

Original Article

An Explorative Study on Solid Waste Management System in Burdwan Municipality

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Abstract - This is an explorative study on the solid waste management system in Burdwan Municipality (BM). The paper investigates the municipal solid waste (MSW) generation practice in Burdwan Municipality and identifies the socioeconomic factor associated with it. This study is based on field survey data which are collected from Burdwan Municipality during 2021-22. Basic statistical tools and techniques are applied for the study. The paper also investigates the primary source of waste generation and examines the classification, identified sources and current status of solid waste generation in Burdwan Municipality. This study observes that bio-degradable waste is the maximum among all municipal solid waste generation compared to non-biodegradable waste in Burdwan Municipality. This study observes that waste per day per household is more in low-income household level compared to others. Daily wage earners generate more waste compared to others. The primary level of education of households generates maximum biodegradable and non-biodegradable waste compared to others. Considering per capita waste per day, results remain the same, which may suggest that family size does not affect it, while the education level of gender affects it much. Low-educated male households generate more waste than female households, which is the reverse in higher education. Results show that low-educated female households generate less waste than higher-educated female households. However, education (specific gender) has a significant role in controlling solid waste generation in urban life.

JEL Codes: Q530, R21, R22

Keywords - Burdwan Municipality, Municipal Solid Waste (MSW), Waste generation, Education, Biodegradable, Non-Biodegradable Waste.

1. Introduction

In the twenty-first century, India's economy¹ has become the one with the quickest rate of growth. India's urbanisation is accelerating along with its economic expansion. Being a global economic leader, India's consumption has expanded with changing lifestyles, generating massive amounts of waste, including large amounts of solid waste², which endangers the environment and depletes natural resources. Large-scale solid waste creation may create a certain barrier to sustainable growth. For sustainable urban development,

it is necessary to handle all sorts of trash scientifically. To accomplish the Sustainable Development Goals (SDG), which unquestionably focuses on reducing aspects of municipal solid waste for less environmental stress and

minimising resource depletion, a paradigm shift in the solid waste management (SWM) system is urgently needed to be required. Due to India's high population density, solid waste management and generation constitute a significant issue in both developed and developing nations. While the amount of waste produced in cities continues to rise daily, the efficiency of the means of handling waste in terms of garbage collection and disposal remains dismally low. This is particularly evident in the solid waste management and generation segment in various developed and developing countries. If the source or origin of municipal solid trash is appropriately known, it can be controlled and managed. For a thorough understanding of this context, it is essential to comprehend the distributional pattern of waste generation in civic life in a particular urban region. This study has considered Burdwan Municipality in West Bengal, India, in this regard. Burdwan has some distinctive qualities, which will be covered later.

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¹ Kausik Basu (2015), the Former Chief Economist of the World Bank, said that India is leading the World's growth chart..., the global economy is shifting and Indian economy is ready to escalate its economic activity..., (See, the Times of India, June 11, 2015, p 1 & 6).

² Wastes are any discarded or abandoned materials. Wastes can be solid and semi-solid or materials containing gas. Sources of municipal waste are households, construction and demolition debris, sanitation residues, hazardous waste from industries; and hospital waste which is generated during the diagnosis, treatment or immunization etc.



Prior studies have identified individuals or organisations that would be interested in proper waste management. Local and federal governments are composed of individuals or organisations (Shekdar, 2009; Ackerman et al., 1997). According to several studies, many factors can affect the parts of a waste management system. Sujauddin et al. discovered that factors such as household size, level of education, and monthly income affect waste production. The Municipal Housing Commission's participation in public participation, real estate companies' active support, and the cost of collection services based on waste volume and weight all impact how families feel about trash separation (Scheinberg et al., 2011; Sujauddin et al., 2008). Ekere et al. assert that community involvement in active environmental organisations is necessary for a better system. Taxes prevented city officials from disposing of solid waste (Ekere et al., 2009). The right waste management services are those that deal with issues including high service charges, a lack of financial backing, a lack of resources, a reluctance to pay customers for services, and poor financial resource utilisation. The delivery has been halted (Sharholy et al., 2007, 2008; Sujauddin et al., 2008; Bhattarai, 2000). Administrative deficits are routinely taken into consideration by local governments. Municipal waste management organisations lack leadership and knowledge, according to several experts who have looked at the institutional factors that impact the system. Furthermore, it has been found that the amount of information accessible to the general public is little (Chung & Lo, 2008). Very little of the information is missing or scattered across numerous linked websites. Consequently, it can be difficult to gain a general knowledge of the complex challenges of urban solid waste management (Seng et al., 2011). Garbage workers are perceived as having low social rank because they lack passion (Vidanaarachchi et al., 2006; Pokhrel et al., 2005). Politicians prioritise other municipally owned activities over solid waste management, which results in a shortage of trained staff with municipal training (Moghadam et al., 2009; Sharholy et al., 2008). Local government support and strategic waste management planning to enable yearly system monitoring and review were identified as positive features for system development (Asase et al., 2009). According to scientists, inadequate legal frameworks can actively contribute to improving integrated waste management systems, but inadequate legislation and suboptimal policies stand in the way. Public health also tends to actively support SWM when it is on the public agenda in low-income developing countries, but for the same reasons as in rich countries. Growing urbanisation, socioeconomic disparities, poor environmental sanitation and water supply, social disadvantages and injustice in the current SWM systems, and a high frequency of problems with poor waste management, sanitation, and water supply. Additionally, mortality was reported, particularly in low-income countries' less developed regions (Zohoori & Ghani, 2017). Despite the development of several waste treatment methods, landfills continue to be the most commonly utilised system (Hamer, 2003; Shekdar, 2009). The bulk of

landfills currently in use is still rather basic, despite strict regulations on the types of waste that can be processed in landfills and the possibility of many enhancements to landfill systems (Hamer, 2003). Economic and environmental considerations of waste treatment options are always at the forefront when choosing the optimal technology (Aye & Widjaya, 2006; Daskalopoulos et al., 1997). Developed Asian countries like Japan, South Korea, and Singapore are in the process of outlawing landfills, but some other Asian countries still struggle with difficulties related to uncontrolled dumping (Bai & Sutanto, 2002; Shekdar, 2009). Developed countries choose incinerators because they have well-funded resources and a desire to recover electricity from rubbish (Kleiss & Imura, 2006). Small countries like Singapore have selected incinerators as a method of rubbish disposal since they lack territory (Bai & Sutanto, 2002). However, there are certain additional risks associated with incinerators. Reports claim that incinerators' detrimental effects have been exaggerated and that technological developments have greatly reduced their environmental impact (Hamer, 2003). severe punishments, like (Badgie et al., 2009). The most important aspect to consider when developing a good waste management system is trash creation. Based on culture, public knowledge, and management, different countries produce different amounts of waste (Hazra & Goel, 2009; Wagner & Arnold, 2008). Every study has found that environmental quality decreases in the early stages of economic growth or development and then improves later. In other words, environmental pressure increases more quickly than income at the beginning of development and more slowly relative to GDP growth at higher income levels (Dinda, 2004).

The purpose of this essay is to pinpoint the sources of garbage production and the state of it right now in Burdwan Municipality. This study examines the development of solid waste, its collection, transportation, disposal, and existing infrastructure to comprehend the SWM practise. This study evaluates the sources of waste generation, examines the classification, current level, and socioeconomic factors associated with solid waste generation in Burdwan Municipality, and attempts to identify the organisational functioning and major obstacles, if any, to achieving its efficiency in Burdwan Municipality. The paper is organised as follows: Section 2 describes the data and methodology. Section 3 discusses the results, and Section 4 concludes with remarks.

2. Data and Methodology

This study mainly uses primary data which are collected from the Burdwan Municipality area. This study uses field survey data which are collected from Burdwan Municipality during 2021-22. Municipal Solid Waste (MSW) per week is measured in Kilogramme (Kg) at the household level. Burdwan Municipality has 35 wards, around 3.2 lakhs population, and 71.6 thousand households. Essential statistical tools and techniques are applied for the study. Tabular and graphical presentations are used for basic analysis purposes.

3. Results and Discussion

This section analyses the results focusing on primary waste generation sources and examines the identified sources, classification, and current status of solid waste generation in Burdwan Municipality and identify socioeconomic factor associated with it to manage MSW in Burdwan Municipality.

3.1. Preliminary Observations on the Broad Distribution of Location-Wise Waste

3.1.1. Results and Discussion

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3.2. Preliminary Observations on the Broad Distribution of Location-Wise Waste

Table 1 displays the distribution of ward-wise waste generation and its type in Burdwan Municipality. The study provides classifications of municipal solid waste (Table 1) and an outline of the socioeconomic elements contributing to MSW generation (Table 2). These tables are prepared using primary survey data conducted within Burdwan Municipality. Table 1 includes two types of waste—biodegradable waste and non-biodegradable waste—as well as household waste by ward in the Burdwan Municipality area. Identifying the major types of waste and their nature, followed by identifying the sources of its formation, is made easier with the help of the classification of municipal solid waste. If the waste class and its source or origin are well understood, municipal solid waste can be controlled and managed.

Table 1. Ward Wise Waste Generation Distribution in Burdwan Municipality

Ward (BM)	Waste Generation (Kg/Week)	Bio-Degradable Waste Generation (Kg/Week)	Non-Bio-Degradable Waste Generation (Kg/Week)
1	185.18	170.60	14.58
3	216.51	198.62	17.89
6	190.81	174.24	16.57
9	142.90	130.05	12.85
12	192.78	175.44	17.34
14	122.60	110.94	11.66
20	90.76	84.38	6.38
25	147.75	133.29	14.47
29	92.69	84.27	8.42
32	47.99	43.60	4.39

Source: Author Computation

Table 1. shows that ward-wise waste generation distribution in Burdwan Municipality, the top three contributing wards for waste production are 3, 12 and 6.

The least garbage is produced in Burdwan Municipality’s Wards 9, 14, 20, 29 and 32, and the least waste is produced in Burdwan Municipality’s Ward 32.

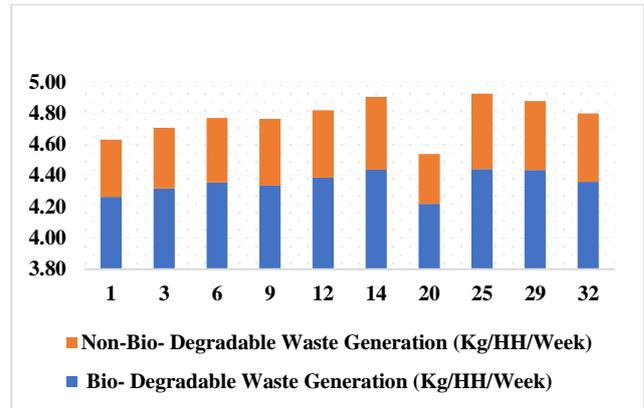


Fig. 1 Ward-Wise Waste Generation Distribution in Burdwan Municipality

In Fig.1 displays the ward-wise waste generation distribution in Burdwan Municipality. The Burdwan Municipality’s ward 20 is the one that contributes the least.

Table 2. Area-Wise Socio-Economic Factors Profile in Burdwan Municipality

Type of Waste	Mean	S. D	Min	Max
Age	50.44	9.86	26	70
Gender	1.24	0.428	1	2
Education Status	3.14	1.11	1	5
Family Size	3.95	1	2	6
Type of house	2.02	0.396	1	3
House ownership	1.49	0.844	1	4
primary occupation	2.33	1.19	1	5
Average Family Income (monthly)	35773.52	18486.2	10000	125000

Source: Author Computation

Table 2 display the area-wise socioeconomic elements in Burdwan Municipality.

Table 3. Type-Wise Waste Profile in Burdwan Municipality

Type of Waste	Mean	S. D	Min	Max
Waste Generation(kg/Week)	4766.55	429.13	2066	6191
Bio-Degradable Waste Generation(kg/Week)	4351.44	299.48	1920	5870
Non-Biodegradable Waste Generation(kg/Week)	415.11	160.91	139.5	676
Waste Generation(kg/day)	680.94	61.3	295.14	884.43
Biodegradable Waste Generation(kg/day)	621.64	42.78	274.29	838.57
Non-Biodegradable Waste Generation(kg/day)	59.3	22.98	19.93	96.57

Source: Author Computation

According to Table 3, the average amount of waste produced each week is 4766.55 kg. In contrast, the average amount of biodegradable waste is 4351.44 kg, and the average amount of non-biodegradable waste is 415.11 kg. The average amount of waste produced daily is 680.94 kg, whereas the average amount of biodegradable waste is 621.64 kg, and the average amount of non-biodegradable waste is 59.3 kg.

Table 4. Classification- Wise Waste Profile in Burdwan Municipality 2021

Type of Waste	Mean	S. D	Min	Max
Food Waste	1820.17	182.35	140	200
Garden Sweepings	31.19	36.40	0	150
Paper, Books, Cardboard	132.58	56.88	30	210
Plastic, Synthetic Fibre	116.52	25.72	40	150
Glass, Bulb etc	5.84	4.38	0	76
Rubber, Leather	5.30	2.03	0	9
Metal, Cans	48.48	20.55	10	95
clothes	71.76	63.28	8	185
Hazardous Waste	4.31	6.64	0	35
Electronic Waste	8.83	5.22	0	18
others	1085.67	177.75	650	250
Vegetable Waste	1246.87	383.08	840	210
fish/meat	173.62	60.35	100	250
Cement & Bricks Waste	5.88	26.91	0	185
Expired Medicine	15.72	7.41	0	30

Source: Author Computation

Table 4 shows the classification-wise waste distribution in Burdwan Municipality. The average amount of food waste per week is 1820.17 kg, and the average vegetable waste per week is 1246.87 kg. Electronic waste weight is 8.83 kg weekly on average and 4.31 kg for hazardous waste. Hazardous waste from plastic and synthetic fibres weigh 116.52 kg weekly, but the average amount of waste from expired medicine is 15.72 kg weekly. The average weekly waste of glass, bulbs and other materials is 5.84 kg, and the average weekly waste of paper, books, and cardboard is 132.58 kg. Average weekly waste includes 5.88 kg of cement and bricks, 1085.67 kg of other materials, 48.48 kilogrammes of metal and cans, and 71.76 kg of clothing.

Table 5 shows that low-level education (Primary) household produces 4.37 kg of biodegradable waste per week. A household with secondary education generates 4.17 kg of biodegradable waste per week. A household with higher secondary education produces 4.33 kg of biodegradable waste per week. A household with graduate-level education generates 4.48 kg of biodegradable waste per week, whereas a household with a master’s degree generates 4.26 kg. In Burdwan Municipality areas,

households with low levels of education (Secondary) produce the most biodegradable waste in comparison to other respondents. The Burdwan Municipality household with higher secondary education makes the least contribution.

The waste generation by education in the Burdwan Municipality is described in Fig. 2. Households with graduate-level education produce 39% of the overall waste, which is a large amount of waste. The percentage of waste produced by households with higher secondary education is 25%, the percentage produced by households with secondary education is 19%, the percentage produced by households with master’s degrees is 8%, and the percentage produced by households with primary education is 9%. In Burdwan Municipality areas, households with graduates produce the most waste relative to other respondents. The least-contributing household in Burdwan Municipality has only a master’s level of education respondent.

Table 5. Education-Wise Waste Profile in Burdwan Municipality

Education Status	No. of Respondent	Bio-Degradable Waste Generation(kg/week)	Average Bio Degradable Waste Generation(kg/HH/Week)
Primary	28	122.33	4.37
Secondary	60	249.86	4.17
Higher Secondary	77	333.26	4.33
Graduate	112	501.97	4.48
Masters	23	98.01	4.26

Source: Author Computation

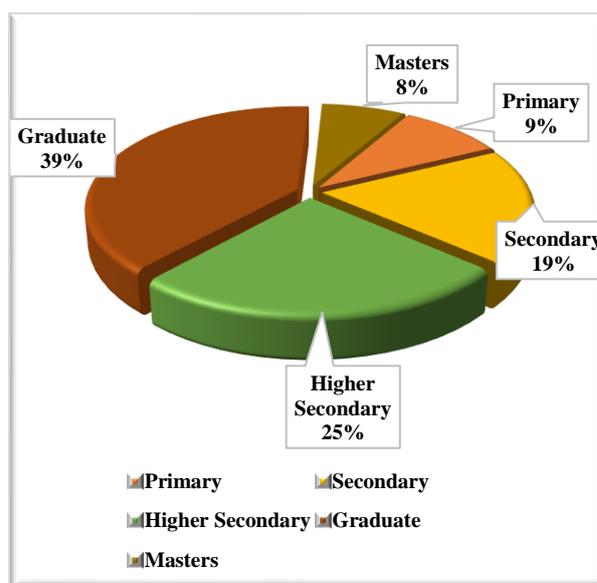


Fig. 2 Education-Wise Waste Generation in Burdwan Municipality (kg/week)

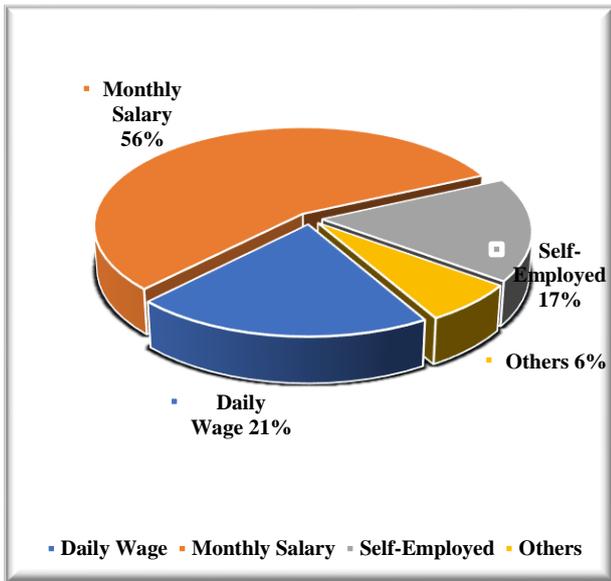


Fig. 3 Occupation-Wise Waste Generation in Burdwan Municipality (kg/week)

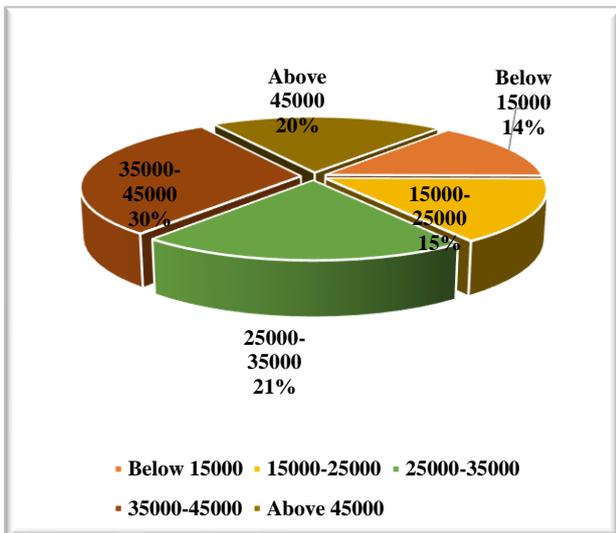


Fig. 4 Income level-Wise Waste Profile in Burdwan Municipality

Fig. 3 clearly demonstrates that households with salaried earners produce a considerable amount of waste (56%), which is a large amount of waste. Households with daily wage earners produce 21% of waste, while households with self-employed individuals produce 17% of waste. 6% of waste is produced by households with other occupations, a small quantity of waste. In Burdwan Municipality areas, households with wage earners produce the most waste relative to other respondents.

Fig. 4 shows that high-income households produce less waste, which is waste in low quantities, whereas Middle-income households produce more waste, which is waste in large quantities.

Compared to other respondents, households with higher income levels produce less waste in Burdwan Municipality areas.

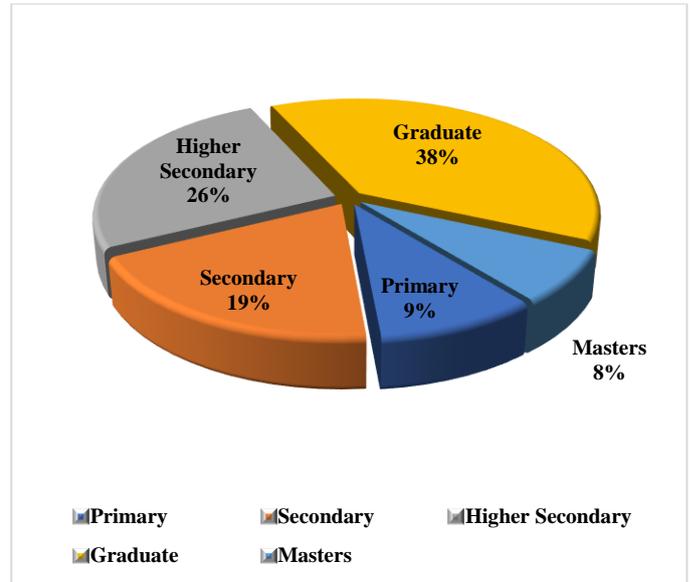


Fig. 5 Education level-Wise Bio-degradable Waste in Burdwan Municipality (Kg/Week)

Figure 5 demonstrates that households with graduate-level education produce a significant amount of biodegradable waste—38%. Higher secondary-level educated households produce 26% of biodegradable waste, secondary-level educated households produce 19%, master’s degree-level educated households produce 8%, and primary-level educated households produce 9%. This is a small percentage of the total amount of biodegradable waste produced. In Burdwan Municipality areas, households with higher levels of education produce the most biodegradable waste relative to other respondents.

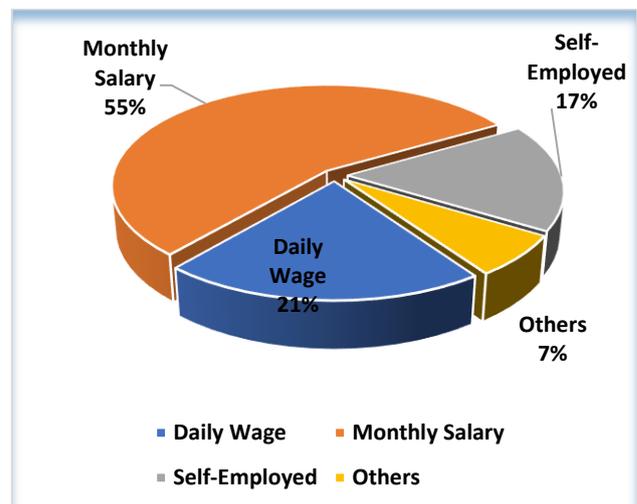


Fig. 6 Occupation-Wise Bio-degradable Waste in Burdwan Municipality (Kg/Week)

Fig. 6 shows that Salary earners generate the maximum amount of biodegradable waste in Burdwan Municipality. Daily wage earners produce a moderate amount of biodegradable waste (21%). Self-employed people (17%) produce the least amount of biodegradable waste. Compared to other respondents, households with

Salary earners produce the most biodegradable waste in Burdwan Municipality areas.

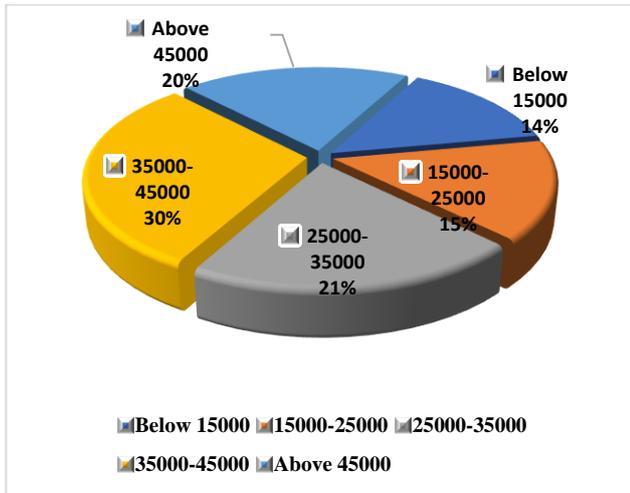


Fig. 7 Income level-Wise Bio-degradable Waste in Burdwan Municipality (Kg/Week)

Figure 7 demonstrates that households with higher income levels produce less amount of biodegradable waste. In comparison, those with lower income levels contribute a smaller amount of biodegradable waste, and middle-income level household generates a large amount of biodegradable waste. In Burdwan Municipality areas, households with higher income levels produce less biodegradable waste compared to other respondents.

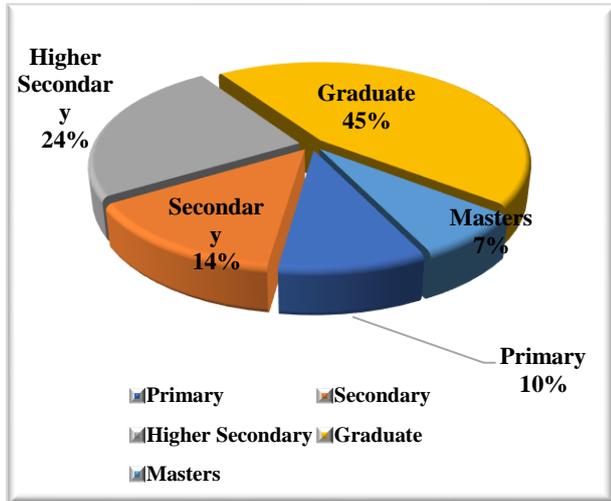


Fig. 8 Education level-Wise Non-Biodegradable Waste in Burdwan Municipality (Kg/Week)

Figure 8 demonstrates that households with graduate-level education generate a significant amount—45%—of non-biodegradable waste. Regarding the overall amount of non-biodegradable waste, those with higher secondary education generate 24% of it, those with secondary education generate 14%, those with master’s degrees produce 7%, and households with primary education produce 10%. Graduate-level households in Burdwan Municipality areas produce the most non-biodegradable waste compared to other respondents.

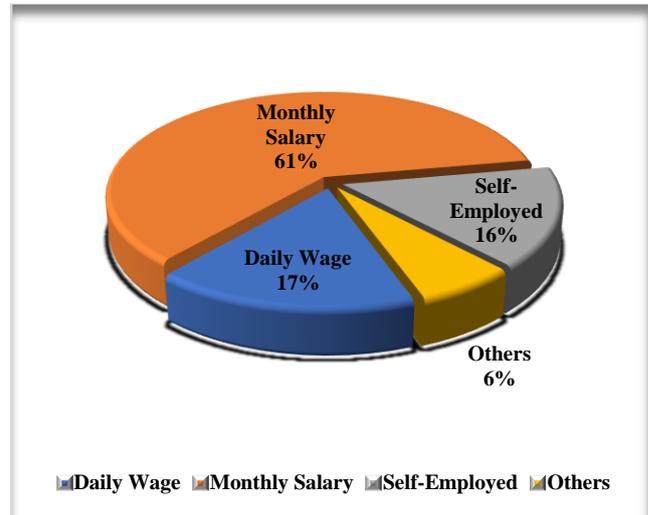


Fig. 9 Occupation-Wise Non-Biodegradable Waste in Burdwan Municipality (Kg/Week)

The non-biodegradable waste generated by salary earners in Burdwan Municipality is at its highest level (61%), as shown in Fig. 9. Daily wage earners produce a minimum (17%) of non-biodegradable waste. Self-Employed households produce moderate amounts of non-biodegradable waste (16%). Compared to other respondents, households with salary earners produce the most non-biodegradable waste in Burdwan Municipality areas.

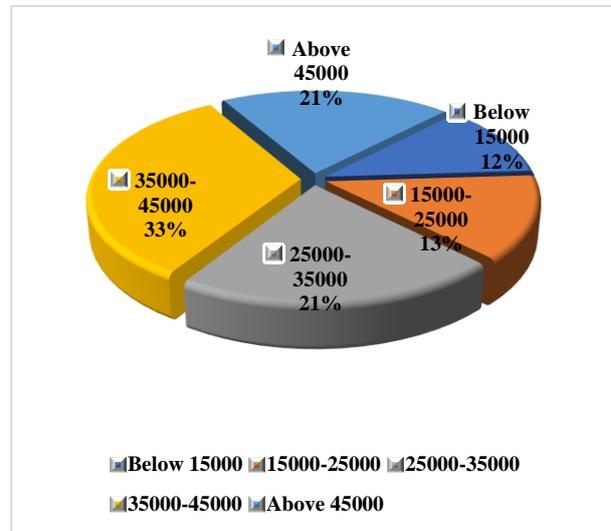


Fig. 10 Income level-Wise Non-Biodegradable Waste in Burdwan Municipality (Kg/Week)

According to Fig. 10, high-income households produce less non-biodegradable waste than middle-income households, which is represented by the significant amount of non-biodegradable waste they produce. Middle-income households produce more non-biodegradable waste in Burdwan Municipality regions than other respondents.

5. Conclusion

This paper has analysed and identified the main sources of waste generation in Burdwan Municipality. This study has examined the waste classification, current status,

and socioeconomic factors that may affect how Burdwan Municipality manages its municipal solid waste (MSW). The study also looks at the many types of waste that are generated, and it shows that in Burdwan Municipality, biodegradable waste is the main source of solid waste. The distribution of solid waste and its current status at the level of the ward and household level. Individual households are examined in this study. This study finds that high-income households produce the maximum garbage relative to other respondents in Burdwan Municipality. This study observes that bio-degradable waste is the maximum among all municipal solid waste generation compared to non-biodegradable waste in Burdwan Municipality. This study observes that waste per day per household is more in low-income household level compared to others. Daily wage earners generate more waste compared to others. The primary level of education of households generates maximum biodegradable and non-biodegradable waste compared to others. Considering per capita waste per day, results remain the same, while the education level of gender affects it much. Low-educated male households

generate more waste than female households, which is the reverse in higher education. Results show that low-educated female households generate less waste than higher-educated female households. However, education (specific gender) has a significant role in controlling solid waste generation in urban life.

To reduce waste, some initiatives are needed to increase public awareness, education, and civic discipline. All residents must engage in and collaborate with the municipal authority, be aware of the services provided by their corporation, and be informed. The waste management system cannot be achieved without the support of law-abiding citizens. In this context, policymakers should focus on education, more specifically, awareness campaigns related to controlling municipal waste and its consequences for attaining sustainable and smart urban life. The urban authority should ensure a proper infrastructure for managing waste in daily life in the Municipality area. Municipal authorities should implement financially and economically viable plans for their management system.

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