

## **SOLID WASTE GENERATION AND CHARACTERISTICS OF HOUSEHOLD IN THE SLUM AREAS OF KHULNA CITY**

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**Key words:** Solid waste, Slum, Household, Degradable and Non-degradable

### **ABSTRACT**

*A slum is an informal or scattered area where low-income people live in poor-quality housing which is not filling up their basic needs. In urban slums, people face many problems, solid waste and its management is one of them. This research was carried out in slum areas of Ward no. 2, 12, and 13 of Khulna City. A simple random sampling method was used to collect information with questionnaire survey. There are 70 households are selected from these three slums for collect the information where 20 households are selected in Senpara slum, ward no. 2. 30 and 20 households are selected from Behari Colony, 3 no camp, ward no. 12 and Alamnagar Pora-mosque, ward no. 13 respectively. There are Seven days data of degradable waste and non-degradable waste collected at same time in every day afternoons or evening. A digital weight balance was used to measure the amount of waste produced per day where organic and inorganic waste are separated. There are evaluated the existing solid waste disposal and collection practices regarding household waste and 3R (reuse, recycle, and reduce) practice. The families are classified with respect of family member and occupation as well as small family, maximum member of 4 and big family, family member of 5 to 9. Educational status of these slum peoples is also classified where minimum class of 5 and maximum of graduate. From the data analysis of this study area average degradable waste generated per family per day are 0.722kg, 0.860kg and 0.602kg of the family of Senpara, Alamnagar and Behari Colony respectively. From this three-slum maximum degradable waste generated in the big family of Alamnagar where their maximum occupations are worker and others. There are average non-degradable waste generated per family per day is 0.252kg, 0.196kg and 0.209kg for slum of Senpara, Alamnagar and Behari Colony respectively. Field investigation reveals that socioeconomic condition of the people of Behari colony is higher than other two slum. Maximum peoples are job worker. Their solid waste management system is much better than other two slums where the slum of Senpara has no solid waste management system. There are no waste management system and dustbins to dispose their waste. The slum households throw their waste in surrounding area.*

### **INTRODUCTION**

Due to rapid urbanization, industrialization, and population growth, the amount of waste generation is constantly increasing. In order to manage the waste of an area, it is necessary to know the waste generation rate and its characteristics of that area. Khulna is the 3<sup>rd</sup> largest metropolitan city in Bangladesh after Dhaka and Chittagong (Rafew and Rafizul, 2021). According to Abir-ul-Jabbar (Chief Planning Officer of Khulna City Corporation), "Khulna city regions has 294 slums area". The majority of Khulna's population lives below the poverty line, and most of them engaged in a variety of jobs in the informal sector or small businesses.

As a result, they are forced to live in slums and squatter areas without any access to basic city services and facilities. The poor people in urban areas are those who live in these areas and cannot meet their basic needs with their own income (Tanni et al., 2015). The people of the slum area are facing many problems in which waste management is one of them. It leads to creating many problems; mosquitos are the main problem here as there is no fixed place for throwing their household waste. It continuously contaminates the land of slum areas, water, and also air quality.

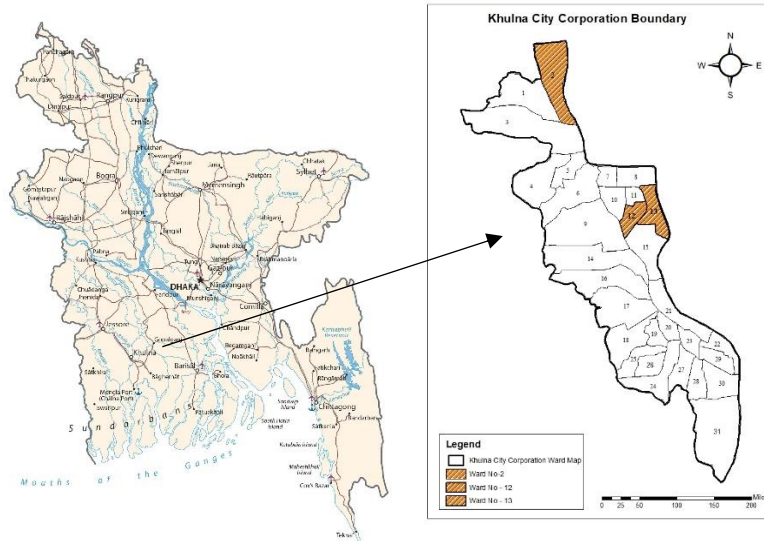
The majority of developing countries produce a significant amount of MSW (Jadoon *et al.*, 2014). One of the major effects of population growth is the rise in waste generation. Rural-urban migration has resulted in a significant increase in population growth are changing living conditions. There is also concern that other factors may be contributing to this exponential rise in MSW amount in emerging cities in Asia and Africa (Suthar & Singh, 2015). Measuring waste generation rate and characterizing waste composition are important steps in creating and executing a feasible solid waste management system at any given location (Gomez et al., 2008a). Household waste needs to be measured and classified in order to design a waste collection and treatment plan for urban residential units. Municipal solid waste generation also depends on different income levels (khan et al., 2016). Uncollected household waste in the streets and other public areas is created to block the drainage system and waterlogging. This water logging is become contaminated which is posing a significant health concern. This is especially acute during the rainy season in crowded, unplanned communities with narrow roadways that prevent municipal trucks from passing (Ahsan et al., 2009). Waste management is an important development sector that leads to a healthier life and better economic conditions. The main advantage of sustainable waste management is to reduce its impact on the environment by improving air and water quality and reducing greenhouse gas emissions (Ashikuzzaman and Howlader, 2020).

This study has been conducted on solid waste generation and management practices of three slum dwellers Ward no. 2, 12, and 13 of Khulna City. A simple random sampling method was used to collect information with a questionnaire survey. There are 70 households selected from these three slums for collect the information. There are seven days data of degradable and non-degradable waste collected in every day. A digital weight balance was used to measure the amount of waste produced per day where organic and inorganic waste is separated. Educational status and family size are classified where education status is minimum class 5 and maximum graduate. From the data analysis of this study area average degradable waste generated per family per day are 0.722kg, 0.860kg and 0.602kg for slum families of Senpara, Alamnagar, and Behari Colony respectively. From these three-slum maximum degradable waste is generated in the big family of Alamnagar where their maximum occupations are workers and others. There is average non-degradable waste generated per family per day is 0.252kg, 0.196kg and 0.209kg for slums of Senpara, Alamnagar, and Behari Colony respectively. From this study, it is revealed that the socioeconomic condition of the people of Behari colony is higher than the other two slums but their waste management system is poor. On the other hand, there are no dustbins available to dispose of household waste in the Senpara slum. They throw their waste in the surrounding slum area.

## METHODOLOGY

### Study Area

Khulna is located in the southwestern part of the country in Bangladesh between 22°47'16" to 22°52' North latitude and 89°31'36" to 89°34'35" East longitude. Khulna is the second-largest port city in Bangladesh covering 45.65 square kilometers of land and has a population of approximately 1.30 million people (BBS, 2015; Rahman & Kabir, 2019). The study area is located at Senpara, Fulbarigate, 2 no. ward, and 3 no. Camp, Bihari Colony ward no. 12 and Pora-mosque Alamnagar ward no. 13, Khalishpur in Khulna City Corporation (KCC). In this study, data are observed in wards no 2, 12, and 13 in KCC. Ward No. 2, was situated in the north part of KCC. 12 and 13no. ward are located in the middle east parts of Khulna City. Figure 1 (a & b) is shown the three-study site location in Khulna City Corporation.



(a) Location map of Khulna in Bangladesh

(b) Study site location in KCC

Figure 1 Site location of the study site in Khulna City.

### Waste Disposal System of slum area in KCC

As a public institution, KCC is responsible for the collection and management of municipal solid waste in the city. The solid waste management system of the slum area of Alamnagar Pora Mosque and Behari Colony camp no. 3, Khalishpur Wards no. 12 and 13, are much better than the Senpara slum in KCC. Solid Waste management systems of households in the Senpara slum are not working. There was no community-based waste collection and management technology. According to the information of the Ward Commissioner of 2 no. ward of KCC, there are a few Non-government organizations like Nabarun Sangha, Prodipan, Rustic, Amader Paribartan, Unnaya, etc., are working to overcome the waste management problems in KCC. But in this slum, they don't provide any collection process. KCC also provides bins but slum people have not used this system. The slum people throw their waste in the surrounding area. Slum households of Alamnagar Pora Mosque and Behari Colony camp no. 3, Khalishpur Wards no. 12 and 13, are tried to use the solid waste management system of KCC but few families are not used it.

### Sampling and Collections

The survey was carried out in KCC Wards No. 2, 12, and 13. The survey was conducted with 70 households in these three slums, and quantitative data was collected from it. A household survey was conducted in order to better understand the socioeconomic profile and household waste generation rate of the people who live in this slum. Household waste has been collected from randomly selected households. In addition, qualitative data were collected by focus group discussion (FGD) with the local people and local leaders. The interviews were conducted with community members to understand their perceptions of household waste management and to assess the public's willingness to participate in waste management activities as shown in figure 3 (a). The interviews were audio-recorded, and the data were transcribed and coded for qualitative content analysis. There are two plastic bags are provided for each household per day. One is used for degradable waste another is used for non-degradable waste. There are degradable waste as well as kitchen waste and non-degradable waste such as plastic bottles, metal, and paper are weighed using a digital weight balance to determine the rate of household waste production. Figure 2 (a) and (b) are shown waste collection at in-side of the Senpara slum area and the waste dumping area at entry outside of the slum area respectively. Figure 3 (b) is shown the data collection at 12 no. word, Khalishpur in KCC.



(a) Waste collection at inside of the Senpara slum area



(b) Waste dumping area entry side of

Figure 2 Slum area, at Senpara, Fulbarigate, Ward no 2 in KCC.



(a) Questioner survey at 12 no. word, Khalishpur in KCC



(b) Waste collection at in-side of 12 no. word, Khalishpur in KCC.

Figure 3 Data collection at 12 no. word, Khalishpur in KCC.

### Waste Separation

Household waste was separated into degradable and non-degradable waste. There is degradable waste as well as kitchen waste and non-degradable waste such as plastic bottles, paper, metals, cloths are separated after collect the sample. There are some non-degradable wastes are sold to street hawkers. Most slum children are collected waste such as plastic bottles and food storage containers in the surrounding area, and sometimes even from waste collection bins to earn money by sold them to street hawkers.

## RESULTS AND DISCUSSION

### Education and Income Level of Slum People

In this study for calculating the waste generation rate by 70 households in three slum areas, Senpara, Alamnagar Pora Mosque and Behari Colony camp no.3. There were degradable and non-degradable waste collected from randomly selected from 20 households of Senpara, slum, 20 households of Alamnagar slum and 30 households of Behari Colony slum. The waste generation rate also depends on the household's income level and population number in family which is shown in table 1, 2, 3 and 4. High-income family's food consumption rate is higher than low-income families. Thus, more waste is generated by high-income families, which leads to an increase in the overall waste generation rate. The income level of Senpara Slum Peoples are taka (Tk.) 7000 to 22000. Slum peoples of Behari colony camp no.3 and Alamnagar Pora-masque, are earned Tk. 5000 to 20000 and Tk. 7000 to 20000 tk. respectively. The education level of these slum peoples are not high. Most peoples of their education are class 5 to 10. Few peoples are graduate whose lives in Senpara slum.

### Waste Generation of Study Areas

Table 1 shows the waste generation with respect of the monthly Income and education level of the slum people at Senpara in KCC. This table shows that occupation of day labor of people which da degradable waste generation rate is 0.753 kg/day/family and non-degradable waste generation rate is 0.283 kg/day/family. Waste generation with respect of occupation and Income level of slum people in Behari colony camp no. 3, ward no. 12 are shown in Table 2 where workers family produce maximum degradable waste values of 0.839 kg/day/family. There are 0.153 kg/day/family non-degradable waste produced of this workers family. Table 3 shows the waste generation with respect of occupation and Income level of slum people of Alamnagar Pora-masque, ward no. 13.

Table 1 Waste generation with respect of occupation and Income level of Senpara Slum People, ward no. 2

Occupation	Total Family	Percentage	Monthly Income (Tk)	Educational Status	Degradable waste rate (kg/day)	Non-degradable waste rate (kg/day)
Small business	4	19.05	7,000-12,000	Class 5-10	0.716	0.557
Teacher	2	9.5	10,000-22,000	Graduate	0.792	0.129
Day Labor	5	28.6	7,000-12,000	Class 5-8	0.711	0.148
Domestic worker	1	4.76	5,000	Class 5-8	0.652	0.321
Rickshaw Puller	1	4.76	10,000	Class 5	0.849	0.110
Driver	4	19.05	9,000-15,000	Class 5-12	0.604	0.153
Worker	2	9.5	7,000	Class 5-12	1.101	0.225
Tailor	1	4.76	9,000	Class 10	0.604	0.618

With respect of their family members slum families are separated by two groups. One is small family and another is big family. Table 4 shows the comparison of waste generation with respect of family member and Income level of slum people of Senpara, Alamnagar Pora-masque, and Behari colony where small family are denoted the family member of 1 to 4 and big family are denoted the family member of 5 to 7 or 9. The comparison of waste generation for per family per day of the slum of Senpara, Alamnagar Pora-masque, and Behari colony are shown in figure 4. From this figure it is shown that degradable waste generation per family/day of Alamnagar slum is maximum than other two slum and maximum degradable waste generation per family/day is in Senpara slum.

Table 2 Waste generation with respect of occupation and Income level of slum people, Behari colony camp no. 3, ward no. 12

Occupation	Total Family	Percentage	Monthly Income (Tk)	Educational Status	Degradable waste rate (kg/day)	Non-degradable waste rate (kg/day)
Small business	5	16.67	5,000-12,000	Class 5-10	0.677	0.722
Day Labor	4	13.33	7,000-12,000	Class 5-8	0.724	0.098
Domestic worker	1	3.33	3,000-7000	Class 5-8	0.519	0.382
Rickshaw Puller	2	6.66	6,000-10,000	Class 0-5	0.688	0.349
Driver	4	13.33	9,000-15,000	Class 5-12	0.751	0.557
Worker	10	33.33	7,000-20,000	Class 5-12	0.839	0.294
Carpenter	2	6.66	12,000-15,000	Class 5-8	0.395	0.048
Color Painter	2	6.66	8,000-12,000	Class 5-10	0.950	0.302

Table 3 Waste generation with respect of occupation and Income level of slum people, Alamnagar Pora-masque, ward no. 13

Occupation	Total Family	Percentage	Monthly Income (Tk)	Educational Status	Degradable waste rate (kg/day)	Non-degradable waste rate (kg/day)
Domestic worker	10	47.36	3,000-7000	Class 5-8	0.821	0.405
Rickshaw Puller	4	21.05	6,000-10,000	Class 5	0.614	0.242
Worker	5	26.32	7,000-20,000	Class 5-12	1.124	0.054
Hawker	1	5.26	18,000	Class 5-8	1.147	0.164

Table 4 Comparison of waste generation with respect of family members and Income level of slum people, Senpara, Alamnagar Pora-masque, and Behari colony

Name of the Slum	Income status	Number of members	Household status	Amount of degradable waste (Kg/day)	Amount of non-degradable waste (kg/day)
Senpara	7,000	1-4	Small family	0.670	0.315
	22,000	5-9	Big family	0.774	0.189
Alamnagar Pora-masque	8,000	1-4	Small family	0.813	0.265
	10,000	5-7	Big family	0.907	0.128
Behari Colony Camp no. 3	12,000	1-4	Small family	0.500	0.123
	20,000	5-9	Big family	0.705	0.296

From data analysis and physical investigation, it is shown that living in a poor condition or for their low income, they are producing less waste. Usually, waste collectors of KCC go to slum 2 to 3 days in a week. Low-income people do not want to invest 30 to 50 taka per month for the purpose of waste management. That's why the waste collector shows less interest to go there and take their waste regularly. For this reason, they throw their waste in the surrounding area which is shown in the slum of Senpara. On the other hand, the solid waste generation and management system of Behari Colony is much better than the slum of Senpara and Alamnagar.

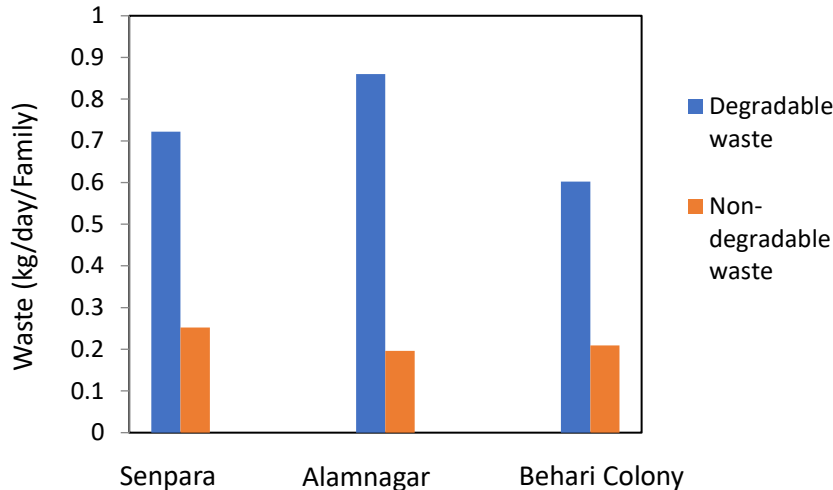


Figure 4 Comparison of waste generation for per family per day of the slum of Senpara, Alamnagar Pora-masque, and Behari Colony

## CONCLUSIONS

Waste management in Bangladesh faces many challenges due to its large, rapidly growing population in a densely populated country. One of the most adverse impacts of poor waste management, especially municipal waste, is the incidence and prevalence of diseases. This study has been conducted on solid waste generation and management practices of three slum dwellers, Senpara, Behari Colony, and Alamnagar respectively wards no. 2, 12, and 13 in Khulna city. There are 70 households selected from these three slums to collect the information where 20 families are selected in Senpara slam, 30 families and 20 families are selected from Behari Colony, and Alamnagar respectively. The average degradable waste generated per family per day is 0.722kg, 0.860kg and 0.602kg for the slum family of Senpara, Alamnagar, and Behari Colony respectively. And average non-degradable waste generated per family per day is 0.252kg, 0.196kg and 0.209kg for the slum of Senpara, Alamnagar and Behari Colony respectively. These results depend on the family members, occupation, and economic condition of each household. Based on the study the following conclusion can be made:

1. Slum dwellers living in a poor condition for their low income. They are producing a small amount of waste. The degradable waste generation of Alamnagar slum is maximum than other two slums of the Senpara and Behari Colony but in Alamnagar slum dwellers generate maximum non-degradable waste.
2. Due to lack of proper knowledge of solid waste management systems low-income level people of slum areas in KCC are not interested to involve in their waste management system regularly. They through their waste in the surrounding living area.
3. This study reveals that to protect the environment of slum areas the proper management system of solid waste should be in a system. The solid waste management system of KCC will be in reached and it should be a strike of this issue.

## REFERENCES

Ahsan, R., Islam, A. K. M. K., & Shams, S. (2009). *Municipal waste management mechanism for Khulna city: a practice for better environment* (Doctoral dissertation, Khulna University of Engineering and Technology).

Ashikuzzaman, M., & Howlader, M. H. (2020). Sustainable solid waste management in Bangladesh: issues and challenges. *Sustainable waste management challenges in developing countries*, 35-55.

Gomez, G., Meneses, M., Ballinas, L., & Castells, F. (2008). Characterization of urban solid waste in Chihuahua, Mexico. *Waste Management*, 28(12), 2465-2471.

Jadoon, A., Batool, S. A., & Chaudhry, M. N. (2014). Assessment of factors affecting household solid waste generation and its composition in Gulberg Town, Lahore, Pakistan. *Journal of material cycles and waste management*, 16, 73-81.

Khan, D., Kumar, A., & Samaddar, S. R. (2016). Impact of socioeconomic status on municipal solid waste generation rate. *Waste management*, 49, 15-25.

Rafew, S. M., & Rafizul, I. M. (2021). Application of system dynamics model for municipal solid waste management in Khulna city of Bangladesh. *Waste Management*, 129, 1-19.

Suthar, S., & Singh, P. (2015). Household solid waste generation and composition in different family size and socio-economic groups: A case study. *Sustainable Cities and Society*, 14, 56-63.

Tanni, T. T., Hasan, M. J., Azad, A. K., & Bakali, B. (2015). State of the environment in slum area: a case study on Khora slum, Khulna. *Journal of Environmental Science and Natural Resources*, 7(1), 295-304.

Rahman, S. T., & Kabir, A. (2019). Factors influencing location choice and cluster pattern of manufacturing small and medium enterprises in cities: evidence from Khulna City of Bangladesh. *Journal of Global Entrepreneurship Research*, 9(1), 61.