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## Solid Waste Management Practice in Burdwan Municipality, West Bengal: An Overview

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### Abstract

This study provides an overview of solid waste management practices in Burdwan Municipality and identifies sources of waste generation. The study primarily relies on both primary and secondary data collected from Burdwan Municipality. A prepared questionnaire was utilized during field studies conducted in the wards of Burdwan Municipality. Secondary data, available in the form of reports and documents from the year 2019, were also employed. Tabular presentations, flowcharts, pie charts, statistical tools, and techniques were used for the study. A flowchart model is employed to describe the current practices of solid waste management in Burdwan. Municipal solid waste is classified and identified based on waste characteristics. Biodegradable waste is the primary source of municipal solid waste (MSW) generation in Burdwan city. Commercial places generate more MSW than institutions, while the top contributors from residential premises are low-income group (LIG) households. This study observes a mismatch between MSW generation and available infrastructure, as well as poor management practices. MSW accumulates day by day leading to environmental pollution. However, this problem could be resolved by adopting a reuse and recycle mechanism to convert waste into useful products.

**Keywords:** bio-degradable waste, Burdwan municipality, municipal solid waste (MSW), resident premises and non-resident premises, municipal infrastructure, reuse, recycle.

## Introduction

Waste Management is now a burning problem in the world, especially in emerging nations like India. The production and consumption processes generate waste quickly. In terms of environmental, social, and economic sustainability, it keeps getting worse every day and has become a global problem. In this perspective, waste management, which is currently a widespread problem in the majority of emerging economies, should be built up and developed in every community and economy.

India, a major emerging economic powerhouse, is one of the top five nations producing the most e-waste, which is a type of solid trash and is growing at a pace of 20% per year. According to the 2020-2021 data, total of 160038.9 TPD of solid waste is produced in the nation, of which 152749.5 TPD is collected with a 95.4% efficiency rate, 79956.3 TPD is treated, and 29427.2 TPD is landfilled. 31.7% of the entire garbage produced, or 50655.4 TPD, is still unaccounted for. In various Indian states, managing solid waste is one of the duties that must be performed by urban-local organizations. After exercising extreme prudence, it is growing dramatically and steadily every day in the various stages of India. Although the government is already aware of this fact, the results are that the government cannot do anything about the waste management system without public support because the public is responsible for all functions. According to the report of the Ministry of Environment, Forest and Climate Change (EFoCC), with an average yearly growth rate of 4%, the nation produces about 62 million tonnes of garbage. Additionally, India currently produces 70 million metric tonnes of municipal solid trash. Only 20% of it is recycled, and the rest ends up in landfills. A solid waste management system is required in this case. Waste management in India might grow to be a \$15 billion business, according to estimates. 25% of India's total trash production consists of recyclable dry waste components. This recyclable garbage can be used as a source of raw materials after being improperly collected and deposited into landfills. It can be a very profitable method of earning income if appropriately classified and further processed.

West Bengal's recycling efforts are inadequate given how much rubbish is produced. According to a report by a state expert, waste production is extremely low; its percentages are often closer to 10%. Most of the differences are now widely spread over West Bengal. Kolkata is the only unusual city in West Bengal that has reached its pick-up point. Kolkata has the highest garbage pressure in India—16.5 tonnes per square kilometer—according to a 2013 National Physical Laboratory assessment. Out of the 5372 tonnes produced, only 700 tonnes are collected and recycled. Around 1900 tonnes of waste are recyclable, while the other rubbish is dumped at a landfill. Its impact quickly spreads to the nearby city of Burdwan as well.

Burdwan is currently gaining the percentage of waste management quickly in most of the urban environment. According to the report of 1991 to 2001, despite having a high literacy rate of 76.4%, there is a high population growth rate of 14.19% and a lack of civic consciousness among residents. Due to governance carelessness, there was an estimated 65.83 tonnes of total home waste that was not collected daily in 2008. The primary source of garbage is dispersed across Burdwan in many locations, including the vegetable market, the agro-based sector, the hospital, nursing home, pathological center and so on. It can also be attributed to the above-mentioned areas' subpar waste management practises, which inevitably degrade the appearance of the urban landscape. Municipal solid waste could be efficiently controlled and managed with proper knowledge of its sources or origins (Adipah & Kwame, 2019). So, it is necessary to understand the waste generation and management pattern in civic life in a specific urban body.

Hence, the objectives of this study are to identify the sources of waste generation and understand the SWM practice in Burdwan Municipality. This study investigates the process of solid waste generation, its collection, transportation, dumping, and available infrastructure. This study assesses the current practice in solid waste management (SWM) in Burdwan Municipality and attempts to

identify the organizational functioning and major constraints, if any, for achieving its efficiency in Burdwan Municipality. It plays a crucial role in developing strategies for sustainable waste management practices and reduces the negative impacts of waste on the environment and society.

The paper is organized as the following: Section 2 provides a literature review on municipal solid waste management practice in brief. Section 3 describes the background of Burdwan Municipality and objectives of the study. Section 4 describes data and methodology, Section 5 describes the Results and Discussion and finally, section 6 concludes with remarks.

## Literature Review

Rapidly rising urbanisation generates huge solid waste in an emerging economy like India. Urbanization and industrialization lead to changing lifestyles and human behaviors which affect waste composition from organic to synthetic materials that last longer such as plastics and other packaging materials (Idris et al., 2004; Tarmudi et al., 2009), hazardous E-wastes and so on. Changing the modern city lifestyle generates a bulk amount of solid waste (Abba et al., 2013; Abel, 2007; Thakuria, 2009), which is a threat to the environment. It creates an obstacle to sustainable development. Hence, it is required to manage scientifically all types of waste for sustainable urban development (Moh & Abd Manaf, 2014; Othman et al., 2013). An urgent need is to change the paradigm in solid waste management (SWM) practices to achieve sustainable development goals (SDG) by reducing environmental stress, and improving human welfare minimizing economic losses due to ill health associated with municipal waste and its pollution (Abrhame, 2018; Aitsidou et al., 2019; Xue et al., 2015). According to United Nations Human Settlements Programme (2006), only about 20% of urban solid waste is correctly collected in the world. Due to the failure of municipal governments to collect garbage, Urban people dump waste in open spaces and peri-urban areas, that pollutes the environment and exposes health risks (Aguadze, 2020; Balasubramanian, 2015; Coad, 2006; Dinda, 2004). Uncollected garbage poses a significant challenge to cities, particularly in developing countries (Thanh et al., 2010; Thomas-Hope, 1998). The problem is the product of rapid unplanned urbanization, and a high population growth rate (Chakraborti et al., 2017; Samanta, 2019). Suitable policy measurements may improve the municipal solid waste management (MSWM) practice (Badgie et al., 2009; Beigl et al., 2008; A. Ghosh & Sarkar, 2022).

Asian countries have focused on formulating national legal frameworks, managing institutions, technology, operational and financial aspects, creating public awareness and participation (Shekdar, 2009; Vidanaarachchi et al., 2006), and reducing the waste management-related problems of the municipality (C. Ghosh & Pal, 2017).

## Background of Burdwan Municipality

This study has considered Burdwan Municipality, West Bengal, India, which has certain unique features. Burdwan is the headquarter of the Maharajas of Burdwan under British rule since 1865. Burdwan is the storehouse of food grains and connects the rest of West Bengal and India. Burdwan is an essential town having 35 administrative wards for providing municipal services to a population of around 3.2 lakhs. A typical and traditional waste management system is poor which displays irregular municipal services and low amount of waste collection coverages, open dumping, and so on in Burdwan Municipality. The Chairman, Commissioner, Sanitary Inspector, and other labourers are involved in the MSW management of Burdwan town. For smooth management and functioning, it is required to know the major sources of waste generation places and premises such as households in residential premises, and non-residential premises like commercial and marketplaces, institutions, industrial areas, hotels and restaurants, hospitals and nursing homes. Burdwan is the hub of medical care centers and medical services. Medical waste is generated in

large amount in Burdwan and needs proper scientific management techniques to control medical waste (Das et al., 2015).

The general objective of the study is to get an overall idea about the Solid Waste Management practices of Burdwan Municipalities in West Bengal. The specific objectives are:

- i. To understand the distributional pattern of Solid Waste which is generated in Burdwan Municipality.
- ii. To examine the source and nature of the Solid Waste in Burdwan Municipality.

## Data and Methods

This study mainly uses primary and secondary data which are collected from Burdwan Municipality. The prepared questionnaire is used during a field study in the wards of Burdwan Municipality. Secondary data are available in the form of reports and documents. This paper uses several data which are taken from Burdwan Municipality for the year 2019. Municipal Solid Waste (MSW) is measured in grams (g) for the household level, otherwise in Kilogramme (Kg) and Metric Tonne (MT). Burdwan Municipality has 35 wards, around 3.2 lakhs population, 71.6 thousand households, 1571 non-residential premises (NRP) including 330 commercial establishments. Tabular presentation, flowchart and pie diagram basic Statistical tools, and techniques are used for the study purpose.

## Results

### Waste Generation in Burdwan Municipality

Burdwan Municipality generates 88.4 metric tons of wet waste, 41.7 metric tons of dry waste, and in aggregate 130.1 metric tons of solid waste per day. Location-wise residential premises (RP) and non-residential premises (NRP) contribute 63.2 and 66.9 metric tons, respectively. Table 1 demonstrates the location-wise daily waste generation in Burdwan Municipality.

**Residential premises (RP):** Households generate around 44.3 metric tonnes of wet waste and 18.9 metric tonnes of dry waste per day in the residential premises of Burdwan Municipality (Table 1). Household premises generate 44.3 MT/day of wet waste which is 2.3 times more than that of dry waste.

Table 1

#### Source-wise Distribution of Waste Generation per day in Burdwan Municipality

Type of Premises	Total Waste (MT/day)	Wet Waste (MT/day)	Dry Waste (MT/day)
RP (HH)	63.2	44.3	18.9
NRPs	66.9	44.1	22.8
<b>Total</b>	<b>130.1</b>	<b>88.4</b>	<b>41.7</b>

Sources: Burdwan Municipality (2019)

**Non-residential premises (NRP):** Educational institutions, commercial places, public places and so on are considered non-residential premises which generate around 66.9 metric tonnes of solid waste every day. Nearly 67% is wet waste and the remaining 33% is dry waste in NRPs.

From Table 1, it is noted that wet waste is generated nearly the same amount (around 44 MT/day) in both (RP and NRP) premises while dry waste is more in NRPs (22.8 MT/day) compared to RPs (18.9 MT/day). Following it, we observe that 1571 NRPs of Burdwan Municipality generate daily 66.9 metric tonnes of solid waste (Table 2 and Figure 1).

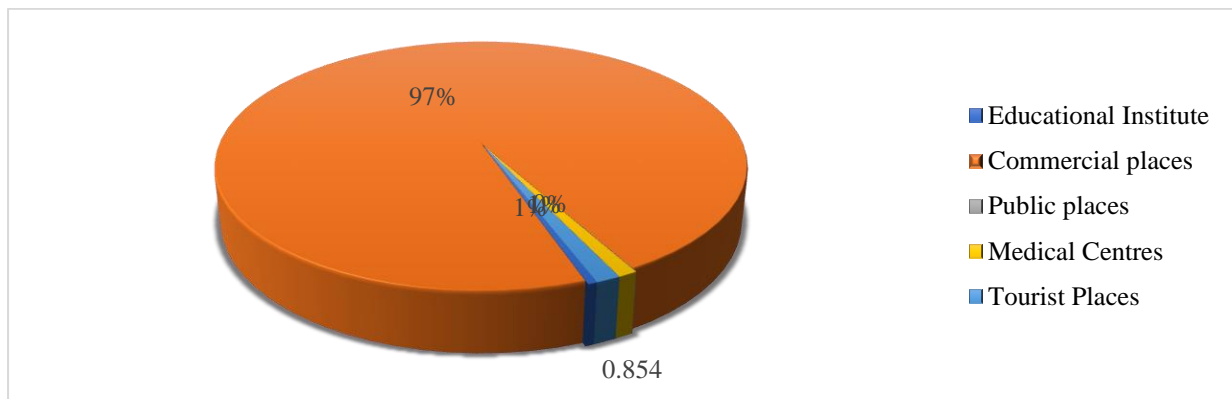
**Table 2**  
**Distribution of Category wise NRPs and their Waste Generation in Burdwan Municipality**

Category of NRP	No. of NRPs	Percentage (%)	Total waste generated by the NRP of the entire city (MT/day)	Total wet waste generated by the NRP of the entire city (MT/day)	Total dry waste generated by the NRP of the entire city (MT/day)
Educational Institute	40	2.546	0.320	0.232	0.088
Commercial places	1095	69.701	65.043	42.924	22.119
Public places	2	0.127	0.0212	0.0092	0.012
Medical Centres	129	8.211	0.6579	0.4773	0.1806
Tourist Places	305	19.415	0.854	0.488	0.366
Total	1571	100.0	66.8961	44.1305	22.7656

Sources: Burdwan Municipality (2019)

Table 2 shows the distribution of category-wise NRPs and their total waste generation in Burdwan Municipality. Total waste from non-residential premises (NRPs) of the municipality is generated from five sectors as Educational Institutes, Commercial Places, Public Places, Medical Centres, and Tourist Places. The total number of NRPs is 1571 in the Burdwan Municipality area and among them, a commercial place is a maximum number of 1095, followed by Tourist places (305) and medical centres (129), and educational institutions (40). Commercial places are around 70% of the total number of NRPs in Burdwan municipality and generate around 97% of total waste generated in NRPs. Medical centres also generate 0.658 MT/day of medical waste, of which 27.45% is dry waste and the rest 72.55% is wet medical waste.

**Figure 1**  
**Total waste generated by the NRP of the entire city (MT/day)**



### Waste Generation Pattern in RPs:

Residential premises (RPs) of Burdwan Municipality generate nearly 63.2 tonnes of total solid waste daily across administrative 35 wards. Around one and a half tonnes of solid waste is generated in each ward daily in Burdwan Municipality. There is a wide range of variation in waste generation across wards. The amount of waste generation varies from a minimum of 0.9 tonnes to a maximum of 3.3 tonnes within 35 wards of Burdwan Municipality. On average each ward generates 1.806 MT of solid waste per day in a residential area of Burdwan Municipality. It is compared with state and national levels to judge the position of Burdwan Municipality in daily waste generation. Detail and discussion of it is given in a separate section in the later part of the paper. The amount of waste generation depends on the characteristics of the household and community and/or their social behaviour (Thakuria, 2009). One of the important sources of solid waste is the residents of Burdwan Municipality. Hence, we try to understand the distribution pattern of solid waste generation at the household and individual levels. The total generated waste of households is distributed among 3 categories or groups<sup>1</sup> like High-Income Group (HIG), Middle-Income Group (MIG), Low-Income Group (LIG), and Slum. Table 3 shows household category-wise waste generation in residential premises in Burdwan Municipality. Around 757 grams (0.757kg) of waste per capita is generated per day. However, it is noted that per capita waste generation is high in low-income groups (LIG) and high-income groups (HIG) while it is least in slums (Table 3). It is also observed that HIG and LIG create a large amount of wet waste, however, LIG generates more dry waste than HIG.

**Table 3**

#### Household category-wise Waste generation in Burdwan Municipality

Category of household	Waste per capita (Gram/day)	Wet Waste per capita (Gram/day)	Dry Waste per capita (Gram/day)
HIG	213.8	149.6	64.2
MIG	184.9	130.1	54.8
LIG	215.8	149.7	66.1
Slum	142.5	100.7	41.9
<i>Average</i>	<i>757.0</i>	<i>530.1</i>	<i>226.9</i>

*Sources: Burdwan Municipality (2019)*

To capture the variation of waste generation this paper analyses its distribution across wards, individual citizens, and household levels. This study analyses the distributional pattern of solid waste generation inwards as well as at household and/or individual levels in RPs.

### Classification of Municipal Solid Waste:

Classification of municipal solid waste helps to identify the major characteristics of the waste and its nature, and next to identify its generation sources. Municipal solid waste could be controlled and managed efficiently with proper knowledge of waste class and its source or origin. Overviewing the key sources of waste generation (Table 1), now the paper presents the classifications of municipal solid waste (Table 4 and Figure 2). These tables are prepared based on a sample survey in Burdwan Municipality.

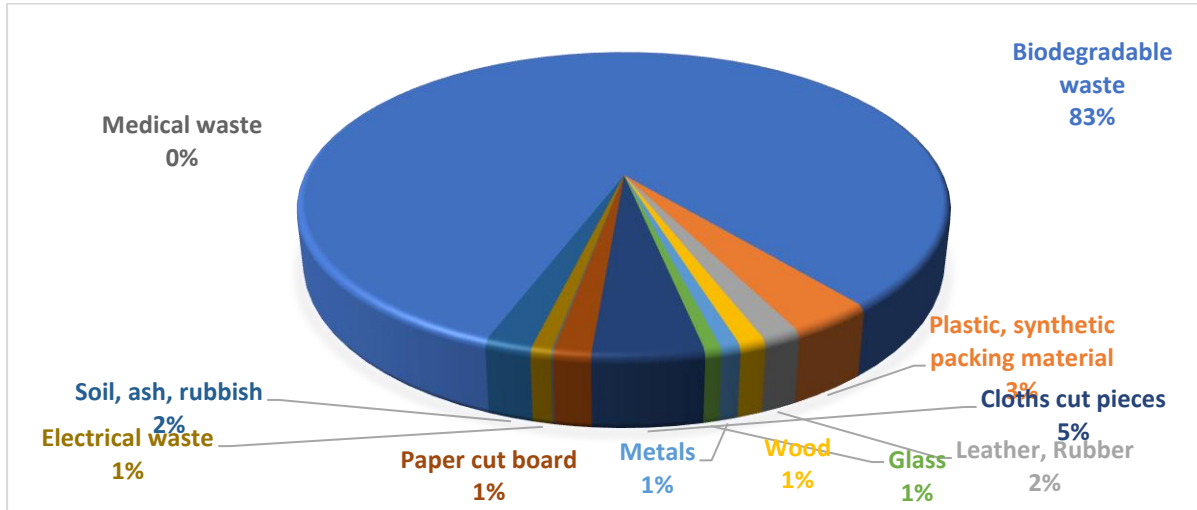
<sup>1</sup>Following municipal tax payment resident households are divided into 4 categories such as High income group (HIG), Middle income group (MIG), and Low-income group (LIG) and Slum.

**Table 4**  
**Classifications of solid Waste in Burdwan Municipality in 2019**

Classification	Amount (MT/day)	Percent (%)
Biodegradable waste	36.35	83.09
Plastic, synthetic packing material	1.55	3.55
Leather, Rubber	0.694	1.59
Wood	0.484	1.11
Metals	0.361	0.82
Glass	0.301	0.69
Cloths cut pieces	2.04	4.67
Paper cut board	0.677	1.55
Medical waste	0.049	0.11
Electrical waste	0.372	0.85
Soil, ash, rubbish	0.866	1.98
<b>Total</b>	<b>43.745</b>	<b>100</b>

Sources: Burdwan Municipality (2019)

**Figure 2**  
**Classifications of Solid Waste in Burdwan Municipality**



Municipal solid wastes (MSW) are classified into several categories such as biodegradable, plastic, metal, glass, wood, leather and rubber, cloth, paper, E-waste, Medical waste, and rubbish (soil, ash, etc.). Table 4 describes classification-wise solid waste in Burdwan Municipality in 2019. As per classifications, major municipal solid wastes are plastics and package materials, papers, rubber and leather, wood, metals, glass, cloths, electrical and electronic wastes, rubbish, and bio-degradable wastes. Among all waste classes, biodegradable waste is in the top rank, it is nearly 83% of total solid waste. Cloth and plastic wastes are in second and third rank contributing 4.67% and 3.55% respectively. Figure in Table 4 indicates that bio-degradable waste is the largest amount of solid waste in Burdwan municipality and hence, it is required to identify its source.

**Infrastructure for Municipal Solid Waste Management:**

Municipal solid waste management crucially depends on its infrastructure particularly solid waste management-related infrastructure such as Dustbins, Vats or garbage points, open dumping spots, garbage vans, build-up drainage systems, and waste transport systems like tricycle vans, light vehicles or heavy vehicles. Each municipal administrative ward has at least one concrete dustbin and its maintenance and garbage clearance at regular intervals. Garbage points like vats and tricycle vans are kept as garbage points in every ward for managing the generated solid waste daily.

**Dustbins and Vats:** Garbage dumping points and/or dustbins and vats are the most important municipal infrastructure where households and/or individuals dump their generated solid wastes. Recently most of the dustbins are replaced by vats and mobile vans in several wards and slowly mechanization is also introduced partially in Burdwan Municipality. On average 3 to 4 vats are required in each ward of Burdwan Municipality, however, in reality, it varies widely from 1 to 8 vats. So, the distribution of vats in the wards is asymmetric. It is observed that one-third of wards have 1 to 2 vats only, and fifty percent of wards have 3 to 4 vats. A number of 5 to 6 vats are available in six wards and the highest number of available vats is 8 in one ward only.

**Tricycle Vans:** Tricycle van is the bare minimum vehicle that is required to carry municipal solid waste from one location to other locations or from small to larger garbage points/vats. Tricycle van is available ward-wise for the collection of solid wastes and maintaining the cleanliness of the city. It is observed that 80% of wards have 3-9 Tricycle vans, while less than 3 and more than 9 Tricycle vans are available in 2 and 5 wards respectively in Burdwan Municipality.

The management process can be complex and challenging due to limited resources, infrastructure and regulatory frameworks. Burdwan Municipality Authority is responsible for managing waste generated in the town having 35 wards. The flow chart of the solid waste management system is given in Chart 1, which identifies the steps of waste creation to disposal points and displays the flow chart of solid waste management practice in Burdwan currently. The flow chart shows the logistic supply from waste generation to collection and waste storage to transportation to disposal or dumping sites, and in between boxes are given a list of agents or sub-agents of waste generators, waste collectors, waste transport operators and so on. Here is an overview of the full waste management process in Burdwan Municipality:

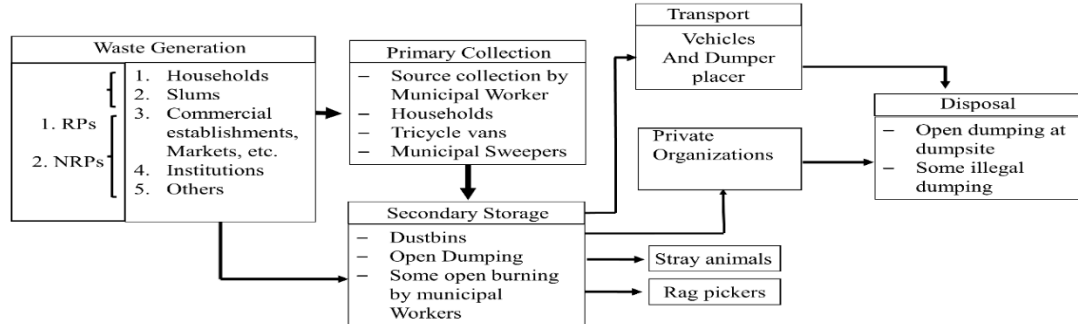
- A. **Waste Generation:** Waste is generated from various sources, including households, businesses, industries, institutions, and slum households. The type of waste can vary significantly, encompassing municipal solid waste, hazardous waste, industrial waste and more.
- B. **Waste Collection:** Collection methods may vary from informal waste pickers gathering recyclables to formal waste collection services provided by municipalities or private organization. In some cases, community-based initiatives play a significant role in waste collection.
- C. **Waste Transportation:** Collected waste is transported to temporary storage facilities like dustbins, open dumping or transfer stations. Transportation methods can range from hand-pulled carts to motorized vehicles, dumper placers depending on available resources.
- D. **Waste Disposal:** Waste is temporarily stored at transfer station or open dumping at dumpsite or some illegal dumping or holding areas before further processing or disposal.

Chart 1 shows the flow of municipal solid waste from waste generation sources to final disposal points through collection and transportations. From the flowchart, it is clearly observed that all the final solid waste is actually dumped in landfilling area, which is increases day by day. Municipal solid waste is mount up over time in Burdwan.



Figure 3

Flow Chart for Solid Waste Management in Burdwan Municipality

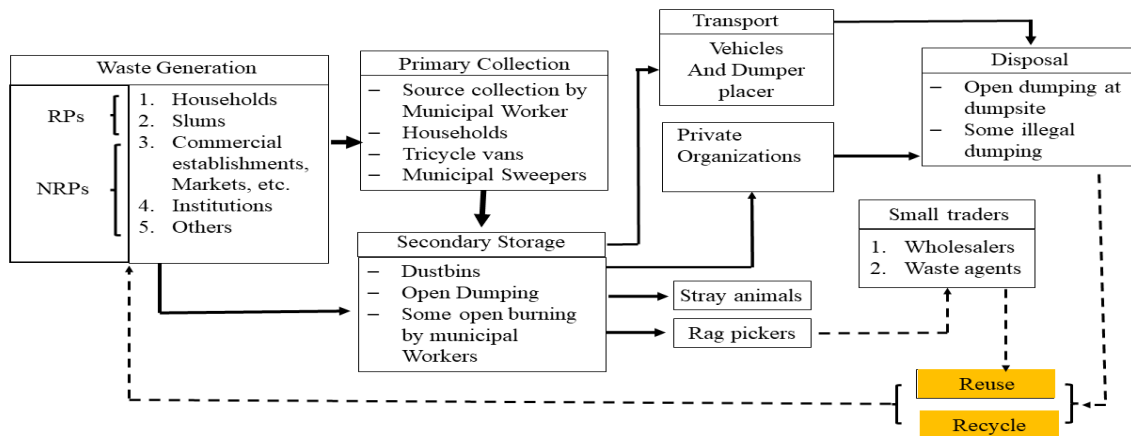


## Discussion

This section deals with the waste management system of Burdwan Municipality and its constraints. Ward-wise waste generation suggests that two wards are generating more than 3 MT of waste per day and six wards generating the least amount of waste (less than and equal to one MT per day). Few wards generate a huge amount of solid waste while these wards have moderate or low populations. Some wards generate a low amount of solid waste due to proper management with available infrastructure like dustbins, vats, and try cycle vans. Recycling mechanism is absent in Burdwan Municipality (Chart 1). Reuse and recycle mechanisms are incorporated in Chart 2. MSW is piled up day by day and available reuse and recycle techniques are required to reduce it adopting a modified flow chart in Chart 2, which leads towards sustainable development goals, as well as understanding consumer behavior and attitudes towards waste disposal and recycling to develop effective educational campaigns and also raise public awareness and encourage responsible waste management practices and also needs to engage communities and stakeholders in waste management decision-making processes for increased cooperation and support.

Figure 4

Flow Chart for Sustainable Solid Waste Management in Burdwan Municipality



## Conclusion

This study identifies residential and non-residential premises are major source points of waste generation and observe the classification-wise solid waste generation. Bio-degradable waste is the largest contributor to solid waste generation in Burdwan Municipality. Commercial places generate more MSW, while low income group (LIG) and high-income group (HIG) households generate more municipal solid waste compared to others in RPs. Basic municipal infrastructure related to SWM is poor and action is needed to take certain technical measurements for solid waste management systems for introducing and adopting reuse and recycle mechanisms. We suggest a modified flow chart for incorporation of recycle approach that should lead towards sustainable solid waste management in Burdwan Municipality as given in Chart 2. Certain efforts are required to raise public awareness, education, and discipline civic life for attaining minimum waste. Municipal Authority should adopt different policies for improving their management system along with the participation of all stakeholders otherwise unable to reach the targets of SDGs within 2030. The waste management system of Burdwan Municipality may achieve a sustainable and long-term solution for proper waste management if several actions should be implemented at all levels such as technical, financial, social, and institutional levels. As the title mainly focuses on waste management practices, there is less discussion about how the municipality manages the waste and also focuses on reducing waste generation at the source through measures like packaging reduction and promoting sustainable consumption patterns also explores strategies for safe and environmentally responsible landfill operation and to optimize waste collection routes to minimize fuel consumptions, reduces emission and improve efficiency as well as examining legal framework related to waste management, including waste disposal bans and extended producer responsibility (EPR) laws. This research assesses the effectiveness of waste management policies and regulations in achieving waste reduction and environmental goals as Chart 2 shows.

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