban sanitation management. Despite these initiatives, implementation remains weak at the municipal level because of inadequate technical capacity,

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poor enforcement, insufficient monitoring, and lack of public awareness on importance of appropriate construction of FS containment.

Savar Paurashava, a rapidly urbanizing municipality located near Dhaka, presents a representative case for examining urban FS containment challenges. The municipality is characterized by high population density, expanding residential and industrial development, and growing pressure on sanitation systems.

This study aims to:

1. Assess the current status of fecal sludge containment in Savar Paurashava;
2. Identify technical, institutional, and behavioral gaps;
3. Integrate quantitative and qualitative evidence to evaluate existing practices; and
4. Recommend strategies for improving FS containment management.

LITERATURE REVIEW

FSM includes the collection, containment, emptying, transport, treatment, and safe disposal or reuse of fecal sludge generated from onsite sanitation systems. Containment is considered the most critical component because failures at this stage compromise the entire sanitation service chain.

Studies in Bangladesh consistently reveal widespread deficiencies in septic tank design, absence of soak wells, direct drain connections, and weak regulatory oversight. Existing research also highlights institutional fragmentation, low technical capacity, and inadequate enforcement of sanitation regulations.

The Bangladesh National Building Code (BNBC) 2017 provides technical specifications for septic tank design, including minimum dimensions, retention periods, and effluent management requirements. However, compliance remains limited in most urban municipalities.

Globally, Sustainable Development Goal (SDG) 6.2 emphasizes access to safely managed sanitation services for all. Bangladesh has undertaken policy reforms toward achieving this target, but operational implementation at local government level remains insufficient.

MATERIALS AND METHODS

Study Area

Savar Paurashava is located approximately 26 km northwest of Dhaka and covers an area of 13.54 km². It consists of 9 wards and had a population of approximately 296,851 according to the 2011 census, though unofficial estimates exceed 800,000.

Research Design

A mixed-methods approach integrating quantitative and qualitative analysis was adopted.

Quantitative Components

- Household survey data from 379 sampled holdings;
- Physical measurements of septic tanks;
- Statistical analysis using MS Excel;
- Development of a Fecal Waste Flow Diagram (FWFD).

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Qualitative Components

- Key Informant Interviews (KII);
- Field observations;
- Institutional consultations;
- Stakeholder discussions with municipal officials.

Sample Size Determination

The study applied stratified random sampling using Cochran's formula with:

- 95% confidence level;
- 5% margin of error;
- Total holdings: 28,839.

The calculated sample size was 379 households.

Indicators

The study evaluated:

- Containment infrastructure;
- Containment size;
- Structural condition;
- Accessibility for emptying;
- Outlet connections;
- Regulatory compliance.

RESULTS AND DISCUSSION

The observations from this study are summarized in both qualitative and quantitative analysis.

Quantitative Findings

Containment Status

Out of 379 surveyed holdings:

- 20.31% had no containment systems and discharged directly into drains;
- 57.3% used septic tanks;
- 21.37% used pit latrines with slabs;
- 1.06% used pit latrines without slabs.

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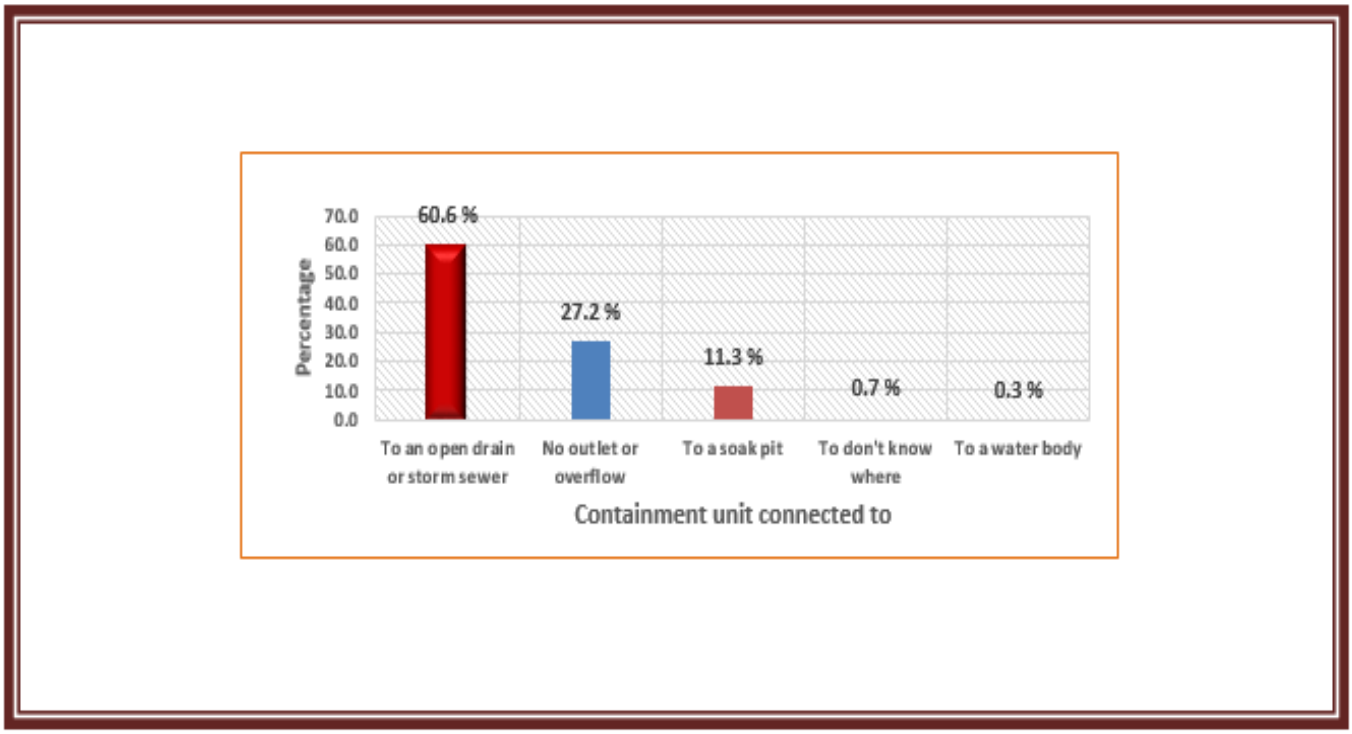
Among septic tanks:

- Only 8.97% were connected to soak wells;
- Most were directly connected to drains.

Containment outlet connection for effluent disposal

The study found:

- 60.6% of containment outlets connected to open drains or storm sewers;
- 11.3% connected to soak wells;
- 27.2% had no identified outflow system.



This outlet connection of containment unit is presented in figure1.

Fig 1: Status of outlet connection of containment (septic tank)

Septic Tank Compliance

Field measurements of 13 septic tanks showed:

- Improper dimensions;
- Incorrect length-width ratios;
- Absence of partition walls;
- Direct connections to drains.

Most septic tanks failed to comply with BNBC standards.

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Qualitative Findings

Institutional Weaknesses

Key Informant Interviews and stakeholder consultations revealed:

- No dedicated municipal unit for FS containment management;
- Weak enforcement of building regulations;
- Inadequate manpower for inspection and monitoring.

Technical Deficiencies

Municipal officials reported that sanitation design review is generally absent for buildings under five stories.

Local masons strongly influence septic tank construction, often without technical knowledge or regulatory oversight.

Public Awareness

The study identified widespread lack of awareness among residents regarding:

- Proper septic tank design;
- Environmental risks;
- Need for soak wells;
- Importance of desludging and maintenance.

Integrated Analysis

The integration of quantitative and qualitative findings demonstrates a systemic sanitation governance failure in Savar Paurashava.

Quantitative evidence confirms widespread non-compliance with sanitation standards, unsafe effluent disposal, and poor containment performance.

Qualitative evidence explains these deficiencies through:

- Weak institutional enforcement;
- Limited municipal capacity;
- Financial constraints;
- Informal construction practices;
- Insufficient public awareness.

Descriptive statistical analysis was performed to interpret the collected data. In addition, a Fecal Waste Flow Diagram (FWFD), commonly known as a Shit Flow Diagram (SFD), was developed (presented in Figure 2) to evaluate the proportion of safe and unsafe fecal sludge flows within the study area. The findings further validate that sanitation services in Savar Paurashava are not safely managed across the municipality.

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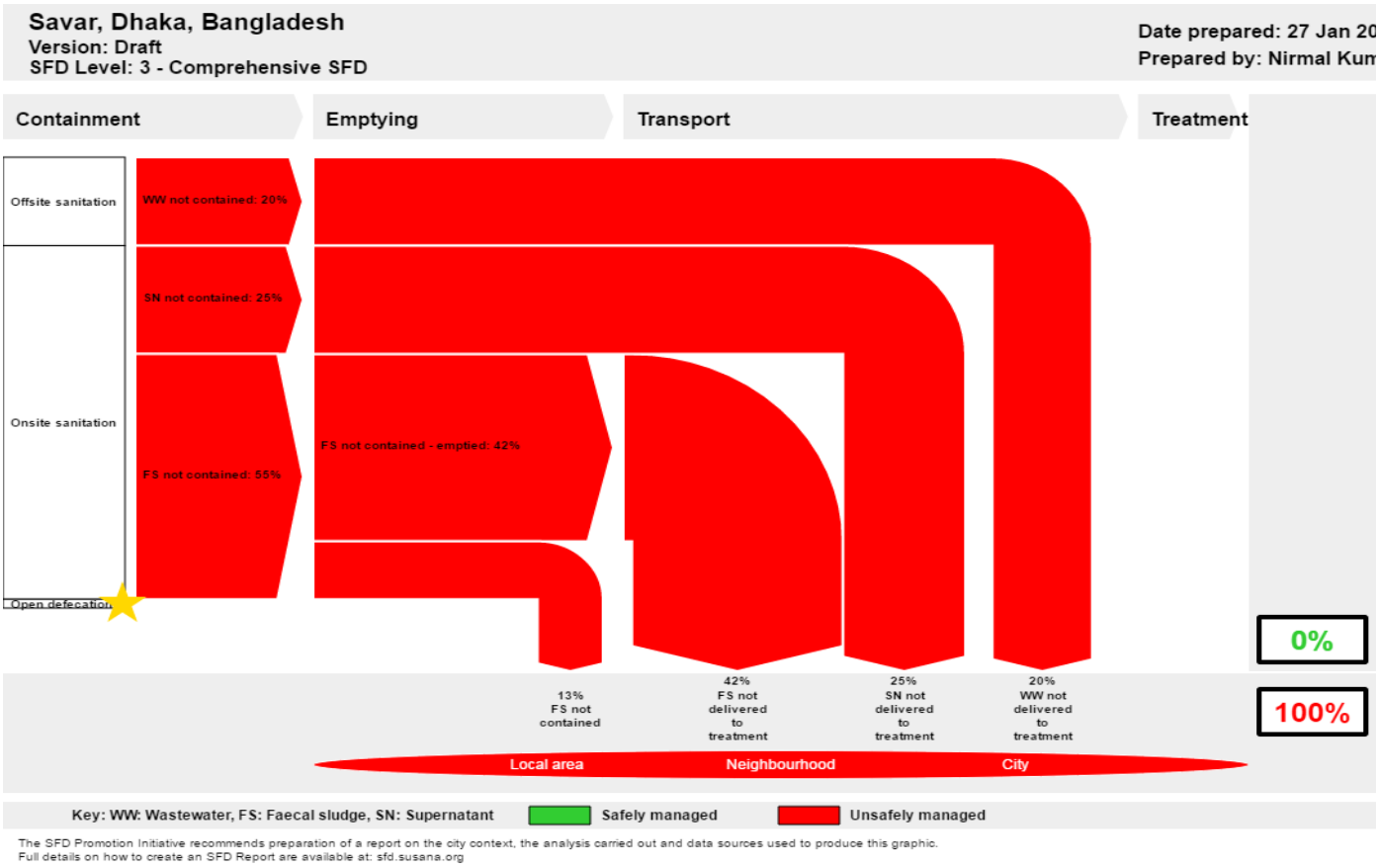

Figure 2: Shit Flow diagram of Sanitaion System in Savar Paurashava

Challenges of FS Containment Management

The challenges associated with implementing remedial measures for FS containment management are summarized in the table below.

Findings	Proposed Remedial Measures	Challenges
In appropriate size of septic tanks	Re- construction of existing tanks	1. Un willingness of dweller 2. Re-construction cost
	Construction of an additional tank	1. Availability of space/land 2. Construction cost
	Should ensure in new building construction	Effectiveness of Fecal Sludge Containment Management Committee (FSCMC)
Septic tanks without partition wall	Enforce construction of partition wall in existing tanks	Un willingness of dweller
	Should ensure in new building construction	Effectiveness FSCMC
Septic tanks without soak well	Enforce construction of soak well for existing tanks	1. Un willingness of dweller 2. Construction cost
	Should ensure in new building construction	Effectiveness of FSCMC
Effluent out flow connection to open drain	Should ensure the construction of a soak well and connect with the septic tanks	1. Un willingness of dweller 2. Construction cost 3. Effectiveness of FSCMC
Lack of awareness among urban dwellers regarding the	Taking program for awareness-building campaign	• Effectiveness of FSMC • Fund/development partner for the program.

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necessity of appropriate FS Containment		
Influence of masons to construct inappropriate FS containers	Taking program to provide training to masons and contractors on standard septic tank and soak well design norms and their effectiveness	Fund/development partner for the program.

Proposed Improvement Strategies

To address the pressing issues identified in this study, the following interventions are proposed:

Technical Interventions

- Enforce BNBC compliant septic tank construction;
- Promote mandatory soak wells;
- Retrofit defective systems where feasible;
- Improve containment accessibility for desludging.

Institutional Measures

- Establish a Fecal Sludge Containment Management Committee (FSCMC);
- Strengthen municipal inspection systems;
- Allocate dedicated FSM budgets;
- Improve inter-agency coordination.

Community and Capacity Development

- Conduct awareness campaigns on safe sanitation and fecal sludge management practices;
- Train local masons and contractors on proper containment design and construction practices;
- Promote stakeholder engagement and public participation.

Support for Infrastructure Improvement

Savar Paurashava should undertake programs to assist urban residents in reconstructing or retrofitting defective fecal sludge containment systems (e.g., septic tanks or pits) and constructing soak wells to prevent direct effluent discharge into municipal drains.

Policy and Regulatory Actions

- Implement the Paurashava Sanitation Management By-Laws 2021;
- Strengthen enforcement of building approval conditions;
- Develop municipal sanitation databases.

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CONCLUSION

This study demonstrates that fecal sludge containment systems in Savar Paurashava are largely unsafe, technically deficient, and institutionally weak. Most containment systems fail to comply with BNBC standards and contribute to environmental pollution through direct discharge into drains and water bodies.

The mixed-methods approach provided a comprehensive understanding of the problem by integrating quantitative evidence with qualitative institutional and behavioral analysis. The findings emphasize that improving urban sanitation requires not only technical upgrades but also stronger governance, public awareness, and institutional accountability.

The proposed interventions can support Bangladesh in progressing toward SDG target 6.2 and achieving safer, more sustainable urban sanitation systems.

Further studies should be conducted to develop sustainable mechanisms for operating and maintaining fecal sludge management service chains.

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Data Availability

Data are available from the corresponding author upon reasonable request.

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