M. Alamgir, S.M.T. Islam and J. A. Saju (Eds.)
ISBN: 978-984-35-4034-8

Proceedings of the Waste Safe 2023 – 8th International Conference on
Integrated Solid Waste and Faecal Sludge Management
25-26 February 2023, Khulna, Bangladesh

DOMESTIC SOLID WASTE RECYCLING PRACTICES IN NOAKHALI REGION, BANGLADESH: A SURVEY-BASED STUDY

Habiba Sultana *, Nur Nahar *, Partho Deb Nath, Md. Shakib Alom** and M. G. Toufik Ahmed****

*Department of Environmental Science and Disaster Management, Noakhali Science and Technology University, Noakhali, Bangladesh

**Department of Chemical Engineering, Khulna University of Engineering and Technology, Khulna, Bangladesh

ABSTRACT

This study aims to investigate the recycling practice of domestic solid waste in the Noakhali region of Bangladesh. This research relied on data collected from a questionnaire that was conducted both online and offline. There were a total of four sections to this study that included background data, awareness, attitude, results, and environmental concerns about solid waste management. In this study, male participants were found to have a greater familiarity with solid waste than female participants. About 47.8% of participants didn't have formal policies for disposing or recycling solid waste, and almost 13% did not even know. Additionally, graduates are more interested in a clean environment. Our study found that the vast majority of people agree that recycling is good for the environment but their initiative to recycle domestic solid waste is inadequate. Nonetheless, the Noakhali municipality authorities were unwilling to devote much attention to the proper management of solid waste.

INTRODUCTION

Bangladesh is one of the countries in South Asia with the most rapidly urbanizing economies. 63 million people, or 38 percent of the total population, live in urban areas in Bangladesh (Diaz and Beerli, 2005). This rapid urbanization has increased trash production and waste management complexity, with negative effects on urban livability, the environment, and public health, especially in rapidly growing cities like Noakhali (Chowdhury, 2006). Sustainable Development Goal 11 aims to "reduce the adverse per capita environmental impact of cities by 2030, paying particular attention to air quality and municipal and other waste management" (Bandhara, 2006). Moreover, the achievement of other SDGs is intrinsically linked to this objective. Recycling waste, for instance, can contribute to the achievement of sustainable energy and support SDG 7, which aims to "provide access to affordable, reliable, sustainable, and modern energy for all" (Zahur, 2007).

Waste refers to any product, material, or thing that has outlived its usefulness and is discarded, intended for discard, or mandated for discard by its holder (Vicente, 2007). You can classify it as either dangerous or non-hazardous. Industrial, medical, and electronic wastes (sometimes known as "e-waste") are all considered hazardous (Sharholy et al., 2006). Non-hazardous municipal waste includes things like regular garbage and debris from building projects. Instead, trash can be solid or liquid, and both require unique approaches to cleaning up and getting rid of. Both hazardous and non-hazardous waste, if not properly collected and disposed of, pose serious threats to human and environmental health (Alamgir, 2007).

The urban poor, who are frequently found in peri-urban areas, are those who experience the most life-threatening conditions resulting from inadequate SWM throughout the developing world because municipal authorities frequently allocate their limited financial resources to the wealthier, higher-tax yield areas where residents are more politically active (Carrus, 2008). Typically, as citizens' income rises, a portion of their wealth is utilized to shield them from local environmental issues, but since trash generation rises along with rising wealth, the issues are simply moved elsewhere. As a result, even while environmental issues at the home or neighborhood level may disappear in better-income areas,

regional and citywide environmental deterioration caused by poor SWM persists or worsens (Bhuiyan, 2009).

Rapid urbanization, shifting living standards for city dwellers, and the transition to a middle-income economy all contribute to a growing waste problem. Since this is the case, it is projected that by 2025, the amount of urban solid waste produced per person will increase to 0.60 kg from 0.49 kg in 1995 (Tania, 2014). Current waste management practices are characterized by ineffective garbage collection, high costs associated with removal and disposal methods, a lack of land for final disposal, no policy governing recycling practices, and inadequate environmental awareness**.**

Since waste is a problem that plagues every community, solid waste management is also a recent development. Since gaining independence in 1971, Bangladesh has operated under a traditional waste management system. In the early stages of waste management in Bangladesh, indiscriminate open dumping, burning, disposal into bodies of water, landfilling, and direct disposal into agricultural land in rural regions were all permitted (Abedin and Karim, 2022). In metropolitan areas, the Water Supply and Sewerage Authority (WASA) undertook house-to-house collection as well as midnight garbage collection using Bullock Carts for solid waste. The nation changed its waste management system from a conventional to a modern one as time went on. In Bangladesh, resource management has replaced waste management since waste is now viewed as a resource. Since waste is a problem that plagues every community, solid waste management is also a recent development (Barua et al., 2020). Since gaining independence in 1971, Bangladesh has operated under a traditional waste management system. In the early stages of waste management in Bangladesh, indiscriminate open dumping, burning, disposal into bodies of water, landfilling, and direct disposal into agricultural land in rural regions were all permitted. In metropolitan areas, the Water Supply and Sewerage Authority (WASA) undertook house-to-house collection as well as midnight garbage collection using Bullock Carts for solid waste (Alam et al., 2020). The nation changed its waste management system from a conventional to a modern one as time went on. In Bangladesh, resource management has replaced waste management since wastes are now viewed as resources (Rafew et al., 2021).

Waste collection efficiency in major cities is anywhere between 37% and 77%, with an average of 55% of trash going uncollected (Mukti, 2013). Uncollected trash, especially plastic and polyethylene products, ends up in waterways and drains, clogging pipes and polluting the environment. As a result, the water in Noakhali is now unsafe for human consumption and has become uninhabitable for aquatic life (Afroz et al., 2010). The results of an investigation into the perspectives held by consumers in Bangladesh are presented in this body of work (Ashikuzzaman and Howlader, 2020) identified some common issues with SWM based on comprehensive literature reviews, observations, and discussions in a variety of developing nations:

(1). Operational shortcomings in municipal SW management and services. (2). Little official or informal private sector involvement in recycling efforts. (3). Issues with the final disposal of solid waste, as well as issues with the management of (non-industrial) hazardous waste. An overview of solid waste management is given in this present study, with a special emphasis on the city of Noakhali. Domestic solid waste management is "controlled processing of waste material from creation at the source through the recovery processes to disposal," according to the United Nations (1997). Because of its volume and management issues, municipal solid trash presents a significant burden in urban areas. In Bangladesh's cities, 170 kilograms (kg) of solid garbage are produced per person annually, or over 25,000 tons of solid waste every day.

The purpose of this study is to investigate the factors that may play a role in the correct manner in which families in Noakhali City, Bangladesh, collect, dispose of, and recycle waste. Through the use of a questionnaire survey, the purpose of this research is to explore information regarding Solid Waste Collection (SWC), recycling activities, socio-economic characteristics, and attitudes in household areas of the Noakhali region. Putting in place a Substantial Waste Management System, also known as an SWMS, for Noakhali City's residential areas.

Study Area

The district of Noakhali, Bangladesh, was selected as the study's primary location. As a result of their contributions to the remittance industry, Noakhali residents are extremely important to Bangladesh's economy. As a result, agriculture is essential to the local economy. 45% of the local population works in agriculture, contributing 30% to the regional GDP (Rahman et al., 2012). It's no surprise that the

fishing business accounts for a disproportionate share of jobs in lower-income communities. 15–20% of the working population is employed here every year (boating, fishing, drying, and net and boat making and repairing, and transporting fish from one location to another) (Afsar, 2003).

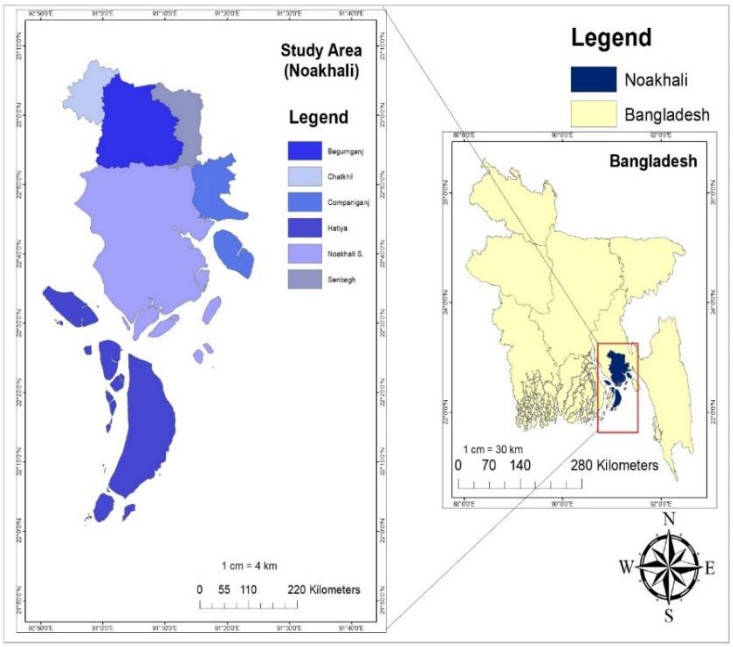


Fig. 1 Study area of Noakhali

This region is vital to our country since its rapid population expansion is directly tied to the success of the national economy. The following material will detail this location, which was chosen as a study area because of its strategic significance.

Placed between 22.8246° north latitude and 91.1017° east longitude, Noakhali (Chittagong division) has a total area of 4, 202 km2 (1,622 sq mi). Noakhali District is bordered by the Cumilla district to the north, the Meghna estuary and the Bay of Bengal to the south, Feni and Chittagong districts to the east and Lakshmipur and Bhola districts to the west (Dey et al., 2014).

MATERIALS AND METHOD

Materials

This study's primary data source is the participant's responses. A questionnaire was prepared based on previous research. An online and offline survey was used to collect information. Secondary data was also utilized to evaluate the outcome of the study.

Method

The survey method has a significant impact on determining an appropriate value. This investigation is divided into four parts; 1) Demographic information 2) Awareness 3) Attitude 4) Environmental concern of solid waste management identified by the respondents. However, the study's objectives were met, and context for the places under investigation was provided, thanks to the collection and analysis of relevant data.

Source of data

Quantitative data from secondary sources and qualitative data from primary sources were gathered using separate methods and strategies. The evaluation made use of a variety of strategies, including in-person interviews and web-based questionnaires. However, for the residential districts of Noakhali City, the most likely solution and recommendations were provided as SWMS. Potential participants were informed of the study's aims, methods, risks, and benefits. They were assured that there would be no negative consequences for dropping out at any time and that participation was completely voluntary

Questionnaire Preparation

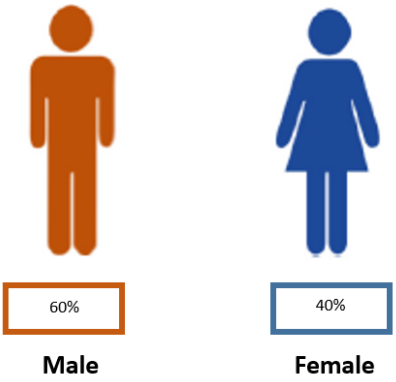
The participants' understanding of SWM served as the focal point of this study, which analyzed their SWM-related knowledge. In the section titled "Practices of waste recycling," people of every background were asked about their involvement in the recycling of solid waste. The last section investigates the SWM barrier as well. It's beneficial for all the different departments to conduct studies along these lines. Age, sex, occupation, family member, monthly household income, and education level in the workforce were also taken into account along with other basic characteristics.

RESULT AND DISCUSSION

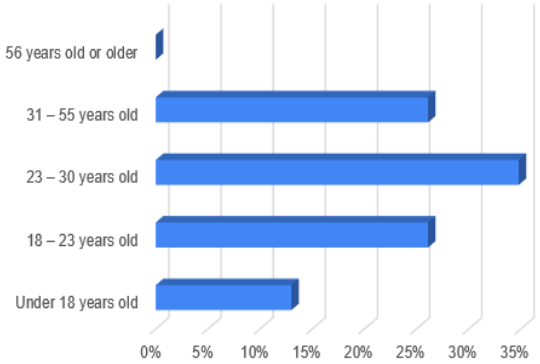
Demographic information

There were a total of 230 participants in the study, and 56.5% of them were male compared to 34.8% were female. The remaining 8.7% preferred not to say their gender. About 34.8% of monthly household income was less than 25000, while 30.4% were between the income of 25,000 and 49,999. Comparatively the higher income is the lowest such as 8.7% of household income is between 100000 and 149,999. About 34.8% are between the ages of 23 and 30, while 26.1% are the same for two groups such as the group whose ages are between 18 and 23 and the other group is 31 and 55 years, and the remaining participants fell within the age demographic of under 18. The number of participants is the same for income of 50,000 to 99,999 and 150,000 or more. The majority of the participant is student, while the number of retired and housewife are same, 13%, the remaining 26.1% of the participant is service holder and the other 17.4% is businessman. The majority of participants had completed their graduation, the second majority of participants had completed their diploma, 8.7% of participants of three categories are no formal education, higher education and secondary school certificate, respectively, and the remaining participants had completed their primary education.

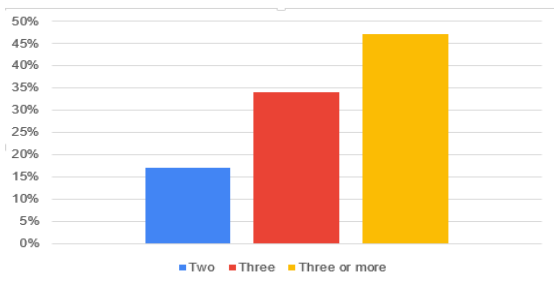
Demography



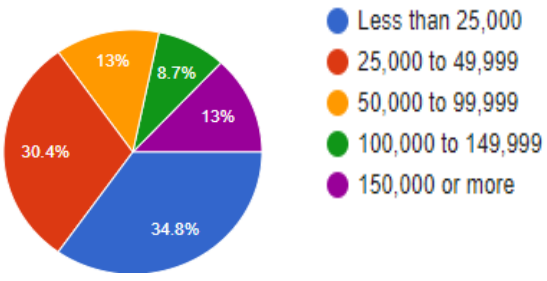
Gender



Age

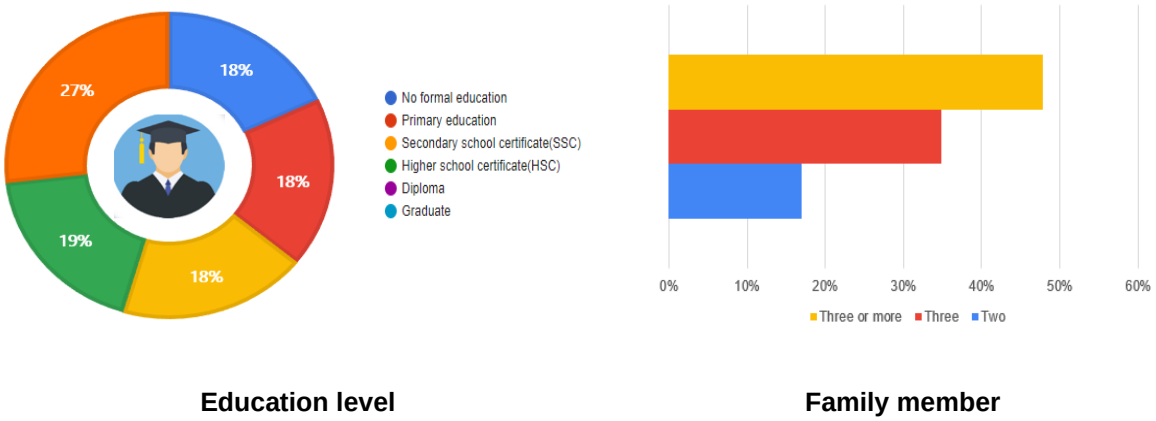


Employment



Household Monthly Income

ISBN: 978-984-35-4034-8



Education level **Family member**

Fig. 2 Demography Information

Table1. Detail Investigation of Survey Questionnaire

Variables	Items	Basic Information					
		Gender	Age	Family member	Education level	Employment	Income
		Contents			Responses		
Awareness	AW 1	Have you heard the term “solid waste management?			Yes	No	Maybe
	AW 2	Are you aware of the hazards/negative effects of solid waste management if it is not handled carefully?			Yes	No	Maybe
Attitude	A1	Do you ever perceive a clean environment as a personal responsibility?			Yes	No	Maybe
	A2	Is there any time when you disposed of waste responsibly during outings where no waste bins were available?			Yes	No	Maybe
	A3	Do you participate in any clean environment campaigns or projects?			Yes	No	Maybe
	A4	Were you involved in some environmental protection activity?			Yes	No	Maybe

ISBN: 978-984-35-4034-8

	A5	Do you practice recycling?	Never practiced recycling		Seldom did		regularly practiced			
Environmental concern	**EC1**	Do you have environmental policies (addressing solid waste management) in your area?	Yes		No		Maybe			
	EC2	Which way do you prefer to practice recycling?	Separate the recyclable materials from the waste and sell them to Feriwalla		Separate the waste and give them to waste collectors		Separate the waste, sell the recyclable materials and compost the organic materials			
	EC3	What are the reasons for never or seldom practice of recycling?	There was no facility for recycling	Lack of time	No economic incentive		What are the reasons for never or seldom practice of recycling?	There was no facility for recycling.		
	EC4	What are the reasons for the regular practice of recycling?	Good for environment	Allows for	composting		What are the reasons for the regular practice of recycling?			
	EC5	Municipal waste collection (institutional setup)?	Regular		irregular		Not available			

Analysis based on the questions and demographic criteria

The response to the questionnaire is provided in the figure. The answer of the respondents was further analyzed and discussed according to their demographic information. The analysis was performed in Microsoft Excel.

For question 1 "Have you heard the term "solid waste management", the majority of individuals (73.9%) were familiar with the term "solid waste management. 85% of male participants were too exposed to the term "solid waste management", while 75% of females were familiar with the term. A large proportion of respondents in the 23-30 age range were very familiar with the term "solid waste management," while those in the 31-50 age range were unfamiliar with it. 100% of the respondents with a background in university faculty had heard the term "solid waste management", while 55% of the respondents with a background in either students or other professions had heard the term and the remaining 27% did not hear the term and 18% responded as they do not know whether they heard it or not (maybe) conveying the message that higher educated people are more knowledgeable about solid waste management. Those with middle incomes were more likely to have heard the term “solid waste management”, while those with higher incomes were not exposed to the term solid waste management”.

100% of the participants with a background in the student had heard the "solid waste management", while 66% of the respondents with a background in housewife had not heard the term "solid waste management" which is not good.

1. Have you heard the "solid waste management" term?

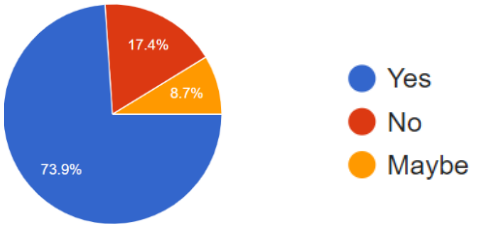


Fig 2. Response from question 1

2. Are you aware of the hazards/negative effects of solid waste management if it is not handled carefully?

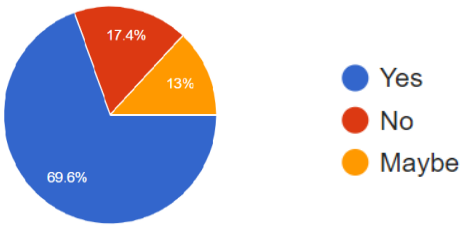


Fig 3. Response from question 2

Question 2 titled "Are you aware of hazards/negative effects of solid waste management if it is not handled carefully?" was distrusted to determine whether or not the participants were aware of the dangers posed by unmanaged solid waste management. The majority responded positively to this. Male participants were more likely to give a positive response. While 100% of students and 83% of service holders responded the same, 33% of retired responded yes.

Around 47.8% of participants lacked formalized policies concerning the disposal of solid waste and nearly 13% were uncertain (question 3). The highest percentage was found in the area of male participants. The majority of participants' workplaces lacked environmental policies concerning e-waste, despite the fact that they earned a middle income annually and had 3 or more 3 family members. These data clearly show how ignorant our organizations are regarding the hazardous effects of solid waste management.

3. Do you have environmental policies (addressing solid waste management) in your area?

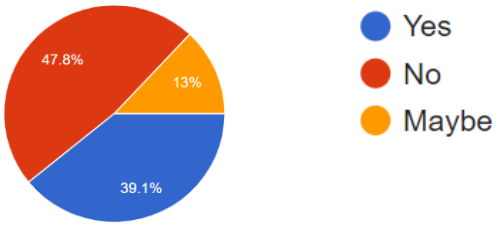


Fig 4. Response from question 3

4. Do you ever perceived a clean environment as a personal responsibility?

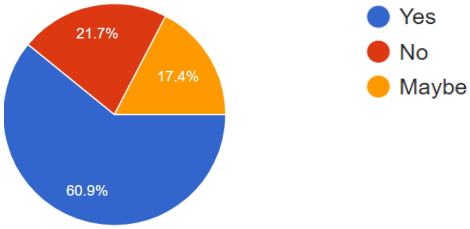


Fig 5. Response from question 4

The majority of male survey respondents perceived a clean environment as a personal responsibility, for the female it was 28% (question 4). Students were more familiar with the perceived a clean environment as a personal responsibility than those who were housewives and retired, from whom some were negative, and some were confused. Participants old aged than 30 years of age were aware of the clean environment, which is significant because people of a greater age category are more likely to participate by themselves and gain knowledge about campaigns and other community events. 50% of the participants have not perceived a clean environment as a personal responsibility, for the male it was 100% despite the fact that they earned lower to middle income. The majority of participants graduated. So, it can be assumed that the more people are educated, the more they do perceive a clean environment as a personal responsibility.

However, from the response to question 5, 39% of females disposed of waste responsibly during outings where no waste bins were available, while 61% of males did that. The majority of graduates fulfilled their responsibility when there was no bin available. From this statement it is obvious to the point that graduates are more concerned than any other background. 88% of middle-aged people (23-30) participated responsibly during outings where no waste bins were available, whereas teenagers were 100% honest about their responsibility. The majority of students who graduated were concerned about

their responsibility which was relaxing. 100% of participants who earned less than 25000 disposed of waste responsibly during outings where no waste bins were available, while 50% of high-earned participants (100000-149,999) disposed of waste responsibly during outings where no waste bins were available which is alarming.

5. Is there any time when you disposed of waste responsibly during outings where no waste bins were available?

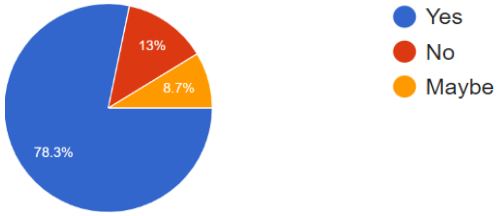


Fig 6. Response from question 5

6. Do you participate in any clean environment campaigns or projects?

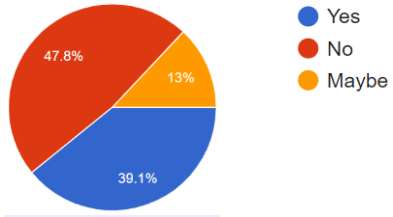


Fig 7. Response from question 6

35% of respondents participated in any clean environment campaign or project (Question 6). Male participants attended cleaner environment campaigns or projects than female ones. One reason can be that males go out more for different purposes. In comparison to other age groups, those between the ages of 23 and 30 were the most active in the clean environment campaign or project. Only about 25% of students, service holders, and businessmen have ever attended any clean environment campaign or project. The situation depicts our ignorance, lack of interest and unavailability of a proper management system for attending any clean environment campaign or project.

From the responses to question 7, it was found that exactly half of the answerers did not know about being involved in some environmental protection activity in their student life which is an alarming thing. Regarding the response to question 8 'Do you practice recycling?' the maximum number of survey candidates (43.37%) claimed to practice recycling rarely or not too often which is unhealthy. In addition, 30% of respondents said they practiced recycling regularly. 26% of people who participated in the survey did not practice recycling.

7. Were you involved in some environmental protection activity?

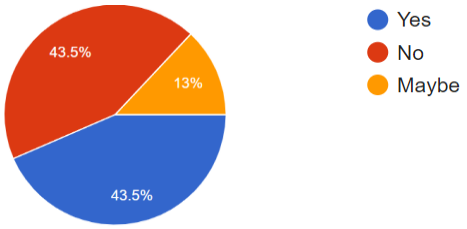


Fig 8. Response from question 7

8. Do you practice recycling?

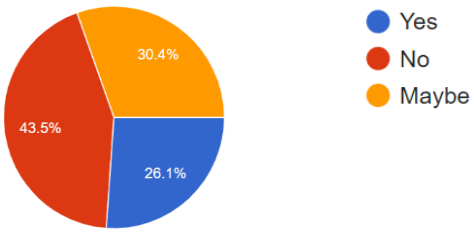


Fig 9. Response from question 8

For the way of recycling 47% of the population separates the waste, sells the recyclable materials and composts the organic materials (question 9). 30% of the respondents actually Separate the waste and give them to waste collectors. 23% of participants acclaimed that they had no facility for recycling, while 21.7% reported they had not had enough time to practice recycling (question 10). The majority of businessmen and service holders had no time for recycling and were middle to high-earned participants.

9. Which way do you prefer to practice recycling?

10. What are the reasons for never or seldom the practice of recycling?

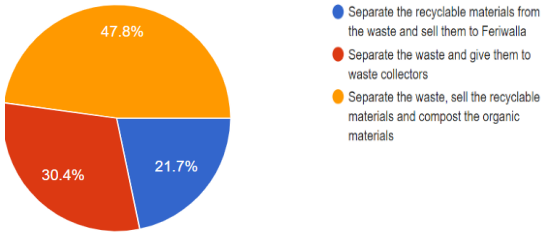


Fig 10. Response from question 9

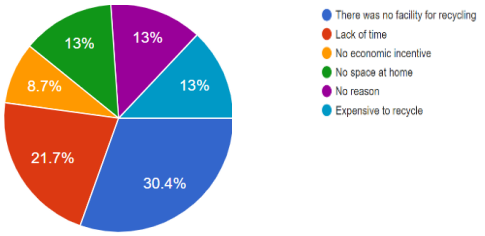


Fig 11. Response from question 10

Moreover, in response to question 11, 60% of participants responded recycling was good for the environment and the majority of participants were male. 28% of respondents were students and 83% were graduates. Almost half the respondents who reported recycling as good for the environment were 23-50 years old. So, it proves that people know recycling is good for the environment, but they do not take the necessary steps to improve the situation. Though they are aware of the detrimental effects of solid waste, such behavior is really alarming. 47% of participants reported that Municipal waste collectors (institutional setup) collected waste regularly, while 17% of participants acclaimed that there were no Municipal waste collection (institutional setup) available which is concerning for the environment. This situation was surprising actually because most of them knew about the danger of solid waste still authorities were not willing to pay much attention to the proper management of it.

11. What are the reasons for the regular practice of recycling?

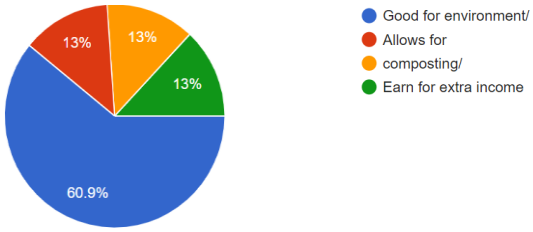


Fig 12. Response from question 11

12. Municipal waste collection (institutional setup)?

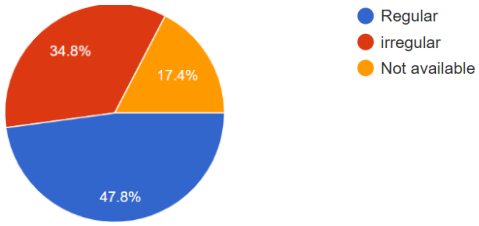


Fig 13. Response from question 12

CONCLUSION

This study established a clear need for a uniform solid waste management system suitable for the current economic, social, environmental, and occupational scenario of Bangladesh. The survey found that few people are aware of solid waste, and even fewer give a hoot about the environmental consequences of throwing away solid waste. Students and residents alike are developing their own systems for handling trash and garages and applying them in the same manner they handle other types of trash. Making changes now is necessary to address the problems in the future. However, several crucial policies, plans, and programs have been considered to support solid waste management objectives. Along with businesses, environmentalists, researchers, NGOs, CBOs and the general people, the country is working to ensure proper solid waste management. To maintain the sustainability of waste management in Bangladesh, institutional norms and citizens' desire to operate on a modern platform are required. In conclusion, the authors state their conviction that effective education on solid waste management is crucial to increasing awareness among the next generation.

REFERENCES

Abedin, M.Z., Karim, A.L. 2022. Waste to Energy Technologies for Municipal Solid Waste Management in Bangladesh: A Comprehensive Review. Int. J. Eng. Mater. Manuf. 7, 78–88.

Afroz, R., Hanaki, K., Tuddin, R., Ayup, K. 2010. A survey of recycling behaviour in households in Dhaka, Bangladesh. Waste Manag. Res. J. Sustain. Circ. Econ., 28, 552–560. https://doi.org/10.1177/0734242X09353434

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

Barua, T., Kanon, P.S., Munna, M.H. 2020. The Status of Recyclable Solid Wastes at Sadar Upazila of Noakhali, Bangladesh, *Asian J. Environ. Ecol.,* 1–12. https://doi.org/10.9734/ajee/2020/v12i230153

Alam, O. and Qiao, X. 2020. An in-depth review on municipal solid waste management, treatment and disposal in Bangladesh, *Sustainable Cities and Society*, *52*, p.101775

Alamgir, M. and Ahsan, A. 2007. Municipal solid waste and recovery potential: Bangladesh perspective, *Journal of Environmental Health Science & Engineering*, *4*(2), pp.67-76.

Ahmed, C.T. and Rownak, A.S. 2006. Waste management in Dhaka city–Atheoritical model, *BRAC University Journal*, *3*(2), pp.101-111

Barua, T., Kanon, P.S., Munna, M.H. (2020). The Status of Recyclable Solid Wastes at Sadar Upazila of Noakhali, Bangladesh, *Asian J. Environ. Ecol*, 1–12.

Bandara, N.J., Hettiaratchi, J.P.A., Wirasinghe, S.C. and Pilapiiya, S. 2007. Relation of waste generation and composition to socio-economic factors: a case study, *Environmental monitoring and assessment*, *135*(1), pp.31-39

Bhuiyan, S.H. 2009. A Crisis in Governance: Sustainable Urban Solid Waste Management in Bangladesh, *Nepalese Journal of Public Policy and Governance*, *24*(1), pp.63-80.

Carrus, G., Passafaro, P. and Bonnes, M. 2008. Emotions, habits and rational choices in ecological behaviours: The case of recycling and use of public transportation, *Journal of environmental psychology*, *28*(1), pp.51-62.

Meneses, G.D. and Palacio, A.B. 2005. Recycling behavior: A multidimensional approach, *Environment and behavior*, *37*(6), pp.837-860.

Mukti, S.A., 2013. Solid Waste Management In Dhaka City: Problems And Prospects, *International Journal of Innovative Research & Development*, *2*(11), pp.33-37.

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

Rahman, M., Tazim, M.F., Dey, S.C., Azam, A.K.M.S. and Islam, M.R. 2012. Alternative livelihood options of fishermen of Nijhum Dwip under Hatiya Upazila of Noakhali District in Bangladesh, *Asian Journal of Rural Development*, *2*(2), pp.24-31.

Sharholy, M., Ahmad, K., Vaishya, R.C. and Gupta, R.D. 2007. Municipal solid waste characteristics and management in Allahabad, India, *Waste management*, *27*(4), pp.490-496.

Tania, F. 2014. Solid waste management of Dhaka city: A socio-economic analysis, *Banglavision*, *13*(1), pp.91-100.

Vicente, P. and Reis, E. 2007. Segmenting households according to recycling attitudes in a Portuguese urban area, *Resources, Conservation and Recycling*, *52*(1), pp.1-12.