Paper ID: 263

A Case Study on Obstacles and Prospects in the Functionality of the First Integrated Landfill and Resource Recovery Facility of Bangladesh in Jashore Municipality

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Abstract

The Integrated Landfill and Resource Recovery Facility in Jashore Municipality is the country's first waste-to-resource recovery center and was constructed with an ADB-financed budget of 23 Crore BDT under the City Region Development Project. It aimed to transform an uncontrolled dumpsite into a resource recovery site and handle 35-42 tons of waste per day from 60,000 households in the municipality. However, the facility fell short in other areas of its targets, such as producing 2 tons of compost per day, generating 192 kWh of electricity from biogas for the resource center, and fully implementing its designed components, including landfill cells, a pretreatment plant, a fecal sludge management facility, and a municipal fecal-water treatment facility. The study analyzed the fundamental issues preventing the facility from reaching its full potential, which include proper waste chain management deficiencies, regional power influences, construction design flaws, manpower shortages, and the lack of a plastic recycling facility. Field visits were conducted to collect credible and dependable data on the current operational status and challenges. The results indicate significant gaps in the facility's design and operational management, and even at full capacity, it would be insufficient amidst the rising waste generation, which averages 70-80 tons per day at present. Findings of the study demonstrate that an enhanced logistical support within Bangladesh, improved long term management practices by NGOs, strengthened regional cooperation, and necessary technological upgrades are required to meet the expected aims from the facility. The findings have serious implications for sustainable urban waste management, notably in fast-growing cities of developing countries where an integrated approach is critically needed to address environmental and public health concerns.

Keywords: Waste Management, Landfill, Solid Waste, Resource Recovery.

1. Introduction

In the context of Bangladesh, waste generation situation is getting aggravated continuously, especially in the urban areas. The amount of solid waste produced per day is approximately 21,332 tons per day in Bangladesh but it will be raised to 47,000 tons a day by the year of 2030 [1]. The per capita waste generation is projected to increase to 0.75 kg/day by the year 2025, which will result in a total annual waste of almost 21.07 million tons [2,3]. Bangladesh, like in other developing countries, is facing serious waste management problems because of its massive population and urbanization. Most municipalities and metropolitans are still at war with the massive amount of waste we generate. Previous disposal, through open dumping and uncontrolled landfills, caused major environmental damage, health risks and wasted valuable resources [4]. Jashore is a fast-growing urban area in the country that brings numerous issues regarding solid waste management (SWM) as well. It is estimated that total municipal solid waste (MSW) generated in Jashore lies between barely two figures and does not exceed around 69 tons per day [4], [5]. For this reason, waste treatment plants have been vital today to be able to recycle resources, and then consume less harmful products. The Asian Development Bank (ADB) has been helping local governments in Bangladesh to build infrastructure for waste management that should solidly tackle these challenges. The Integrated Landfill and Resource Recovery Facility located in Jhumjhumpur, Jashore, is a part of the waste treatment system being implemented under City Region Development Project (CRDP) by Local Government Engineering Department (LGED) with Asian Development Bank (ADB) funding. The project was taken up as a pilot project to demonstrate the feasibility of converting waste into valuable resources like, fertilizers, biogas, recycled products etc [6]. The goal behind the project is to step towards sustainable waste management

and serves as a model for future waste management projects in the country. Despite the sustainable goal, it operates below capacity and faces quite operational challenges.
The key objective of this study is to investigate the root causes of the inadequate performance of the Jashore Integrated Landfill and Resource Recovery Facility. From the identification of limitations, this study aims to provide perspectives that might establish a more efficient framework to strengthen future waste management initiatives and their operations in Bangladesh.

2. Methodology

A mixed-method approach has been employed for a better understanding of the operational challenges at the Jashore facility. The study combined a comprehensive assessment of project documentation including both qualitative and quantitative analyses to evaluate the facility's performance. The methodology as outlined in Fig. 1, provided an extensive assessment by integrating operational metrics with views from key stakeholders, allowing for a more refined understanding of the issues affecting the facility.

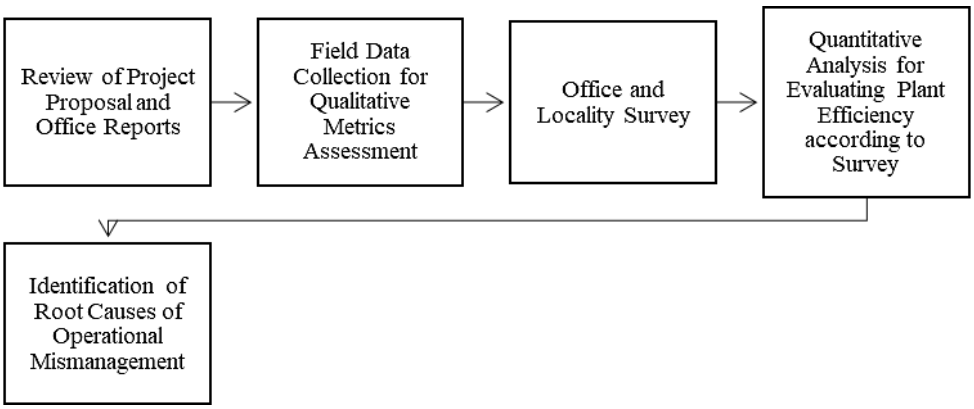


Fig. 1. Schematic Representation of the Research Methodology

3. Data Collection

This section provides a comprehensive review of the documentation related to the Jashore Integrated Landfill and Resource Recovery Facility, focusing on its design, construction, and operational objectives. Firstly, recorded data accumulated from project reports has been examined and then findings from site visits have been discussed to analyze the facility's performance and sustainability potential.

3.1 Documentation Review

Coordinated by Jashore Municipality and executed by the contractors, M/S Mahabub Brothers Pvt. Ltd. and MSC-NH (JV), the investment in this project was supported with an estimated investment of 2,237.968 BDT lac [7]. The construction work started in October 2016 and was completed by March 2017, and then the facility was inaugurated in December of the same year [8]. Collection of project data first involved a critical review of the reports received from ADB and various governmental repositories in an effort to gain an understanding of facility design and operational objectives for the Jashore facility. Projected performance for the facility was compared to traditional approaches to waste management practices in other municipalities. To highlight such a comparison, two flowcharts in Fig. 2 and Fig. 3 are presented. Fig. 2 depicts the traditional solid waste management approach based on indiscriminate collection of generated waste with less or negligible recovery of resources.

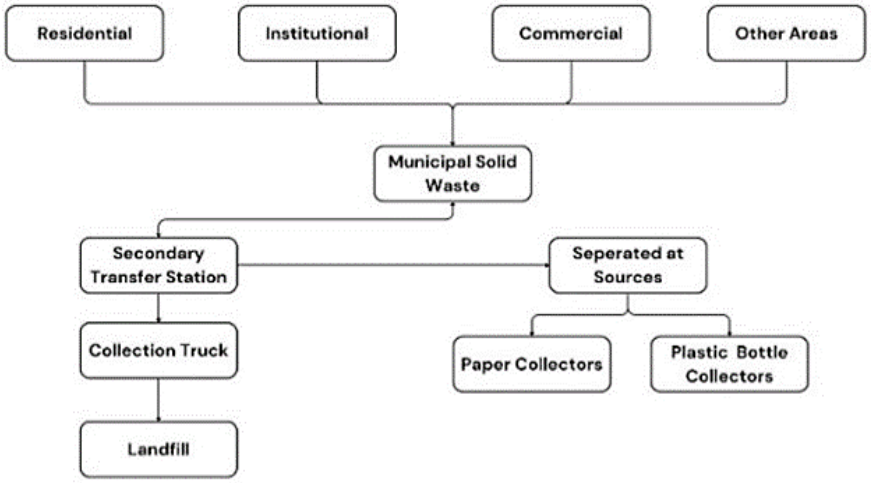


Fig. 2. Traditional waste management practice in Bangladesh

The second flowchart in Fig. 3 outlines the Jashore model, emphasizing structured waste segregation, advanced recycling, composting, and energy recovery within a controlled environment. This comparison underscores the facility's potential to transform waste management practices and establish a new benchmark for sustainability in the region.

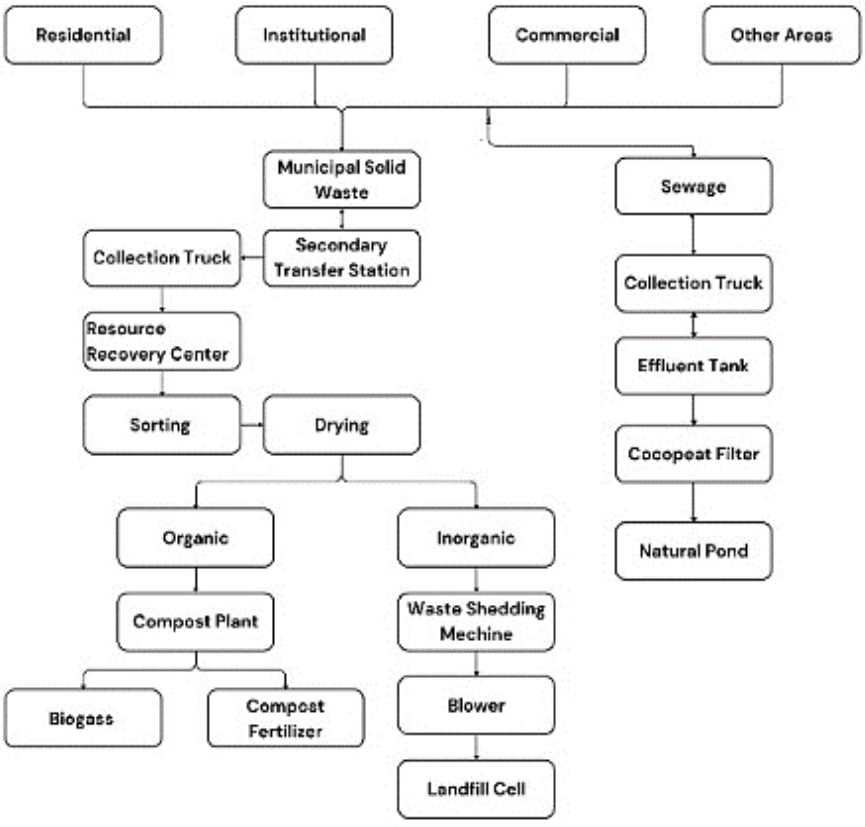


Fig. 3. Intended Waste Management in Resource Recovery Facility

3.2 Qualitative Study

Qualitative data for the study refers to key functions which are installed in this project and their workability. Qualitative data were collected through in-depth field observations. Later the findings have been cross-checked with the project proposal and the expected objective outcome of the project. A comparative analysis was

conducted using the qualitative data, to benchmark the Jashore facility's performance against the expected outcome from the project. The analysis aided in focusing onto the areas where the plant underperformed which allowed the study to illustrate the most challenged aspects of the facility's operations. Table 1 provides a clear overview of the functionality of different components within the landfill and resource recovery center, showcasing which elements are operational and which ones are not working as intended.

Table 1. Status of Functionality of components of the Landfill and Resource Recovery [7]

Facility Type	Status
Functional	Pump, Drying Bed, Control Landfill Cell, Waste Shredding Machine, Belt Conveyor, Weighing Scale, Dumping Trucks
Non-Functional	Compost Plant, Pre-treatment Plant, Effluent Tank, Cocopeat Filter, Landscaping, Pipe Network & Inspection Pit, Biogas Digester, Gas Generator, Centrifugal Backward Curved Blade Blower, Rotary Drum Dryer, Floating Aerator, Pneumatic Pumping System, Leachate Treatment Plant, Equipment Excavator & Wheel Loader

The qualitative study reveals that that the facility is facing major challenges, with a large portion of its essential waste management components not functioning. As a result, the plant is primarily operating as a conventional landfill as illustrated in Fig. 2, rather than fulfilling its intended role as a comprehensive resource recovery center as illustrated in Fig. 3. This situation significantly limits its ability to reduce waste, recover valuable resources, and promote sustainable practices, ultimately undermining its purpose.

3.3 Quantitative Study

Quantitative data have been collected through interviewing the key stakeholders, including facility staff, local residents, municipality officials, and officials from the constructing organization of the plant. Local Government Engineering Department and Jashore Municipality jointly were in charge of constructing this plant. Quantitative data were analyzed to evaluate the facility's operational effectiveness. Metrics such as waste processing capacity, resource recovery rates, operational downtime, and maintenance schedules were analyzed in this stage. These metrics, shown in Table 2, provide a clear picture of how the facility is performing and highlight the specific areas where improvements are most needed.

Table 2. Quantitative Report of the Plant [7], [8] [9]

Metric	Quantity	Present Scenario
Waste Intake Capacity	65 ton/day	68-72 ton/day
Sorting Capacity	0.5 ton/hour	Manually
Compost Production Capacity	4 ton/day	0 ton/day
Biogas Plant	4	4 (all inactive)
Biogas Production Capacity	720 cubic meters	0 cubic meter
Electricity Generation	432 kW	0 kW

The Jashore Integrated Landfill and Resource Recovery Facility demonstrates considerable operational shortcomings despite adhering to its design standards. The volume of waste received surpasses capacity, and manual sorting results in processing delays. The facility does not create compost, and its biogas facilities are nonfunctional, leading to no biogas or energy generation. The deficiencies in resource and energy recovery, presumably due to technological or managerial shortcomings, require prompt action to attain sustainable waste management objectives. The quantitative findings reveal that the facility falls short in its primary goal of converting waste into reusable resources. This inefficiency is likely driven by the non-functionality and inadequate maintenance of key components, as found out from the qualitative analysis through field surveys, which significantly hampers effective waste management and resource recovery.

4. Results and Discussions

The facility's performance is significantly below the projected outcomes majorly due to failure to process and convert substantial waste quantities into compost and energy. Though it started its biogas and recycling subsystems but failed to continue. The analysis indicates that the root causes of these failures lie in a combination of design flaws, such as the inefficient layout of the conveyor belt system, number of important treatment units being non-functional alongside external factors like, local politics, including management shifts and insufficient willpower. Additionally, the absence of a plastic recycling unit contributes to environmental degradation,

undermining the approach to sustainable facility. Comparative analysis with similar facilities in other countries suggested that a lack of local expertise and technology adaptation further exacerbated the situation.[10]
The facility was initially equipped with a range of technologies designed to sort, process, and recover resources from municipal solid waste. Though, field visits revealed that the planned infrastructure and the actual components are quite alike, real life operation, such as the composting unit and recycling lines, were operating below capacity for severe design flaw of the plant.
The field assessment of the facility's operational status indicated that several treatment and recycling units were not fully functional. The landfill section, intended to serve as a controlled and environmentally secure disposal site, showed signs of mismanagement as in Fig. 4 including inadequate waste compaction and leachate management issues. Important waste treatment technologies like the buffer tank, blower etc. have been found to be non-functional as in Fig. 4 due to technical malfunctions. The non-functional status of these key treatment units further compounds the problem, forcing a reversion to conventional waste management practices. The absence of a dedicated plastic recycling unit, a significant oversight given the prevalence of plastic waste, undermines the facility's goals to promote sustainability in waste management system and contributes to environmental pollution. Interviews with stakeholders highlighted numerous functional challenges, including inadequate training for facility staff, inconsistent waste segregation practices at the source which cause the inefficiency of waste supply chain from the household to dump station, and limited public awareness of the facility's role. Municipality officials raised concerns about political involvement, budgetary awareness, and the lack of technical expertise necessary to regulate and upgrade the facility's infrastructure. The study identified several operational inefficiencies, including inadequate management of waste sorting, recurrent technical malfunctions in the composting units, and design deficiencies in the recycling system. These inefficiencies have resulted in lower-than-expected resource recovery rates and have affected the overall functionality of the facility. To add, poor communication channel with public and so, their lack of cautiousness towards proper waste disposal is also a major mismanagement issue.



(a) Composting unit in inactive status
(b) Stagnant leachate
(c) Open dumping of Wastes
(d) Non-functional buffer tank
(e) Non-functional Compost Box
(f) Non-functional blower
(g) Waste pile left for air-dry
(h) Unsorted waste accumulation
(i) Direct waste disposal into the landfill

Fig. 4. Current Scenario of Jashore Integrated Landfill and Resource Recovery Facility from field visit

The dominance of external factors including political interferences and poor budgetary planning had greatly impaired the operational efficiency of the facility. The vast majority of the political decisions were against

technical guidance and that created a lot of delays in maintenance alongside widespread underinvestment in critical infrastructure. The tightening of the budget has exacerbated these problems, restricting money for essential staff training and mandatory equipment replacements. A comparative analysis with similar integrated landfill and resource recovery facilities in countries like Malaysia and Japan highlighted that the performance of the Jashore facility fell significantly short of expectations. Even neighboring countries, utilizing comparable technologies, have demonstrated higher operational efficiency and resource recovery, underlining the disparity between Jashore's projected capabilities and its actual outcomes.

5. Conclusion

The Jashore Integrated Landfill and Resource Recovery Facility has been a case in point that reveals the yawning gaps in planning, execution, and management which must be addressed for unlocking opportunities associated with such projects related to sustainability. Furthermore, it is duly important to have a detailed plan and design, along with a solid and competent management system as well as enough financial and technological resources. According to the report, policy changes that could have significant impact in helping to solve this issue would be implementing guidelines for facility management transitions and improving technology transfer so that advanced waste processing technologies are better suited for local conditions [11].

From the extensive study, significant issues have been identified which are impairing the performance of Jashore Integrated Landfill and Resource Recovery Facility majorly due to mismanagement, technical breakdowns, financial limitations and external political interferences. All these combined prevent the facility to be operated as a sustainable and efficient solution for management of solid waste.

The findings have several implications for future waste management projects: Training of staff, maintenance regimes for equipment and stakeholder engagement are likely to help improve project operational efficiency. This needs to be supported by greater transparency in decision-making processes and focused budget allocations to ensure these facilities remain operational. Alongside this, local government, NGOs and others must prioritize the development of robust sites with multi-sectoral operations to better manage plastic waste.

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