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SCENARIO OF SOLID WASTE MANAGEMENT (SWM) PRACTICE IN THE MUNICIPALITY AREA OF SATKHIRA

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ABSTRACT

Solid waste management (SWM) is a challenge in developing countries due to the increasing generation of waste, the burden placed on municipal budgets as a result of the high costs associated with its management, the lack of understanding over a diverse range of factors that affect the various stages of waste management, and the absence of links required to allow the entire management system to function. In order to highlight SWM in the southwest area of Bangladesh known as Satkhira pourashava (SP), this research was conducted. To achieve the objectives, primary and secondary data from field observations, questionnaire surveys, and the entire management cost was considered. In the municipality of Satkhira, solid wastes are generated at a rate of 63 tons per day, of which 38-40 tons per day are collected and the remaining 35-40% are discarded haphazardly due to economic constraints, inadequate vehicles, lack of labor, and absence of strategic planning. On the basis of the findings, recommendations were made for the future enhancement of the current SWM system in Satkhira, taking into account the difficulties faced and the possibilities offered.

INTRODUCTION

Environmentally acceptable management of municipal solid waste (MSW) has become a global challenge due to limited resources, an exponentially increasing population, rapid urbanization and worldwide industrialization. In developed nations, waste is deposited in landfills, whereas on developing nations, waste is typically dumped on streets and in vacant lots. When this untreated waste is exposed to the air, it causes environmental hazards and impacts infrastructure. But in Asian countries, these factors are further exacerbated by inadequate financial resources, and inadequate management and technical skills within municipalities and government authorities (Hazra et al., 2009). Therefore, not only will waste management save natural resources, biodiversity, and human life, but it will also have a positive effect on the economy, as more jobs will be generated to run an effective waste management system

Like others, Bangladesh is currently experiencing a period of rapid growth and urbanization concurrently with which proper management of generated solid waste is becoming a major issue (Rashid et al, 2011). Due to rapid industrialization and population explosion in Bangladesh, the increasing rate of waste generation is projected to reach 47,064 tons per day by 2025. The Waste Generation Rate (kg/cap/day) is expected to increase to 0.6 in 2025 (Alamgir and Ahsan, 2007). Therefore, waste management in these areas has been the authorities' greatest challenge (Rahman et al., 2020). The majority of the population does not have access to waste collection services, and only a small portion of generated waste is collected through a door-to-door collection system introduced in the late 1990s by nongovernmental organizations (NGOs) and community-based organizations (CBOs) for a small fee. In addition, due to a lack of desire, knowledge, commitment, experience, and funds, 40-60% of garbage is not adequately kept, collected, or disposed of in the specified locations for final disposal (Ahsan et al., 2005).

This study was conducted to demonstrate solid waste management in the municipality of Satkhira in order to identify gaps in the collection, management, transportation, and recycling of solid wastes. The problem is worsening as a result of the growing urban population and ignorance of city inhabitants.

Therefore, solid waste management is a necessary phenomenon, as poor management of solid waste (SW) poses risks to the population of the study areas. This study also attempted to determine the adverse effects of inappropriate solid waste disposal, which could endanger the environment and human health in the city of Satkhira.

Description of Study Area

The research was conducted in the Satkhira municipality, which is located between 22°43'41"N and 89°05'54"E. In 1869, the Satkhira municipality had an area of 31,10 square kilometers and nine wards. The location and map of the Satkhira municipality are shown in Figure 1. Satkhira, the area of the Sundarbans, has earned a stellar reputation as a business centre because of Bhomra port, the largest land port in Bangladesh. Additionally, it is well-known for the production and export of shrimp and mango (Rahman et al., 2018). The annual temperature of the district is 30.23°C (86.41°F), which is 2.49 percent higher than the average for Bangladesh. The municipality of Satkhira has a population of 200,000 people. The Satkhira pourashava authority (SPA) is accountable for the effective management of waste generated in this study region.

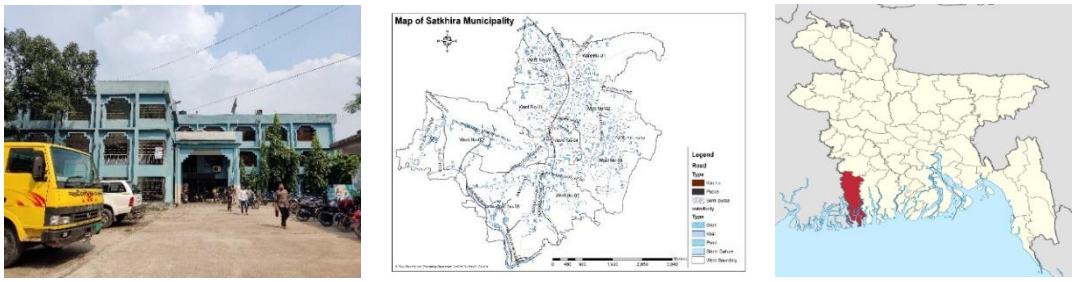


Figure 1 Shows the location of the Satkhira municipality area

The pourashava authority (PA) faces a formidable challenge in managing this enormous amount of solid waste with the resources available now (Table 1). Therefore, the current solid waste management system is inadequate.

Table 1 Present solid waste management practice in the municipality area of Satkhira

Subjects	Satkhira Municipality
1. Year of establishment	1869
2. Area of Satkhira pourashava in Sq. km	31.10
3. No. of wards	9
4. Present population (2020)	200000
5. Amount of daily solid waste generation (Tons)	63
6. Amount of daily solid waste collection (Tons)	38
7. Solid waste generation rate (kg/capita/day)	0.315
8. Time & duration of waste collection	6 am to 12 pm
9. No. of dustbins Available	120
10. No. of final dumping site (FDS)	2
11. Location of FDS	Choyghoria & Binerpota
12. How far away is FDS from Satkhira pourashava?	7 km & 6 km
13. No. of workers engaged in waste collection	150
14. Number & types of waste transport	
i. Dump truck	2
ii. Alom sadhu	2
iii. Trolley	4
iii. Van	10
15. Uses of treated waste	No
16. Recycling activities	
(a) Amount of daily recycling waste generated in SM (Tons)	4-4.5
(b) Number of recycling waste collected from shops	80
(c) Number of people involved in recycling activities	550

Source: Conservancy division and field survey of SM, 2022

OBJECTIVES

The objectives of the study are

- To assess the source of waste generation and waste characteristics in Satkhira municipality.
- To observe the seasonal variation of solid waste generation and management.
- To identify the problems of solid waste collection, transportation and disposal systems in the study area.
- To recommend a better way of solid waste management including reduction, recycling, recovery, and reuse in the Satkhira municipality area.

METHODOLOGY

This paper's methodology includes field observation, a questionnaire survey, and data collecting from the Satkhira pourashava conservation department from July to November 2022. The conservative inspector and in-depth interviews with respondent groups such as pourashava staff and waste collectors, as well as field investigations at the dumping site, acquired the primary data. Following diverse pertinent publications on Satkhira pourashava, numerous papers, journals, and books were utilized to obtain secondary data. A random questionnaire survey was administered in the study area. There were 200 responders in all. According to waste generation sources and composition, waste was characterized. With the aid of a thorough analysis, economical and eco-friendly waste disposal methods were identified. At each stage of this investigation, every effort was made to collect data with the utmost precision; yet, a considerable quantity of waste could not be measured with percent precision. Figure 2 depicts a flowchart that provides a schematic overview of the total project.

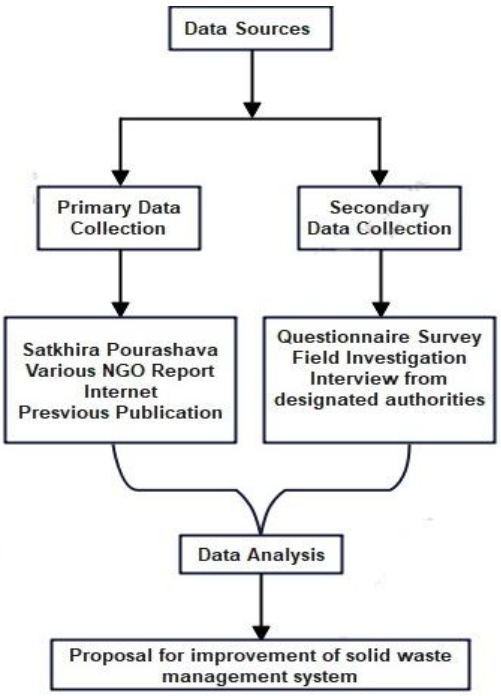


Figure 2 Flow chart of research methodology

RESULTS AND DISCUSSION

Present Solid Waste Collection and Management System in Satkhira Municipality

In the last two decades, the waste volume has increased up to tripled. An average of 55% of solid waste remains uncollected in Satkhira municipality areas, with a variation of collection efficiency from 37% to 77%. The ever-increasing hazardous medical and e-wastes add further burden to the ineffective waste management system.

Table 2 Generation of municipal solid waste

Year	Generation (tons/day)	Generation Rate (kg/capita/day)	Generation Rate (kg/capita/year)
2004	22.0	0.230	84.02
2007	26.0	0.251	91.62
2010	31.0	0.274	99.85
2013	36.0	0.275	100.42
2017	48.2	0.313	114.26
2022	63.0	0.315	114.98

Source: Conservancy division and field survey, Satkhira, 2022

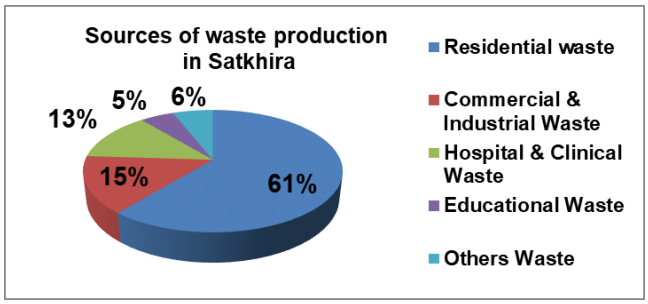
Residential waste is the main source of solid waste in Satkhira municipality (SM) shown in Figure 3 & Table 3. The other important sources of municipal solid wastes are commercial & industrial wastes which comprise markets, hotels, restaurants, hospitals/clinical, institutions including schools, colleges and government offices etc. The average waste generation rate in Satkhira municipality is 0.315 kg/capita/day (Table 2).

Table 3 Classification of collected waste according to source

Source of collected waste	Amount of waste collected (tons)	% of waste collected
Residential waste	23.2	61.0
Commercial & Industrial Waste	5.7	15.0
Hospital & Clinical Waste	4.9	13.0
Educational Waste	1.9	5.0
Others Waste	2.3	6.0

Source: Conservancy division and field Survey, Satkhira, 2022

The regions of Rajshahi, Nawabganj, Satkhira, and Dinajpur provide the majority of Bangladesh's superior mangoes. These are in high demand and have commercial significance. Notable varieties include Himsagar, Langda, Gopalbogh, Fazlee, Ashhwina, Kapahadj, and Lata, among others. According to Banglapedia, the district of Satkhira is renowned for its production, manufacturing, and exportation of mangoes. Consequently, it is readily apparent that the composition of solid waste differs between mango season and other seasons. According to the Department of Agricultural Extension (DAE), Bangladesh, the district's cultivators planted mangoes on 4,115 hectares of land in 2022, while the yield was between 50,000 and 60,000 tons. According to their estimation, five percent of all mangoes gathered become rotten and are discarded as solid waste. Moreover, mango post-consumption wastes consist primarily of seeds known as pits including kernels and thick peels. Depending on the cultivar, the seed makes up between 20% and 60% of the fruit's total weight. The kernel within the seed comprises between 45% and 75% of the total seed (Maisuthisakul et al, 2009). The mango peel accounts for 7% to 24% of the fruit's total mass (Bedardini et al, 2005). According to the kinds of mango accessible in Satkhira, 50% of the mango's total weight consists of the seed, while 10% consists of the peel. The majority of waste was organic (66.0% by weight), indicating a high possibility for resource recovery in the form of animal feed or compost. The percentage of recyclable



waste (plastic, paper, and cardboard) in total waste was around 16.5% by weight. Due to the substantial use of seasonal vegetables, food and vegetable waste accounts for 66.0% of total garbage collection

Figure 3 Contribution of different sources of solid waste

during non-mango season. During mango season, the proportion of mangoes and mango waste increases to 27.0%, while the contribution of other fruits and vegetables decreases to 42.0%. Mango production is higher from May to July because to additional warm and intermittent precipitation. During mango season, the average daily mango waste production is approximately 10.3 tons, or approximately 27.0% of daily waste production. Figure 4 and Table 3 illustrate the amount and variance of solid waste output during mango and non-mango seasons, respectively.

Table 3 Classification of collected waste according to composition (by weight) in non-mango season (left) & mango season (right)

Composition	Non-Mango season		Mango season	
	Total waste tons/day	Percentages of total waste %	Total waste tons/day	Percentages of total waste %
Mango & Mango waste	0.0	0.0	10.3	27.0
Food & vegetables	25.1	66.0	16.0	42.0
Polythene & Plastics	3.0	8.0	2.7	7.0
Paper & Paper products	2.7	7.0	2.7	7.0
Metal	2.7	7.0	2.3	6.0
Textiles	1.1	3.0	1.1	3.0
Glass & Ceramics	1.1	3.0	1.1	3.0
Others	2.3	6.0	1.9	5.0

Source: Conservancy division and field survey, Satkhira, 2022

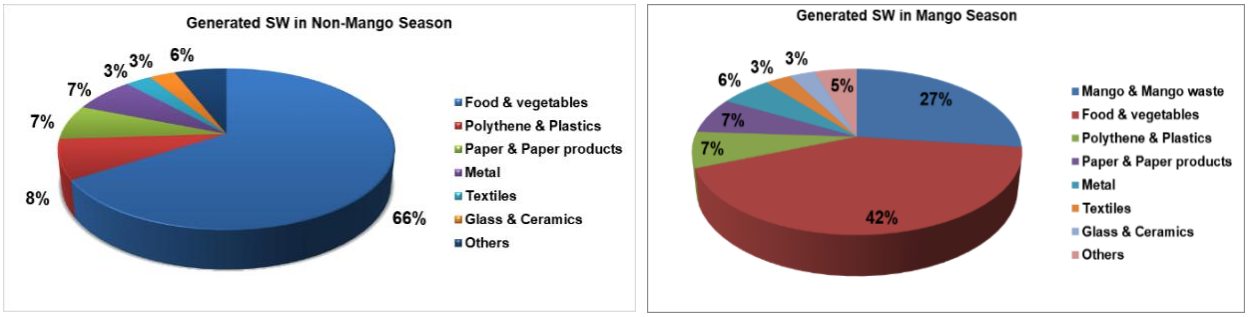


Figure 4 Generation of SW in non-mango season (left) and mango season (right)

According to monthly fluctuation, waste generation is quite high from May to August, with the highest generation rate occurring in June, indicating that during the mango season, discarded mangoes (Figure 5) contribute to the overall waste increase (Figure 6).

Primary Disposal and Collection

Waste collection is a part of the process of waste management. It is the transfer of solid waste from the point of generation and disposal to the point of treatment or disposal. As part of a

Figure 5 Discarded rotten mangoes

municipal landfill treatment program, waste collection also entails the curbside collection of recyclable goods that are technically not waste. In the Satkhira municipality, two types of waste collecting methods are offered. Residential waste is stored in a bin, basket, or bag and is collected daily by a primary collector, who typically carries the waste to local transfer stations in a rickshaw van. This is a primary collection for which the community is responsible. There is no uniform for primary collection employees (e.g., apron, jacket, safety vest, helmet etc.).

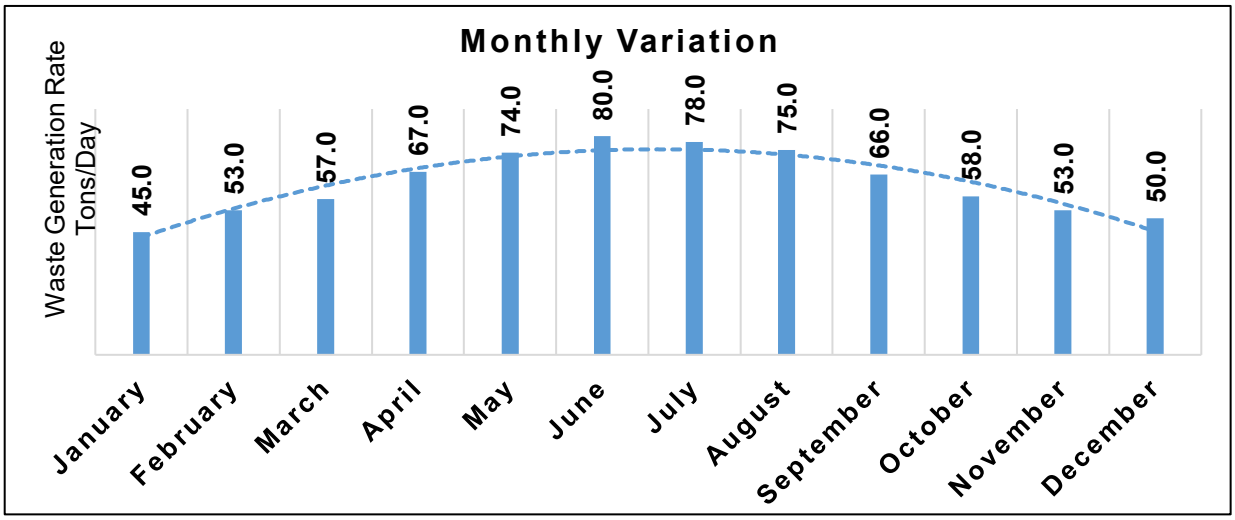


Figure 6 Month wise variation of solid waste generation

The primary collection phase occurs between 6 AM and 12 PM. Recently, door-to-door collection systems have been implemented for municipal solid waste collection from generation sources, primarily households, followed by disposal at the closest secondary disposal site (SDS). In this city, there are a total of 120 waste bins, of which around 70 are now in use. However, most of the plastic trash bins have been stolen, and the oldest cement-concrete trash were not repaired. Under the direction of the conservation department, the sweepers of the Satkhira municipality clean the drains at regular intervals using a fleet of ten small vans (Figure 7). The mango waste is also collected and disposed by the public and certain non-governmental organizations using Van. Then, the waste is unloaded at the secondary transfer station by the van (Figure 7).

Transportation System

The collection of solid waste in urban areas is complicated and laborious. The SPA's Department of Conservation establishes the schedule for MSW collection and transportation vehicle types. MSW collection vehicles typically consist of a dump truck, alom sadhu, van, and trolley. Variable-sized vehicles gather the residential and commercial waste from collection bins and deliver it to open dump sites. The majority of trash hauling vehicles are very old (Figure 8). This increases operational expenses, reduces transfer efficiency, and produces excessive noise and air pollution (Hazra et al., 2009). SPA has two open-air vehicles for transporting solid waste. Unplanned distribution of vehicle trips and lack of awareness on the part of scavengers reduces collecting efficiency and raises the total cost.

Table 4 The number of waste-transporting vehicles in Satkhira municipality

Types of vehicles	Total Number	Capacity per vehicle (Ton/kg)
Dump Truck	2	3 Ton
Alom Sadhu	2	600-650 kg
Trolley	4	300-400 kg
Van	10	100-150 kg

Source: Conservancy division in SM, 2022

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Figure 7 Primary waste collection system in Satkhira municipality

Figure 8 Waste collection in Satkhira municipality

Final Waste Dumping Site at Satkhira Municipality

The municipality of Satkhira operates two landfills: the Choyghoria landfill (about 7 kilometers from the Satkhira pourashava) and the Binerpota landfill (about 6 kilometers away) possesses two waste sites. Currently, all residential and kitchen wastes are transported to the "Choyghoria" disposal site, which is overburdened owing to rain, platform repairs, and maintenance. Each day, around 10 to 15 tons of rubbish are disposed of at this location. There is no suitable facility for trash handling. There is no waste management facility at the "Binerpota" dump site, which has an area of around 10 acres and receives 20 to 25 tons of rubbish from all categories. The current form of garbage disposal cannot be termed sanitary or regulated landfilling because the waste is neither dumped systematically nor covered with soil and compacted into 200–400 mm-thick layers, as is required for sanitary landfills. MSW decomposes swiftly due to climate factors such as high temperature and humidity and a high organic matter concentration, resulting in unsanitary conditions (Hazra et al., 2009). Some kitchen leftovers are fed to pigs. Some wastes are combined with the water in the pond. These leachates produce a variety of difficulties, including air pollution, noise pollution, soil contamination, and water pollution, among others. Currently, the SPA collects and disposes of both biodegradable and nonbiodegradable garbage at the same open dump site. Existing solid waste management systems should be assessed, and their shortcomings identified in order to improve the current situation.

Figure 9 Final disposal of household & kitchen waste in Choyghoria and Binerpota dumping site

Illegal Dumping Causes Different Types of Pollution

Awareness that improper management of municipal solid waste results in contamination of water, soil, and air and has a significant impact on public health has prompted emerging nations to address this issue with increasing urgency (Batool and Ch, 2009; Sharholy et al., 2008). Illegal dumping can also

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influence the environment by polluting our region's waters (including groundwater, streams, rivers, ponds, and lakes), degrading our soil quality, affecting our air quality through open burning, and severely affecting animals. Some residents have littered the roadway with wastes that harm the environment and annoy passersby with their offensive odor. Due to the burning of rubbish in an open area, air pollution is produced. Biodegradation of organic wastes produces combustible and flammable gases during the summer. Carbon dioxide and methane emitted by solid waste are tremendously damaging to the environment. Ponds, canals, and rivers are polluted due to inappropriate solid waste disposal. Each day, a large quantity of solid wastes is dumped in it, contaminating the water. It degrades water quality and disrupts the equilibrium of water's dissolved oxygen (DO), pH, and biochemical oxygen demand (BOD) (Rahman et al., 2020).

Households, especially those from slums, low-income and middle-income groups, and shopkeepers, commonly discharge rubbish into streets, roads, and open spaces, leading drainage systems to become excessively clogged (Figure 10). To avoid these issues, the municipal administration of Satkhira could advise citizens of the timely collection of waste to reduce flooding issues in the town. If residents and merchants are provided with sufficient waste containers, roadside litter is likely to reduce.

Figure 10 Illegal dumping of solid waste in residential areas at various locations in Satkhira municipality.

Present Recycling Process

Recycling is the method through which solid waste can be reused several times. It is the recycling of wastes into the same substance or another material. It has been determined that solid waste recycling is currently appropriate and a sustainable method to solid waste management (Mallick et al.). A questionnaire survey revealed that the majority of recycling shops are located in the city of Sadar. About 550 people were discovered to be active in the city's recycling efforts. Sadar city generates an estimated 4-4.5 tons of recycled solid wastes per day (Figure 11), but SPA does not manage recycled waste. SPA is concerned with the recycling of solid waste, however recycling is hindered by inefficient administration and unconscious labor. Approximately 85 individual businesses in this area purchase recyclable garbage from peddlers. A small number of persons support themselves by selling these recyclable wastes.

Figure 11 Recyclable wastes are collected from Binerpota dumping site

CONCLUSION AND RECOMMENDATIONS

The research revealed that the average daily solid waste generation in Satkhira municipality is 63 tons and the generation rate is 0.315 kg/capita/day, whereas the average generation rate for municipalities of a comparable kind is between 0.30 and 0.35 kg/capita/day (LGED). Waste management decreases the impact of waste on the environment, public health, etc. It can also aid in the reuse or recycling of materials such as paper, cans, glass, etc. There are numerous types of waste management, including the disposal of solid, liquid, gaseous, and hazardous materials. When discussing trash management, many factors must be considered, including waste disposal, recycling, waste avoidance and reduction, and garbage transportation. Waste management comprises the treatment of solid and liquid waste.

During the process, it also provides a choice of options for recycling non-recyclable materials. Recycling facilities may transform garbage into reusable materials. Biodegradable waste, such as food, paper, and wood, can be degraded biologically to provide manure and plant fertilizers.

Waste disposal options include open dumping, burning, and loading waste into a vehicle. If a transfer station or dump is more than 100 meters from a person's home, they are less likely to dispose of waste in streets, open areas, and waterways (Rahman et al., 2018). Air pollution, water pollution, a variety of diseases, and environmental damage are all produced by open dumping and burning. There are some shortcomings in the SPA's method for managing solid waste. To reduce environmental pollution, disease, and overall management costs, residents must first be informed of the proper disposal of solid waste. The SPA would then attempt to enhance the existing solid waste collection and disposal infrastructure as sanitary waste treatment.

A questionnaire reveals that approximately 55% of residents are content with the current service provided by the pourashava authority, while 100% of residents desire new, enhanced service. Therefore, the management of solid wastes in the municipality of Satkhira must be improved.

The following recommendations have been proposed:

- Increase the facility for door-to-door collection in all areas of Satkhira municipality.
- The number of dustbins should be increased and the concrete dustbins should be repaired.
- Sweeping the streets, when the waste is carried on the final disposal.
- The plastic cylindrical dustbin in a street may be covered by a door system to reduce odour.
- NGO participation increase for SWM practices.
- Public awareness strategy.
- Hazardous waste should be collected and transported separately and disposed of carefully.
- GIS-based analysis and optimization techniques can be used to determine proper route selection for waste collection and transfer.
- Increase awareness for the reduction of solid waste generation.
- Increase awareness among the people about resource recovery from solid waste.
- Establish sanitary landfills with proper leachate collection and extraction systems and odorous gas collection and extraction systems will minimize the groundwater contamination problems.

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