Hungarian University of Agriculture and Life Sciences

Doctoral School of Economic and Regional Sciences (Gödöllő)

Determinants of Willingness to Pay (WTP) for Better Waste Management in Urban Bangladesh

DOI: 10.54598/006620

PHD DISSERTATION

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Gödöllő, Hungary

2025

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List of Abbreviations

1. **WTP** – Willingness to Pay
2. **CVM** – Contingent Valuation Method
3. **BDT** – Bangladeshi Taka
4. **CV** – Contingent Valuation
5. **MSW** – Municipal Solid Waste
6. **SWM** – Solid Waste Management
7. **CE** – Choice Experiment
8. **EU** – European Union
9. **USD** – United States Dollar
10. **US** – United States
11. **DCC** – Dhaka City Corporation

12. **PPP** – Public-Private Partnership
13. **WTE** – Waste to Energy
14. **FAO** – Food and Agriculture Organization
15. **COVID** – Coronavirus Disease
16. **SDG** – Sustainable Development Goals
17. **WMS** – Waste Management System
18. **SLR** – Systematic Literature Review
19. **SPSS** – Statistical Package for the Social Sciences
20. **STATA** – Data Analysis and Statistical Software
21. **ADB** – Asian Development Bank
22. **SES** – Socio-Economic Status
23. **UNDP** – United Nations Development Programme
24. **MNRE** – Ministry of New and Renewable Energy
25. **GHG** – Greenhouse Gas
26. **LFG** – Landfill Gas
27. **RCRA** – Resource Conservation and Recovery Act
28. **WTA** – Willingness to Accept
29. **NOAA** – National Oceanic and Atmospheric Administration
30. **NEMAP** – National Environmental Management Action Plan (Bangladesh)
31. **HHI**-Herfindahl-Hirschman Index

1. INTRODUCTION

Waste management is an issue of concern to developing countries because of urbanization and population growth. Waste management systems are essential for the population's health, the protection of the environment, and the quality of life in cities. Nevertheless, the infrastructure and financial capital to support proper waste management are lacking in many developing nations. Among the approaches to increasing waste management efficiency in these regions, one of the essential aspects is the analysis and optimization of the public's Willingness to pay (WTP) for better services. WTP is a concept that entails evaluating the amount of money people or households are willing to spend to enhance waste disposal standards. This financial support is crucial for creating and sustaining the infrastructure and services for proper waste disposal and recycling.

1.1 Background

Waste management is a pressing concern internationally, influencing population health, the natural environment, and development. There is a need to implement sound waste disposal mechanisms as population ubiquity and town expansion increase. WTP for better waste management services is an important aspect of determining how much the communities value the services and the additional amount of money they are ready to pay to improve the services (Ahlheim et al., 2013). Worldwide, there are many differences between waste management practices and the WTP. Most developed countries show better waste management structures, including recycling facilities, technologies that convert waste to energy, and legal measures to enforce the practice. Here, the WTP for waste management services tends to be higher because of factors like higher income, increased health consciousness, and a sound institutional framework (Zhang et al., 2010). Bangladesh is a relatively crowded country with more than one sixty million people, and the management of waste is a great problem for the country. Population growth, industrialization, development, and the expansion of towns and cities result in increased waste generation. Present pragmatic systems in waste management include inefficient transport mechanisms, disposal

facilities, and the absence of public knowledge and involvement in operating waste management systems in Bangladesh. Such problems cause environmental pollution, adverse effects on people's health, and fail to maximize profit-making (Ahmed & Ali, 2006). The population hubs, particularly the urban centres such as Dhaka and Chittagong, are major waste producers in Bangladesh daily. These are ineffective; hence, the municipalities managing waste in these cities experience problems like open dumping, burning of waste, and uncontrolled landfills. These consequences stem from poor and inadequate infrastructures for waste management that directly lead to grave environmental degeneration: air and water pollution; adverse impacts on human health (Enayetullah et al., 2005). Thus, understanding the WTP for better waste management services in Bangladesh is essential for constructing efficient solutions. Research shows a noticeable discrepancy between what can be offered regarding waste management and what the public demands. The population in question demonstrates its receptiveness to paying more for services that will improve residents' well-being. Other factors causing WTP include income per household, information regarding the environmental problems, and others concerning the previous waste management services (Alamgir et al., 2012). Previous studies have been carried out on WTP in Bangladesh. This context reveals that people are interested in paying for improved waste management. This variation is based on economic factors, perceived benefits, and confidence in the service providers' capability to offer better services. Furthermore, improving people's understanding of potential gains from effective waste disposal and different publicity measures can also increase WTP among inhabitants (Babel, Rivas, & Ikeda, 2011). On the other hand, most developing nations in the third world have similar obstacles to those observed in Bangladesh, such as poor infrastructure, scarce capital, and low public health literacy. However, there are effective examples of how the implementation of new ideas and the use of communities is effective in the management of waste. For example, Japan and Germany developed a proper way of sorting waste and recycling. Thus, they have successfully minimized the usage of landfills and encouraged

environmental conservation (Sakai et al., 1996). Analyzing the waste management system in Bangladesh and WTP with international systems reveals some discrepancies and prospects for positive change in correcting them. However, Bangladesh has major problems and threats, which could benefit from the successful strategies of developed and developing countries. These include involving private actors in waste management, efficiency, technical solutions, and investment can be obtained. In PPPs in India and Brazil, the waste collection and processing services have been enhanced due to successful PPPs (Gupta, 2011). The practices of community-based waste management are successful in countries such as Kenya and the Philippines. These programs involve the locals, increase their knowledge, and ensure everyone participates, leading to higher WTP and improved waste segregation and recycling practices (Henry et al., 2006). Identifying some of the existing and promising technologies, like waste-to-energy plants, automated sorting, and systems for waste tracking, and using technology to track waste through digital platforms can increase efficiency. Some developed countries, like Sweden and Singapore, have ensured high recycling levels and low landfill indexes with the help of technology (Pires, Martinho, & Chang, 2011). This is the reason why it is necessary to develop proper regulatory norms and take strong measures to guarantee that they will be followed. The result indicates that countries with strict policies and acts on waste disposal, recycling, and pollution control have changed their current poor waste management results in recent years (Wilson et al., 2015). Hence, the following study attempts to develop a better understanding of the public's WTP for improved waste management with specific reference to the context of Bangladesh. It means that Bangladesh needs to learn from experiences in other countries and apply those successful practices in the Bangladesh context. Various waste management problems can be solved more efficiently. More investment, awareness, and innovative ideas are expected to help improve the cleanliness and health standards of everyone's environment.

Bangladesh, which is undergoing significant urban growth and is a lower-middle-income country, shows these issues clearly. Data from the Bangladesh Bureau of Statistics in 2022 indicates that urban regions make up almost 36% of the population and produce waste equivalent to 33,000 tons every day. Still, most municipalities are facing problems with inefficient waste collection, limited treatment plants, and poorly managed landfills. The difficulties are heightened because not many people are aware of these issues, and there is a lack of organized efforts among institutions. Given these circumstances, readiness to pay more for better waste management is becoming vital for both designing policies and managing finances. WTP describes the highest amount someone is willing to pay for better, more sustainable service. Several studies in various parts of the world have shown that how much people are willing to pay for clean water is affected by their income, environmental attitudes, education, trust in those who supply the water and the level of risk they perceive (Ahlheim et al., 2013; Afroz et al., 2009). Several empirical studies have been done in Bangladesh on WTP for solid waste management. However, they still tend to focus mainly on individual cities.

Furthermore, assessments often do not consider the importance of climate change perception and trust in institutions, two rising factors affecting people's interest in environmental matters. It addresses this issue using a multi-city, holistic approach that merges econometric models and contingent valuation to examine how social, economic, and psychological factors influence people's WTP in urban Bangladesh. Policymakers rely on WTP information because it helps them design fair taxes, work with the private sector, and create campaigns that target the right groups. Additionally, when money is limited, higher WTP helps encourage sustainability and inclusivity in city services.

Bangladesh is currently one of the countries with the most rapid economic expansion. This has led to a lot of waste being made. During the last 30 years, the volume of waste grew by 15% every 15 years. Fifty-five percent of solid waste is left uncollected in cities, with a range of collection efficiency from 37 percent to 77 percent (Bhuiyan, 2010; Hassan, 2017). The growing amount of

hazardous medical and electronic waste is putting more strain on the waste management system, which is not working. Except for a few pilot projects, waste is not adequately separated. This causes waste to build up and puts pressure on landfills that are not sufficiently managed (Afroz, Hanaki, and Tudin, 2011). Urban local government authorities are supposed to deal with waste, but they don't have the ability or the desire to do so. Waste is typically described as any item, material, or entity no longer appropriate for its original use and is thus discarded or designated for disposal. This categorization often differentiates between perilous and non-perilous substances. Hazardous waste encompasses a range of materials, including industrial, medicinal, and electronic (e-waste) substances, that substantially harm the environment and human well-being. In contrast, non-hazardous waste encompasses municipal trash, including residential rubbish and debris from demolishing buildings and other structures. It is crucial to acknowledge that waste can take on diverse forms, such as solid and liquid, which require distinct disposal and management approaches. Irrespective of its categorization, hazardous and non-hazardous waste can pose significant risks to the environment and human health if not collected and managed. Hence, it is imperative to use efficient waste management strategies to minimize these hazards and guarantee long-term environmental sustainability. In April 2020, Bangladesh had a significant challenge in managing 14,500 tons of medical waste. This trash was generated from the materials used in healthcare institutions to treat patients (Tayeb, 2020). Dhaka is the capital city of Bangladesh. It has become one of the most challenging cities in the world in terms of waste management. Lack of suitable infrastructural facilities results in problems like choked up and unauthorised dump sites (Afroz et al., 2009). Another textile producing district is Rajshahi, which is famous for its sills and mango gardening sector. It fails to manage waste due to inadequate arrangements of waste systems and ends up as open dumps (Ray et al., 2023). According to Shehu Usman Adam et al. (2015), Khulna is one of the industrialized port cities of Bangladesh, which is affected by pollution from growing industries and a poor waste management system. Due to the nature of its commerce,

Chittagong, which is the commercial city, disposes of high volumes of domestic and industrial wastes, exerting pressure on its waste management system, and which eventually pollutes the sea (Nkansah et al., 2015). Any sewerage system and general waste management is inadequate in Rangpur, which has become a commercial and agricultural hub, with poorly managed dumpsites (Banga et al., 2011). Barishal is situated at the bank of the Kirtankhola River; thus, they have disputed issues in managing the waste collection and disposal system due to floods, polluting the waterway (Ogawa, 1989). It is worth noting that upgrading the waste collection policies and enhancing the propensity to pay for enhanced services are the key determinants of environmental and public health issues in these cities. During the COVID-19 epidemic, Dhaka city had a daily production of almost 206 tons of medical garbage, further burdening the already weak medical waste management infrastructure. During the pandemic, the effective handling of medical waste decreased significantly to only 7%, a sharp contrast to the regular rate of 14% (Dhaka Tribune, 2021). The increase in medical waste, connected explicitly to COVID-19, highlights the immediate requirement for improved waste management infrastructure and methods to mitigate the elevated environmental and public health hazards caused by the spike in waste resulting from the pandemic. Every day, there are around 6,500 tons of waste in Dhaka. By 2032, that figure is expected to rise to 8,500 tons, which is a lot. The city has shown that it is improving at collecting waste, averaging 77–80 percent efficiency. While private contractors pick up the bulk of the waste, city governments make sure that the waste is moved from secondary container sites to landfills daily. They have built concrete barriers around wards to keep waste from being seen by the public and stop the spread of smells. In Dhaka, where land is limited and people are very busy, landfills to dispose of waste are not a good idea (Chowdhury *et al.*, 2022). Changes in policy, waste minimization, segregation, and recycling must be made at every step of the way. Ward-based management structures involving community participation and partnerships with government, private, and international agencies are also essential for long-term waste management. Changes in the behavior

of waste generators and collectors are also important. Finally, waste management should be looked at to get policymakers' attention and make it easier to get resources. A better way to deal with waste can help meet the goal of SDG 11 (Sustainable Cities and Communities) and other goals, like SDG 7. (Affordable and Clean Energy) (Abdulrazak, Islam and Hossain, 2021; Ananno *et al.*, 2021; Chowdhury *et al.*, 2021; Rahman, 2021).

According to Ahmed (2019), the average household solid waste characteristics in urban areas of Bangladesh are a cause; 55% of solid garbage is not collected at all, while the collection efficiency for organized waste ranges between 37% and 77%. The debris, special plastic, and polyethylene products are usually not collected and end up choking drainage systems and water bodies, leading to the pollution of the surface and groundwater, the soil, and air. However, this negative impact is most evident in Dhaka as water bodies inside and outside the perimeters of the city have turned into an area that not only supplies unhealthy water for human consumption but also an environment that is hostile to marine life. Among the factors responsible for the existence of the waste management issue, the most noticeable factor is that waste is not segregated. The issue of waste management has been solved internationally, as evidenced by world-renowned approaches like the 3R – reduce, reuse, and recycle approaches. Using this approach, a large amount of reusable trash like dropped glasses and plastic bottles that could be recycled in large quantities annually is hitherto buried, causing an economic loss.

Furthermore, because the items are made of organic products, which account for 70% of waste in most establishments, there is a high possibility of converting garbage into compost fertilizers. They state that organic fertilizers enhance food production, which in turn can decrease food insecurity, in addition to reducing the number of chemical fertilizers applied to the soil by a sizable percentage, leading to a reduction in emissions to the atmosphere (Dhaka Tribune, 2015a). However, garbage recycling in Bangladesh is dominated by the informal sector, primarily by the poor and scavengers. However, the official sector has not paid much attention to this dire need for

garbage recycling, as land shortage and high population density are two main constraints of the country. Despite the fact that, based on surveys and studies conducted for different city corporations of Bangladesh, 9 (nine) out of 12 city corporations have designated premises for the disposal of municipal solid waste, there remain problems of landfill management (Razzak, 2020a). There is also an absence of appropriate landfill operation and management units, which has led to the existence of open-air crude dumpsites with no sanitary provisions. Human settlements have occupied several of these sites throughout the years and have become a threat to the health and environment. Similar issues are found in municipalities, including Cox's Bazar, where around 0.3 million tons of waste have been thrown haphazardly in open and typical crude dumpsites since the year 2010, and have the potential to contaminate leachate and flow into the nearby river systems.

Disposing of waste in households in Bangladesh remains a significant concern due to the increasing urbanization, population, and inadequate framework. Municipal solid waste is waste generated in households and is the most important type of urban waste. Cities such as Dhaka are under pressure to sort out practical and efficient ways of handling waste disposal (Ahsan et al., 2014). Still, systematic collection, transportation, and disposal of household waste remain inefficient, which poses negative impacts on the environment, public health, and hygiene (Rahman & Ahmed, 2016). Therefore, WTP for improved waste management services is of pivotal interest to policies. According to Haque et al. (2013), households in Bangladesh are willing to make financial contributions for trash management if those in charge provide them with tangible consequences for their money spent, including better, more frequent garbage collection, safer waste handling, and a cleaner environment. However, WTP depends on factors such as household income, environmental concern, and confidence in local authority service provision. Pay-for-safety and WTP can be attractive to different income groups; for instance, low WTP from low-income households may be because of the ability and/or WTP for enhanced services. Hence, it is important to explore why the population segments do not contribute equally to WTP in order to

develop long-lasting HHWM solutions that are sustainable for the Bangladesh environment (Ahmed & Rahman, 2018).

Table 1: EU Countries Waste Generation Per Capita

Country	Waste Generation (kg per capita)	Recycling Rate (%)	Meets EU Target
Austria	570	58	Yes
Belgium	420	54	No
Bulgaria	435	32	No
Croatia	400	30	No
Cyprus	760	20	No
Czech Republic	400	40	No
Denmark	845	54	No
Estonia	390	30	No
Finland	510	42	No
France	530	42	No
Germany	610	67	Yes
Greece	510	19	No
Hungary	390	35	No
Ireland	600	41	No
Italy	500	49	No
Latvia	380	30	No
Lithuania	440	49	No
Luxembourg	610	48	No
Malta	640	11	No
Netherlands	510	58	Yes
Poland	315	38	No
Portugal	500	28	No
Romania	270	14	No
Slovakia	370	38	No
Slovenia	480	59	Yes
Spain	480	35	No
Sweden	440	50	No

Source: Eurostat, 2024.

Table 1 shows the performance of different EU countries in terms of waste generation and recycling, demonstrating the disparities between the member states in terms of environmental management. Germany is again the example of relatively high waste generation – 610 kg per capita annually, while the recycling rate is 67%, even above the EU's aims for 2025. On the other hand, Maltese citizens have significant difficulties producing 640 kg per capita annually, with recycling only 11% of it. The Netherlands maintains good results with 510 kg per capita per year and a 58

% recycling rate, corresponding to EU norms. These differences raise issues of national differences in waste handling, based on infrastructure, legislation, and awareness created to support sustainability. Such attempts continue to be important for ensuring more synchronization of activities touching on environmental concerns in the EU. Eurostat data suggest that in 2022, the average rate of municipal waste per EU person declined to 513 kg, 19 kg less than in 2021. However, it is still 46 kilograms above that of the year 1995. The above analyses indicate that there has been a slight improvement in the obesity level in the current year compared to the previous year. At the same time, while concerns with waste recycling go up, indicators are down: the average amount of waste recycling per citizen decreased by 15kg as compared to three years before, to 249 kilograms of waste per person on average. The countries that contribute more waste are Austria, Denmark, and Luxembourg, contributing 827, 787, and 720 kg per person, respectively.

On the lowest scale, Romania, Poland, and Estonia have the lowest waste generation quantities, ranging from 301kg per person to 373kg. These variations are said to stem from the differences in the consumption level, economic environment, and abilities of countries to absorb waste management technologies. Also, how collected waste is shared between domestic and commercial use and waste generated from commerce, trade, and administration promotes these differences internationally (Khan et al., 2022; Koul, Yakoob and Shah, 2022).

As for recycling, the top ranking is performed by Austria, Denmark, and Germany; the amount of recycling per inhabitant is 516 kg, 411 kg, and 409 kg, respectively. Other countries like Romania, Malta, and Greece produce lower recycling levels, with some as low as 36kg to 90 kg per person. These figures are troubling given that in its recent assessment, the European Commission stated that at least several EU member states will not achieve the EU's municipal and packaging waste recycling targets set for 2025 and 2035. Austria, Belgium, Cyprus, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Latvia, Lithuania, Netherlands, Portugal, Spain, and Sweden are

some of the countries that are unlikely to achieve the set municipal waste targets for the present level. Nevertheless, Bulgaria, Croatia, Cyprus, Greece, Hungary, Lithuania, Malta, Poland, Romania, and Slovakia will possibly not achieve both municipal and packaging waste objectives.

Regarding plastic waste, despite collaborative efforts, signatories of the Ellen MacArthur Foundation's New Plastics Economy Global Commitment are considered 'off track' in implementing reusable, recyclable, or compostable packaging by 2025. Additionally, Europe's installed plastics recycling capacity declined in growth rate year-on-year by 7% in 2022, reaching 12.5 million tonnes, potentially hindering the continent from meeting legislative targets, as noted by Plastics Recyclers Europe (Khan *et al.*, 2022; Mazzarano, Quatrosi and Pronti, 2022; Testa *et al.*, 2024).

Globally, waste generation is increasing due to urbanization. In 2021, the municipalities made 2.01 billion tons of solid waste yearly. At least 33% of that is still not handled in an ecologically protected way. People worldwide produce about 0.74 kilograms of waste daily, but this can vary widely, from 0.11 to 4.54 kilograms. The generation of municipal waste is projected to move 2.2 billion tons by 2025, owing to increasing population and urbanization (Hoornweg and Bhada-Tata, 2012; Scarlat *et al.*, 2015; Akhtar *et al.*, 2017; Indrawan *et al.*, 2018; AOIKE, 2019). Currently, Sub-Saharan Africa generates 62 million tons of municipal waste annually, an average of 0.65kg/person/day (Wilson *et al.*, 2012). While urbanization is a necessary component of social, cultural, and economic growth, the rate at which it occurs is unsustainable. The growing urban population in emerging countries exacerbates the issues confronting urban planners, service providers of governments, non-governmental organizations, and urban dwellers (Damtew and Desta, 2015; Hoang *et al.*, 2017; Birara and Kassahun, 2018). Urbanization and population increase alone account for the rapidly increasing solid waste disposal rate (Rezaei *et al.*, 2010; Alam and Ahmade, 2013). The overall objective of waste management in urban areas is to treat, accumulate, and dispose of waste created by residents in urban areas. Nevertheless, it is usual for

thirty to sixty percent of waste in developing nations to go uncollected (Monyoncho, 2013). Approximately two billion residents globally need access to urban waste collection services. The collection rate is shallow in lower-income countries like Bangladesh. According to scholarly literature, inappropriate collection, disposal, and management of urban waste results in pollution of all types: soil, air, and water. (Alam and Ahmade, 2013; Rodić and Wilson, 2017; Srigirisetty, Jayasri and Netaji, 2017). These activities are responsible for the ecosystem deterioration in developing countries like Bangladesh. (Marshall and Farahbakhsh, 2013). Concerns over waste production and its treatment have emerged as one of the most enduring environmental and climatic challenges confronting urban centers in developed and developing countries. (Thi, Kumar and Lin, 2015). Agriculture has significantly influenced economic development in several nations, particularly in Bangladesh, where it has substantially impacted economic growth and development during the previous five decades (Miah, Hasan. However, the quick increase in agricultural production has increased reliance on natural resources, harming the environment and contributing to climate change. One of the most significant drawbacks of this intensive agricultural strategy is the enormous quantity of garbage it generates. The majority of this garbage is made up of waste biomass (Duque-Acevedo, Belmonte-Ureña, Cortés-García, *et al.*, 2020; Stegmann, Londo and Junginger, 2020; Muscat *et al.*, 2021). According to the circular economic production models (CEPMs), it is obligatory to transform waste into a resource. In the context of the economy and circular economy, this transformation significantly impacts the production process with high value-added. A better waste management system is a part of the circular economy and renewable resources. It is encouraged for use and organic recovery in the economy as a critical source of bioenergy.

Table 2: Waste Generation and recycling of EU countries

Category	Data/Information
Average municipal waste per EU person (2022)	513 kg (19 kg less than in 2021, 46 kg above the 1995 level)
Average waste recycling per EU person	Decreased by 15 kg compared to three years ago, 249 kg per person on average
Highest waste-generating countries	Austria (827 kg), Denmark (787 kg), Luxembourg (720 kg)
Lowest waste-generating countries	Romania, Poland, Estonia (301-373 kg per person)
Factors affecting waste generation differences	Consumption level, economic environment, waste management technology absorption, domestic vs commercial waste generation
Top recycling countries	Austria (516 kg per person), Denmark (411 kg per person), Germany (409 kg per person)
Lowest recycling countries	Romania, Malta, Greece (36-90 kg per person)
EU countries unlikely to meet municipal waste targets	Austria, Belgium, Cyprus, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Latvia, Lithuania, Netherlands, Portugal, Spain, Sweden
EU countries unlikely to meet both municipal and packaging waste targets	Bulgaria, Croatia, Cyprus, Greece, Hungary, Lithuania, Malta, Poland, Romania, Slovakia
Plastic waste recycling challenge	Signatories of Ellen MacArthur Foundation's New Plastics Economy Global Commitment 'off track' for 2025 goals; Europe's plastic recycling capacity growth declined by 7% in 2022
Global municipal waste generation (2021)	2.01 billion tons annually, 33% not managed ecologically
Average global waste generation per person	0.74 kg daily (range: 0.11 to 4.54 kg)
Projected municipal waste generation (2025)	2.2 billion tons annually due to population increase and urbanization
Sub-Saharan Africa's waste generation	62 million tons annually, 0.65 kg/person/day
Urbanization impact	Exacerbates waste management issues in developing countries, with 30-60% of waste uncollected

Source: Eurostat, 2024.

In recent years, this bio-economic model has emerged as one of the most essential instruments for formulating policies that are compatible with the Sustainable Development Goals (SDGs) (Duque-Acevedo, Belmonte-Ureña, Cortés-García, *et al.*, 2020; Duque-Acevedo, Belmonte-Ureña, Yakovleva, *et al.*, 2020; Duque-Acevedo *et al.*, 2022). Waste management and the possibility of creating value support the economy and the circular economy. It also ensures sustainable and

circular practices in the economy that promote the achievement of the three pillars of the SDGs. Approximately 40% of the world's land is utilized for agriculture. Globally, 26% of the population derives its subsistence from the industry based on agriculture (Fess, Kotcon, Over the previous 20 years, the pace of agricultural growth has slowed by one percent, and the rate of deforestation has decreased. However, success in this sector has occurred at the price of the environment, which has resulted in severe implications for the planet that cannot be denied. The linear production model of food has led to the deterioration of twenty percent of the soil in the world. This production also accelerates the loss of biodiversity and natural ecosystems over the same period. Environmentalists estimate that agricultural operations are responsible for twenty-five percent of all greenhouse gas emissions. The world population tripled by 1945. Due to the increasing world population, the consumption curve shifts significantly to the right. The primary factors driving the growing demand for products come from the agricultural sector. It is expected to expand by fifteen percent over the subsequent decade. As a consequence of this unsustainable increase in agricultural output, the environment has become indebted to the agricultural industry (Bruinsma, 2017; Emmanouil *et al.*, 2022; Feenstra and Hong, 2022; Gryshchenko *et al.*, 2022; Khuc *et al.*, 2023).

1.2 Problem Statement of Research

Even though Bangladesh produces a lot of waste daily, a significant amount goes unmanaged or is managed outside the proper system. In megacities like Dhaka and Chittagong, waste is often dumped in the open, landfilled illegally, and sorted very little. The fact that waste services can damage the environment and cost a lot fails to convince many people to join. A major problem is that people are not unified in wanting to pay more for better public services. Although wealthier people may be willing to spend on the environment, those who earn less may be uncertain or simply unable to afford it. Also, Bangladesh does not have a well-defined set of laws and rules that make WTP a responsibility of citizens or set it up in public policy. Therefore, the government cannot make this extra money even if residents are willing to pay.

Waste is often rejected, unused, unwelcome, or excess material from industrial, agricultural, and urban sources. Federal law, known as the Resource Conservation and Recovery Act (RCRA), provides requirements for handling hazardous and non-hazardous waste. With the rate of urbanization, the growing amount of garbage in metropolitan areas has emerged as a significant global barrier to maintaining a pollution-free planet. Globally, 2.01 billion metric tons of municipal solid waste are produced each year. It is anticipated that by 2030 and 2050, respectively, the yearly worldwide Municipal solid waste (MSW) generation rate would reach 2.59 billion and 3.40 billion tons. An environmentally viable method of handling it is thought to be lacking in 33% of cases (Gryshchenko *et al.*, 2022; Papamichael *et al.*, 2022; Newaz and Appolloni, 2024). In emerging and poor nations, the percentage is considerably higher. MSW production varies with location and economic development, ranging from 0.11 to 4.54 kg/day. Waste creation is anticipated to rise by 19% and 40% in industrialized and developing nations (Khuc *et al.*, 2023; Jiao *et al.*, 2024).

Regarding MSW, the current increase will be greatest in South and East Asia (Pacific). The overall MSW generation in South Asia is predicted to rise by more than double the current rate. The MSW composition's variability and complexity make it extremely difficult to sustainably dispose of this massive volume of garbage, resulting in significant financial losses and negatively affecting the environment and public health (Khan *et al.* 2022, 2022). Because of the fragmentation of different MSW activities, poor governance, institutional frameworks, and management competencies, as well as a lack of cooperation among stakeholders, MSW management is maintained in developing and underdeveloped nations very inefficiently. Numerous researchers have documented the common issues these nations face, such as the use of dispersed and low collection coverage, antiquated treatment technologies and disposal techniques (such as open dumping and burning of waste without controlling air and water pollution), a lack of laws, and a shortage of human resources. In this instance, a lack of public knowledge about appropriate waste management is partly to blame. Since open landfill dumping is the most prevalent practice in South

Asia, immediate action is needed to address the problem because of its substantial social, environmental, and economic effects(Koul, Yakoob, and Shah, 2022; Chang *et al.*, 2024; Newaz and Appolloni, 2024).

A significant amount of MSW is disposed of in landfills in the industrialized world. The two biggest landfill companies in the United States had a combined capacity of 9.98 billion cubic yards in 2020. However, the loss of land area, greenhouse gas emissions into the atmosphere, and possible leaching of dangerous compounds into groundwater, though this is less likely with correct design, are some of the negative environmental effects of landfill disposal. One essential element in trash management is MSW collection. Underdeveloped and emerging economies mostly rely on informal waste collection, whereas developed countries use official waste collection methods (Ahsan et al., 2014). Only 39% of MSW is collected in low-income countries, compared to 96% in high-income nations (Abubakar *et al.*, 2022; Hemidat *et al.*, 2022). Waste collection apparatus and equipment in underdeveloped nations are antiquated, misused, and prone to malfunctions. Developed nations have undertaken several initiatives to fully address the efficiency of SW management systems. It hasn't been the situation in developing and less developed nations. As a result, it has been difficult to solve the associated environmental issues and increase managerial efficiency (Gryshchenko *et al.*, 2022; Yadav, Karki, and Ingole, 2022; Idris *et al.*, 2024). The waste composition, accessible technologies, and socioeconomic structure of the nation determine which technologies are best for managing and processing municipal solid waste (MSW), including thermal and chemical processes, landfill disposal, and process selection (Gryshchenko *et al.*, 2022; Hemidat *et al.*, 2022; Kamuzora, 2024). Under inadequate MSW-based regulation, Bangladesh's existing MSW management practices rely solely on unregulated open dumping, unestablished recycling firms, and informal garbage collecting. The disparities in MSW management give rise to many constraints, such as inadequate budgetary and resource allocation, little or non-existent technological innovation in waste management, and deficient coordination

between non-governmental, municipal, and federal agencies. Bangladesh has suffered the severe effects of an inadequate waste management system in recent decades, and if this scenario persists. In Bangladesh, the potential of waste to become a lucrative resource is yet unknown. Developed and developing nations have supported waste-to-energy initiatives and turned municipal waste into biofuel, syngas, compost, natural gas, charcoal, etc., throughout the past ten years. Bangladesh is where the global technology era began. The nation's industrial growth and infrastructure have advanced noticeably. The literature on MSW creation and management worldwide is extensive, but little information about Bangladesh has been documented. Bangladesh's ineffective MSW management is partly a result of a lack of reliable information and suggestions (Rafiquee and Shabbiruddin, 2024; Sarker *et al.*, 2024).

The bioeconomy is a critical component in changing to a more sustainable economic model. It contemplates the production processes and the usage of biological resources of renewable energy, such as biomass, to convert them into bioenergy sources and bioproducts (Scarlat *et al.*, 2015; Luttenberger, 2020; Tsai *et al.*, 2020). Biomass is not regarded as a waste product, but rather a resource with the substantial capability to manufacture materials and bioenergy resources (Fujii, 2006; Thompson *et al.*, 2009; Meyer, 2015; Gryshchenko *et al.*, 2022; Hemidat *et al.*, 2022). Sustainable manufacturing methods and the circular economy have been getting much attention recently in academia and the business world. This is because it can help businesses improve their supply chain practices. The circular economy is becoming more common in the supply chains of manufacturing businesses. These practices reduce waste, energy, and material use, which is good for the environment (Moktadir *et al.*, 2018). People who move to a circular economy (CE) make money through product life cycle management, closed-loop systems, reverse logistics, and clean production in terms of environmental management. Many barriers make it hard for an organization to make changes during this transition period. These barriers include organizational, financial, technology-based, policy, social, logistics-based, and market barriers (Kazancoglu *et al.*, 2021).

The goal of the economy in the circular business model is not only to make money but also to positively affect society and the environment. Many businesses still have a short-term goal for managing the environment (Korhonen *et al.*, 2018). Many businesses have a short-term goal when it comes to decreasing the environmental effect of the company(Robèrt *et al.*, 2002; Lozano, 2020). Companies need to keep an eye on profits and competitiveness, the environment, and the social effects that they have in the long run (Ormazabal *et al.*, 2018). The use of CE in corporate environmental management opens up new prospects and more environmentally friendly methods by using wastes as resources and allowing for collaboration in creating new products (Baumgartner, 2018).

The amount of waste generation, depending on the population in Bangladesh's urban areas, is given in the table for several years. The rise in the population of the urban area leads to a rise in waste production. From the following table, from 1991 to 2020, the urban population has risen tremendously in Bangladesh, from 20.87 million in 1991 to 64.82 million in 2020, and the percentage of the total population of urban population has also increased from 20% in 1991 to 31% in 2020. There has been little variation in the waste production rate of 0.49 to 0.51 kg/cap/day during this period, while the total waste production has risen from 10,227 tons/day in 1991 to 33,335 tons/day in 2020. This shows that population has increased waste generation, which has been quantified to be higher than the previous figures. In terms of the projected population by 2025, the urban population is expected to reach 78.44 million, which will be 40% of the total population of 196 million people; the waste production rate is expected to increase to 0.60 kg/cap/day; and a resulting overall waste production of 47,064 tons/day.

Table 3: Annual Waste Generation based on Population in Bangladesh

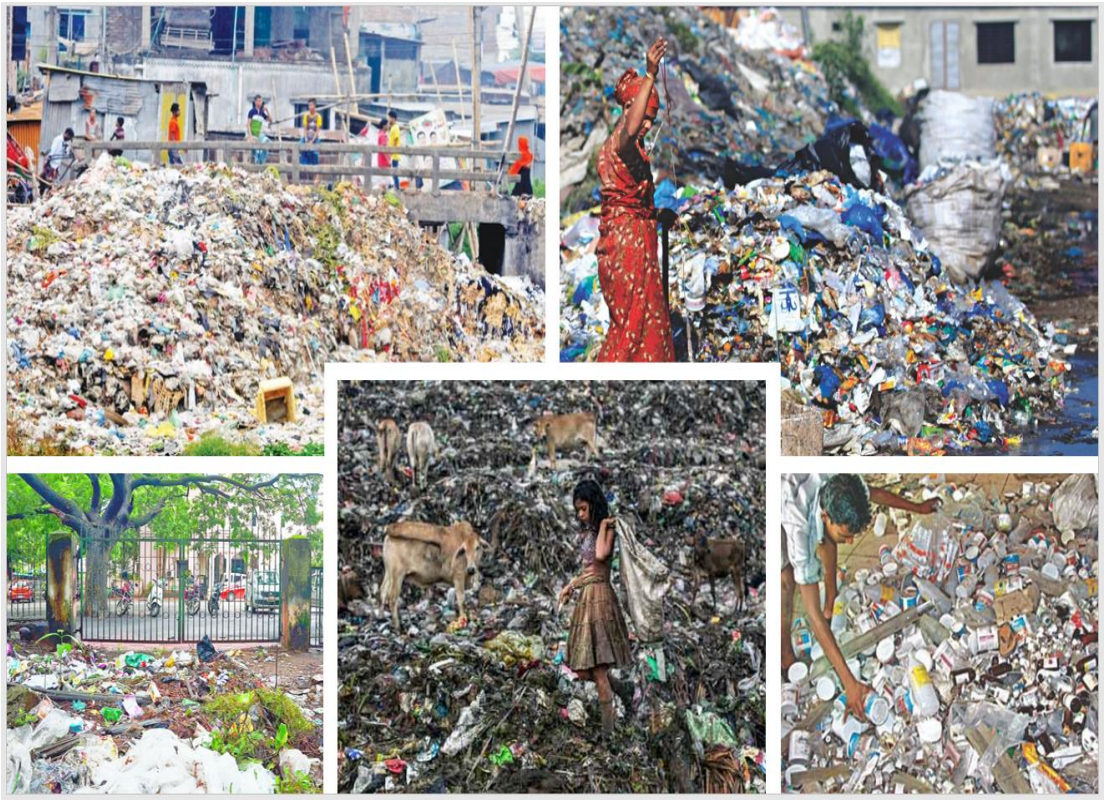
Year	Total urban population	Urban population (% total)	Waste production rate (kg/cap/day)	Total waste production (ton/day)
1991	20872	20	0.49	10227
2001	28808	23	0.50	14404
2004	32765	25	0.50	16383
2011	48059	27	0.51	24360
2012	49821	28	0.51	25270
2013	51624	28	0.51	26247
2014	53456	29	0.51	27212
2015	55305	29	0.51	28209
2016	57168	29	0.51	29203
2017	59047	30	0.51	30218
2018	60944	30	0.51	31238
2019	62866	30	0.51	32279
2020	64815	31	0.51	33335
2025	78440	40	0.60	47064*

Source: author's collection from city corporation offices. * denotes the prospective waste generation. It is calculated based on previous data.

This trend depicts the increasing problems of waste management that the urban areas of Bangladesh will experience due to increasing urbanization and accelerated waste generation (Islam & Hossain, 2020). Figure 1 shows the waste disposal area in landfills in different cities in Bangladesh. These badly stacked waste dumps exist all over the urban areas and consist of household and industrial waste contaminated with plastics, organic matter, and other hazardous waste. This makes the environment depressing and a hub of serious health risks for communities close to these facilities and the waste pickers who sort the garbage in improper working conditions (Haque et al., 2013). As for WTP, the situation illustrated in the picture proves the difficulty in

economically motivating the urban populations and industrial actors to improve waste management.

Figure 1: Waste Disposal Area in Bangladesh



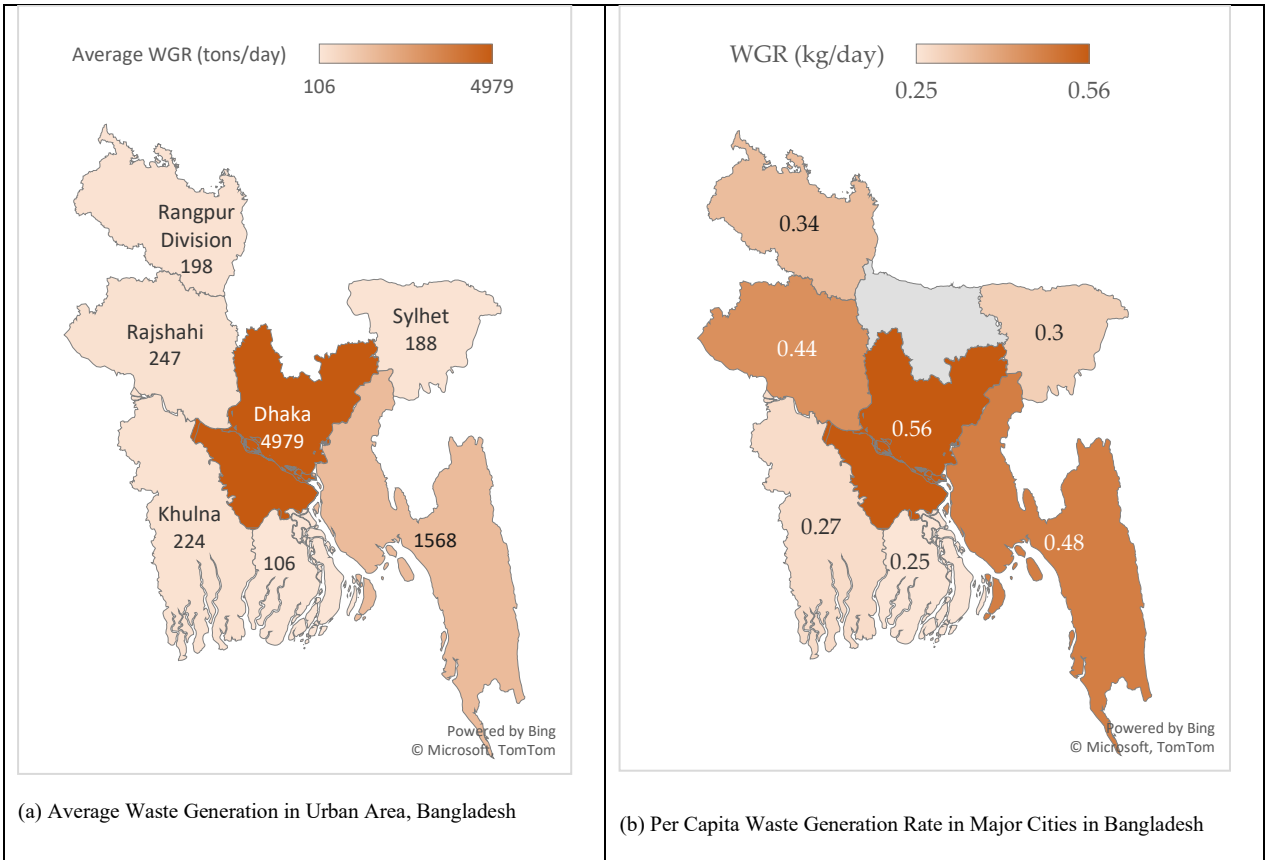
Source: photo taken from city corporation report

The irregular waste collection and disposal methods adopted around various rural and urban regions help develop an impression that waste management is entirely the concern of the municipal government. This perception and the non-observable benefits from current systems mean that low WTP is observed for waste management services (Ahsan et al., 2014). Furthermore, as portrayed in the picture, the decentralised manner in which most recycling and waste processing occurs creates inefficiencies and health hazards that do not instill confidence in the system and discourage the public from paying accredited formal waste management agencies (Islam & Saha, 2017). Therefore, there is a need for infrastructure development and public enlightenment, so that the people appreciate the value of WTP and are willing to invest in it to enhance proper waste management. Daily generated waste in Bangladesh is more than 50778 metric tons. Islam S. (2021)

investigated waste produced in the metropolitan provinces of Bangladesh in 2019, which was more than 32279 tons per day. By 2025, quantitatively, the total waste produced will be 47,064 tons. However, only a small portion of it is treated systematically. More specifically, it was observed that Dhaka city produced 0.67 kg per person per day in 2019, and DCC produced 257 kg of waste per day. It includes a lot of possibilities for fertilizer and biogas production, among other things, such as organic waste material. Lack of municipal support for managing the difficulties and issues entails source separation, poor collection, and a lack of land for disposal/handling. Thus, in 2025, the average per capita urban garbage generation rate is estimated to be 0.60 kg/capita/day (Jerin et al., 2022; Habib et al., 2021; Islam, 2021). The residents of Bangladesh are concerned about the lack of an environmentally appropriate urban garbage management system. Cities, Paurashavas, and small urban centers create a tremendous quantity of solid trash every day, thanks to the rising pace of urbanization in recent decades and a total urban population of 58 million people. Aside from urbanization, people's living standards have risen, and economic activity has grown, resulting in a larger quantity of garbage per capita in the country(Matter *et al.*, 2015). Bangladesh, the world's seventh most populous country, has an extreme urban waste management problem, with 1,015 people per square kilometer. The pollution of ground and surface water, air, and soil poses a hazard to the health of human and animal life. Garbage collection is generally insufficient, and a large volume of trash stays uncollected. Uncollected garbage's organic component pollutes the land, water, and air, wreaking havoc on the surrounding ecology. After each downpour, large amounts of solid waste in the drainage system clog it, creating water stagnation. Again, a large volume of solid trash pollutes the water in bodies of water, rivers, and lakes (Chowdhury *et al.*, 2022; Shammi *et al.*, 2022). Figure 2 shows the city-wise waste generation scenario in Bangladesh. MSW's chemical and physical parts are important for managing, treating, and getting rid of it correctly. Several studies have been done to figure out what MSW is made of. These show whether

composting or anaerobic degradation plants are more likely to work than burning waste. (Yousuf and Rahman, 2007).

Figure 2: Waste Generation Scenario in Bangladesh by City Wise



(a) Average Waste Generation in Urban Area, Bangladesh

(b) Per Capita Waste Generation Rate in Major Cities in Bangladesh

Source: author's calculation

The high amount of organic matter in municipal solid waste suggests the possibility of creating organic fertilizers (Alamgir and Ahsan, 2007). Bangladesh is an energy-stressed nation suffering from a power crisis for the last several decades as a result of insufficient power production in comparison to demand. The nation's electricity production relies heavily on nonrenewable (fossil fuel) energy sources, primarily natural gas, accounting for 64.5 percent of the country's current installed power capacity.

The data presented in Table 4 provides a comprehensive overview of waste composition in six major cities in Bangladesh: Dhaka, Chittagong, Khulna, Rajshahi, Barisal, and Sylhet. The composition is partitioned into waste groups, including organic waste products, wastepaper,

plastics, wood, textiles, dust products, etc. It is therefore important to understand this composition to design specific waste disposal and optimize resources in integrated urban systems.

Waste in these cities reveals that the largest component of waste is the 4600kg of organic waste, which includes vegetables and foodstuffs. The average percentage of organic waste as per the cities is 74.5% & Barisal is 81.10% & Dhaka is 68.30%. This relatively high proportion of organic waste suggests the possibility of composting or anaerobic digestion, as well as technologies that might turn this waste into valuable products such as compost or biogas. Since there is a lot of organic waste generation, investing in organic waste treatment plants could go a long way in relieving the pressure on landfills and producing renewable energy.

Waste papers constitute 9.10% on average of the overall waste index; it is highest in Dhaka city, 10.70%, and the lowest in Barisal division, 7.20%. This goes well with the fact that the paper waste was comparatively smaller than what is produced by the organic waste stream, implying a smaller window for paper recycling. Nonetheless, paper recycling can also slow down deforestation and preserve natural resources if it forms part of the waste management system.

On average, plastics and polythene rank at 3.50% on the scale of waste found in the dumping sites. However, as small as it might look, this percentage is huge when dealing with plastics, a primary pollutant because they are non-degradable. It was found that Dhaka produced a slightly higher percentage of plastic waste, 4.30%, because of high population density and consumption. However, the percentage is much lower in the Chittagong division, 2.80%, and the Khulna division, 3.10%. Efforts to reduce plastic waste through recycling, such as plastic recycling projects, remain a focus area, notably in Dhaka.

Wood, textiles, leather, and rubber make up a small proportion of the total imports, averaging 1.90% and 0.80% respectively. They could be recycled or reused if well-implemented waste management mechanisms. Due to their relatively small volume as a proportion of the total waste

generation, they are not as significant as organic or plastic waste. Still, they could also be included in larger recycling initiatives.

Metals constitute an average of 1.40 percent, and ceramic and glass 0.80 percent of the total waste. Metals, which are saleable for recycling, are disposed of slightly higher in Chittagong (2.20%). Efficient returns could offer economical returns and may decrease the need for new metal ore mining. Similarly, there are expanded applications in the recycling of ceramics and glass, although the proportion is lower, they can contribute less to the total volume of waste recovery work.

Table 4: Composition of Waste in Major Cities in Bangladesh

Composition	Dhaka	Chittagong	Khulna	Rajshahi	Barisal	Sylhet	Average
Organic Matters (Vegetables and Food)	68.30	73.60	78.90	71.10	81.10	73.80	74.50
Paper Products and Paper	10.70	9.90	9.50	8.90	7.20	8.40	9.10
Plastics and Polythene	4.30	2.80	3.10	4.00	3.50	3.40	3.50
Woods and textiles	2.20	2.10	1.30	1.90	1.90	2.10	1.90
Leathers and Rubbers	1.40	1.00	0.50	1.10	0.10	0.60	0.80
Metals	2.00	2.20	1.10	1.10	1.20	1.10	1.40
Ceramic and Glass	0.70	1.00	0.50	1.10	0.50	0.70	0.80
Concrete	1.80	1.10	0.10	2.90	0.10	1.80	1.30
Dust Products	6.70	5.10	3.70	6.50	3.10	5.30	5.10
Others	1.90	1.20	1.20	1.30	1.30	2.80	1.60
Total	100	100	100	100	100	100	100

Source: author's collection from city corporation offices, 2023

Concrete and dust products take average waste fractions of 1.30% and 5.10%, respectively. As discussed earlier, Rajshahi generated the highest percentage of concrete waste (2.90%), perhaps because of some construction and demolition work in that city. Similarly, the Dust products sound like the Dhaka and Rajshahi divisions are 6.70% and 6.50 %. They can be considered to originate from polluted air from urbanization and industries. These materials are sometimes difficult to

handle, but they might find useful applications in constructing roads or other civil structures. The other type of waste, classified as miscellaneous or unidentified, averages 1.60% in the given cities.

As a result of this tendency, sources of nonrenewable energy are rapidly depleted. As a result, it is vital to reduce the reliance on nonrenewable energy sources while increasing the use of renewable energy resources to fulfill the enormous energy demand that the nation is experiencing. Most people in Bangladesh who live in rural, remote, coastal, and isolated locations do not yet have access to electricity (Halder, Paul, and Beg, 2014). Renewable energy resources, particularly biomass, may, on the other hand, play a critical role in electrifying rural, distant, coastal, and isolated places around the United States (Taylan *et al.*, 2018). It has been thousands of years since civilization has relied on a source of energy as biomass. Over the last several decades, Bangladesh has been plagued by several issues. These include issues such as overpopulation, scarcity of energy, and global warming, among others. The sustainable production of an adequate quantity of electricity is a critical problem, considering the fast-expanding population and economic growth. Renewable energy can play an essential role in meeting energy demand. Because Bangladesh is an agricultural nation, biomass can be one of the country's renewable energy sources. Biomass energy is mostly derived from wastes of crops, municipal solid waste, and animal manure in the United States (Sarkar, Ehsan, and Islam, 2003; Kim *et al.*, 2012; Sen and Ganguly, 2017; Uddin *et al.*, 2019).

Organic waste generated from agriculture in the urban areas of Bangladesh is on the rise as urban horticulture becomes popular, and places like Dhaka, Chittagong, and Khulna are accounting for population increase. This category consists of plant remains such as animal and human food from markets within urban areas and wastes produced from urban farming. When it comes to agricultural waste, they are generally produced in the countryside; nevertheless, dense amounts of organic waste stem from the urban environment, attributed to new innovative ideas including rooftop farming, urban gardens, as well as the processing of agricultural products within urban

settings (Islam and Hossain 2017). In urban Bangladesh, agricultural residues and other forms of organic waste have a poorly developed system of collection, and the majority of it is dumped in open-air drains or left to rot in landfills without proper treatment. This results in the emission of methane gas, which is a greenhouse gas and leads to environmental pollution (Rahman & Ahmed, 2018).

Nevertheless, agricultural organic waste has a good viability in composting as well as in biogas production, where waste could be transformed into useful commodities such as organic manure or energy. Composting could be applied in big cities, as this approach can help address a huge amount of organic waste and enhance soil quality for urban agriculture when land is filled (Haque et al., 2013). Additionally, there is no research on the methods of handling agricultural organic waste within urban markets, which affects the public's WTP for waste management services. For instance, if urban populations and potential stakeholders were fully informed of the positive impacts of compost production and biogas manufacture from agricultural waste, they would be more willing to support waste-to-energy projects (Ahsan et al., 2014).

Bangladesh is home to almost 160 million people. According to the household and expenditure survey, 24.3% live below the upper poverty line. The extreme poverty rate is 12.9%, whereas the international extreme poverty rate is 13.8% (World Bank, 2017). Access to electricity is one of the most important prerequisites for the elimination of poverty, the development of living standards, the sustainability of the environment, and the general growth of socio-economic and agricultural activities in rural communities. Now, around 49 percent of the population of Bangladesh is linked to the energy grid. Rural regions are home to more than 70 percent of the population, with just roughly 25 percent of those living there having access to power. Electrification of the whole nation by 2020 is being planned as part of the government's efforts to improve rural people's living standards. As stated in the government policy, the objective of this project will be reached by short, medium, and long-term initiatives aimed at expanding power output through the use of coal, liquid

fuel, natural gas, and renewable and nuclear energy sources (Masud *et al.*, 2020; Sarker *et al.*, 2020). In Bangladesh, biomass is a natural source of energy that has the potential to be utilized.

A poor growth rate afflicts the economy in rural areas, resulting in high unemployment rates, a lack of infrastructure, and utter poverty, among other problems. Bangladesh is now the sixth most populous country on the planet, and biomass accounts for 73 percent of the country's overall energy production (Bildirici, 2013).

Forest and agricultural wastes are used as cooking fuel in rural regions because they include biomass resources (cow dung, agricultural wastes, wood). Approximately 5% of the population in rural regions uses kerosene as a source of energy (Wolde-Rufael, 2005). Most of the residents in the community rely on kerosene-fueled lamps to provide light for their residences at night. In many nations throughout the globe, biomass is already being used to create renewable energy, and this trend is estimated to continue. A variety of benefits are associated with the energy production from biomass. While biomass leftovers are inexpensive, their energy conversion efficiency is superior to other fossil-fuel-based production systems. As a result, it helps to lower the overall cost of power.

In addition to producing electricity, the method produces organic fertilizer, boosts agricultural output, and promotes a green and clean environment (Ng *et al.*, 2012; Kabir and Khan, 2020). Energy generation in Bangladesh relies on traditional resources such as furnace oil, indigenous gas, coal, diesel, and hydroelectric power, all of which are in short supply. The biggest proportion of total electricity produced is from indigenous natural gas (67.21 percent), resulting from furnace oil (22.30%). The percentage of diesel is 5.52. The percentage of hydropower and coal is 2.58 and 2.35, respectively. The contribution of renewable energy to overall electricity production under the current generating scenario is very low. Bangladesh has a tremendous amount of renewable energy potential. Renewable energy sources include solar energy, wind energy, hydropower, and

biomass, to name a few. Bangladesh gets an average of 4–6.5 kWh/m2 of solar radiation daily. The installation of Solar Home Systems (SHSs) to deliver power to rural families and small businesses has grown more popular. More than 0.3 million SHSs with a combined capacity of around 15 MW are available nationwide (K Hossain and Badr, 2007; Md. T. Islam *et al.*, 2014; Zakir Hossain *et al.*, 2014).

Bangladesh creates a large amount of agricultural waste each year, and if these wastes are not properly managed, they may negatively influence the country's economic progress. Open dumping of these items without proper collection negatively influences human health and the environment. In addition to high moisture content and poor calorific value, big particle size and varied composition are all issues that arise when dealing with biomass. The use of good pretreatment may alleviate these fundamental issues, but it is necessary to consider a waste-to-bioenergy method to expand the exploitation of agricultural wastes. Various processes (pyrolysis, gasification, adsorption, etc.) are available for bioenergy production. Research in product conversion to high-energy feedstock and its effective use will help ease the dependence on fossil fuels in the future. People are only vaguely aware of these processes and thus place little emphasis on using renewable energy sources. As a result, it is necessary to encourage research and development activities to utilize agricultural wastes. It will help reduce the amount of waste produced and pave the way for the production of bioenergy, which will help to close the gap between the demand for and supply of energy. For the efficient usage of locally accessible biomass wastes, the Ministry of Natural Resources and Environment (hereinafter: MNRE) has established different biomass power production facilities as well as many gasification units in various states of Bangladesh (Salam *et al.*, 2018; Miskat *et al.*, 2020; Hasan *et al.*, 2022).

The urban area generates 223,688 tons/ day of waste, and authorities can collect only 50-70% of this waste (City Corporation and Pourosava). The rest remains uncollected, meaning that the mixed waste is dumped daily on the city’s roadsides, drains, lakes, and rivers. There are a lot of obstacles

to overcome when it comes to waste management in Bangladesh, especially in its metropolitan areas. The fast urbanization and population growth have resulted in huge increases in the generation of waste, which has overwhelmed the infrastructure that is now in place for waste management. In many cities, the waste collection systems are inadequate to deal with the amount of waste created. Consequently, this leads to the accumulation of waste that has not been collected in public places and streets, which creates health risks and environmental contamination. Many municipalities do not possess adequate trash disposal facilities, resulting in the prevalent practice of open dumping. Because of this, soil and water sources become contaminated, contributing to the destruction of the environment. Recycling efforts are limited, and most recyclable items are disposed of in landfills. Because there is a lack of structured recycling initiatives, precious resources are being lost, and landfill sites are rapidly filling up. It is generally true that there is a dearth of public understanding and engagement in waste management methods overall. It is less likely that communities will participate in sustainable waste management activities if they do not clearly understand the benefits of recycling and efficient garbage disposal, respectively. When investing in modern waste management infrastructure and services, municipalities and city corporations frequently confront financial and resource constraints that limit their ability to do so. The primary issue with the waste management system in Bangladesh is its insufficient infrastructure and limited resources, resulting in ineffective waste pickup, incorrect disposal, and negligible recycling. The rapid process of urbanization and the increase in population have worsened these problems, leading to environmental degradation and posing risks to public health. The garbage collection methods cannot cope with the growing amount of waste, resulting in the accumulation of uncollected waste on streets and public spaces.

Additionally, the reliance on open dumping pollutes soil and water sources, leading to environmental deterioration (Afroz et al., 2009). Moreover, the absence of coordinated recycling initiatives results in the squandering of important resources and rapid filling of landfill sites. There

is a lack of public understanding and involvement in implementing effective waste management techniques, resulting in low adherence and participation in sustainable garbage disposal and recycling (Afroz et al., 2009). By raising households' WTP for enhanced waste management services, we may address these fundamental issues by securing the required finances and promoting greater public participation. Higher WTP can create the necessary income to invest in modern garbage collection, disposal, and recycling facilities and develop a strong infrastructure to efficiently handle the increasing waste volume (Afroz et al., 2009). By receiving sufficient funds from the waste treatment plant, towns have the potential to enhance the quality and dependability of waste management services. This, in turn, results in cleaner streets and decreased health hazards related to waste pollution (Afroz et al., 2009). A higher WTP also signifies greater public participation and responsibility in waste management. This results in improved adherence to trash disposal standards and increased community engagement in maintaining environmental cleanliness (Awunyo-Vitor et al., 2013). Consistent income generated from WTP (waste-to-product) can guarantee the financial sustainability of waste management initiatives, enabling continuous funding and upkeep of the infrastructure (Shehu Usman Adam et al., 2015). Effective waste management minimizes environmental pollution and decreases health hazards, improving people's living circumstances. This is achieved through investments supported by increased WTP (Afroz et al., 2009; Awunyo-Vitor et al., 2013).

Among all the challenges, Waste Management Services faces one of the hardest problems: WTP, especially in countries like Bangladesh, where population growth outpaces industrial activities. The WTP concept represents the maximum amount that individuals or organizations are prepared to pay for services dealing with waste management. Still, finer specifications on what exactly 'paying' means should be provided. In this case, WTP extends not only to waste collection but also to its disposal. A related issue is determining who will pay for these services, though in a country like Bangladesh, the question remains open and without a strong legal foundation (Ahsan et al.,

2014). Although the problem of waste management under existing laws often falls within municipal responsibility, it remains financially challenging to adopt sustainable disposal systems or recycling programs (Rahman & Ahmed, 2016).

The problem centers around funding. Managing waste is difficult due to high population density, rapid urbanization, and the diversity of waste from households and industries. Waste is inconsistent; for instance, industrial waste varies greatly from household waste, and the methods for handling them differ. Therefore, asking people and industries to contribute financially to waste management implies determining where their money should go. The rationale depends on the shared stake in environmental impacts and public health risks associated with unmanaged waste (Haque et al., 2013). However, the fundraising process must determine whether contributions should cover the full scale of waste management, from collection to disposal, and whether such a system is financially viable given Bangladesh's economic conditions (Islam & Saha, 2017).

In summarizing the findings, several practical issues arise. First, there is no clear legal obligation regarding who should pay for waste services, and second, implementing an integrated waste management system, including conventional collection and disposal practices, becomes economically unfeasible (Ahmed & Rahman, 2018). Additionally, the heterogeneity of waste generation between households and industries complicates the design of a common WTP model. Finally, asking the public and industrial users to participate in a WTP plan poses both practical and ethical challenges, as there is often resistance to paying for services people believe should be provided by the government (Khan & Hoque, 2019). Overcoming these obstacles requires policy reform, financial innovation, and a deeper understanding of WTP within Bangladesh's socio-economic and industrial context.

1.3 Research Questions

One of the primary objectives of this study is to discover how WTP can vary in Bangladesh and which factors contribute towards influencing it, focusing on waste management issues in urban

areas. While understanding policies and initiatives, including programs and projects aimed at reducing waste in urban settings, is essential, the core of this research is to understand what drives WTP in waste management. It will explore specific socio-economic factors (such as income), cultural factors (e.g., beliefs), and environmental factors that influence individuals' or organizations' WTP for these services.

The research will concentrate on reasons for WTP, such as income levels, environmental issues, and public awareness. Furthermore, this research attempts to explore the differences in these determinants across different income groups of households using econometric methods. This will help the researchers understand how WTP can be structured and optimized to guide better waste management practices for urban Bangladesh.

This approach will enable the study not only to find out the determinants of WTP but also to offer various policy implications that could help improve the effectiveness of WTP in addressing waste management challenges arising from the rapid urbanization process experienced by cities in Bangladesh.

Therefore, the main and sub-research questions seek to investigate the factors that might influence the WTP significantly for better waste management in Bangladesh and the mediating link between environmental attitude, climate change perception, and WTP. (1) What are the key determinants influencing Individuals' WTP for better waste management in Urban Bangladesh? (2) How does environmental socialization affect the WTP for the development of better waste management systems in the large cities of Bangladesh? (3) How do the awareness levels regarding climate change affect the readiness of urban residents in Bangladesh to pay for sustainable waste management? (4) To what extent do demographic factors (age, income level, and education) influence the WTP for better waste management practices in Bangladesh? These research questions aim to help identify and explain those factors that influence WTP for environmentally

friendly waste management solutions in Bangladesh in response to specific environmental attitudes and climate change perceptions in line with the country's urbanization and industrial development. What are the determinants of WTP for better waste management services in Bangladesh?

1.4 Research Objectives

To provide an answer to the pressing modern global environmental and climate issues, it is essential to understand sustainable waste management practices and their integration into people's values. In Bangladesh, unfortunately, although urbanization and industries are increasing daily, efficient mechanisms to dispose of waste are still a major problem (Ahmed & Ali, 2006). Still, there are big gaps in the willingness of the public to engage and financially support better infrastructure for waste management. This study aims to discover the factors influencing WTP for enhanced waste management service delivery in Bangladesh, particularly in the major cities. As such, it aims to examine the correlation between public environmental attitude, perceived climate change, and WTP. Therefore, it is the study's purpose to provide significant findings about public involvement and support for sustainable waste management policies, which is vital for the development of the overall environmental sustainability programme in Bangladesh (Khan et al., 2022; Koul, Yakoob, & Shah, 2022). Increasing public awareness of global environmental and climate challenges and the need for greenhouse gas (GHG) emission reductions is the driving force behind this research. There are numerous objectives. The primary goals are as follows:

(a) Find out the determinants of WTP for better waste management in Bangladesh.

(b) Identify the relationship between people's environmental attitudes and WTP in the main cities of Bangladesh.

(c) Identify the relationship between people's climate change attitudes and WTP in the main cities of Bangladesh.

1.5 Research Hypothesis

This research establishes five central hypotheses to examine the primary factors that influence households' WTP for enhanced waste management services in urban Bangladesh. These hypotheses are grounded in the theoretical frameworks of behavioral economics and environmental psychology, aligning with the broader aims of the study.

The first hypothesis looks at how education impacts WTP, suggesting that households with higher levels of education are more likely to value proper waste management and, consequently, are more inclined to financially support improved services.

The second and third hypotheses delve into attitudinal factors. Hypothesis 2 analyzes the connection between environmental attitudes and WTP, while Hypothesis 3 considers whether concern about climate change is linked to a stronger willingness to contribute financially to better waste management. These propositions are based on theories of pro-environmental behavior, which indicate that heightened ecological awareness often leads to more sustainable actions, such as paying for environmental services.

Hypothesis 4 investigates the influence of household income on WTP, drawing from the conventional understanding that wealthier individuals have more disposable income and are thus more likely to afford and support public services like waste management.

Hypothesis 5 examines whether there are gender-based differences in WTP, exploring whether male and female heads of households differ in their attitudes or financial capacity to support improved waste services. This hypothesis takes into account variations in household decision-making roles and levels of environmental responsibility.

Collectively, these hypotheses aim to offer a holistic view of how demographic and psychological factors shape WTP for waste management. Validating these hypotheses through empirical data

will help develop inclusive and fair policy strategies for building sustainable waste systems in Bangladesh. These hypothesis are:

(1) H1: The level of education on WTP has a significant effect on better waste management in urban areas in Bangladesh.
(2) H2: There is a positive relationship between WTP's goal of better waste management and environmental attitudes in urban areas in Bangladesh.
(3) H3: There is a relationship between WTP's goal of better waste management and climate change attitudes in urban areas in Bangladesh.
(4) H4: Income level has a positive influence on WTP among people.
(5) H5: There is a positive impact of gender on WTP in urban areas in Bangladesh

1.5.1 Effect of Education on WTP

It has been widely suggested that education is one of the most important predictors of environmental beliefs and practices, including WTP for environmental services. The link between education and WTP can be explained by the theory of planned behaviour, whereby more educated people are expected to have a higher level of knowledge and appreciation of the environment, hence WTP. In different settings, research has established that education positively affects WTP. For example, Singhirunnusorn et al. (2012) revealed in their study in Thailand that the WTP for municipal waste management services was higher among households with higher levels of education. From the study, the authors postulated that education enhances the understanding of the effects of the environment and health due to poor management of wastes, hence enhancing WTP. Thus, the impact of education on WTP might be different in the context of Bangladesh, where the level of education is quite diverse. Afsar (2020) also observed that education is one factor that influences WTP. Still, it can also be influenced by other factors such as income, cultural beliefs, and local environmental conditions. Education may be more influential in the urban areas where education is more easily accessible and may influence WTP and attitudes towards waste

management. However, in less developed areas, the impact of education might be less effective because of other factors that dominate the society, such as the need to earn money in the near future or the perception of waste as undesirable.

1.5.2 Environmental attitude and WTP

Environmental attitudes are the beliefs, perceptions, and attitudes people have towards the environment and its protection. Such attitudes are important in influencing environmental conservation behavior and WTP for public services such as waste collection. Thøgersen's (2006) Danish study established a positive relationship between positive environmental attitude and WTP for green services. People who had a positive attitude towards environmental conservation were more likely to support such measures as recycling and enhanced waste disposal. However, in developing countries such as Bangladesh, the correlation between environmental attitude and WTP could be affected by other factors, such as economic factors and a low level of environmental consciousness. Satterthwaite (2013) pointed out that in many LMUAs, basic survival needs dominate over environmental issues, which might reduce the correlation between environmental beliefs and WTP. In addition, where there is little or no environmental education and awareness creation, as in most parts of Bangladesh, the people may not appreciate the need to embrace improved waste management in the long run, thus influencing their WTP.

1.5.3 Climate change attitude and WTP

Climate change attitudes pertain to people’s beliefs and opinions concerning climate change and its impacts, and the need to address it. Since waste management is related to climate change, through such factors as methane generation in dumps and the carbon intensity of waste disposal, people who are sensitive to climate change may be willing to pay higher prices for improved waste management services. Brouwer et al. (2008) also observed that passengers concerned with the environmental consequences of their travel were willing to pay for carbon offsets. This means that awareness of climate change and its impacts influences the WTP for environmental services that

help to address these impacts. Farhad et al. (2017) found that awareness of climate change is increasing in Bangladesh, especially in the flood- and climate change-affected urban areas. However, the study also revealed that awareness is still low despite the improvement compared to the past, and is still low compared to the international level. This implies that although attitudes towards climate change may affect WTP, they may not do so significantly unless supported by other education and sensitisation initiatives.

1.5.4 Income and WTP

Income is one of the most widely used variables in WTP analysis in the economic literature. The rich have more surplus cash than the average citizen, so they can afford public goods such as waste management services. This is usually attributed to the theory of consumer behavior, whereby with an increase in income, there is also an increase in the demand for and therefore emphasis on public goods. Altaf and Deshazo (1996) in their study in Pakistan revealed that the WTP for better solid waste management was higher among the affluent households. The authors claimed that higher-income households are more sensitive to the quality of services they receive and are ready to pay more. Bangladesh has a high level of income disparity, especially in terms of the urban and rural divide. Karanja and Gakungu (2013) also established the same in Kenya, where the richer urban dwellers were willing to pay more for enhanced waste management services than the poor. In the case of urban Bangladesh, income is expected to be a significant predictor of WTP because income disparity is high in the urban areas. The WTP may be influenced by the capacity and willingness of households to pay for services, which may be higher in rich households than in poor households, who may not be willing to pay for environmental services because other basic needs have to be met.

1.5.5 WTP and Gender

Many empirical works have been conducted to compare the environmental attitudes and behaviors between males and females, and the findings are inconclusive. There is evidence that women,

compared to men, are more sensitive to environmental problems and more willing to pay for environmental services. In a cross-national study, Hunter et al. (2004) revealed that women were more concerned than men about environmental problems and more ready to act to protect the environment. This fact can be explained by other works, for example, Torgler and García-Valiñas (2007), who established that women are more supportive of environmental taxes and other measures to protect the environment. Gender roles in the context of Bangladesh are well-rooted in culture, and this might affect WTP in some way. Female respondents in urban areas, especially heads of households, may be more sensitive to waste disposal and its effects on health and living standards. However, because of the socio-economic factors such as low income earning capacity and less bargaining power, the WTP by women may not always be reflected in the actual monetary outlay (Naved et al., 2018). Hence, although gender may affect environmental attitudes, the effect of gender on WTP may be conditioned by other socio-economic variables.

The literature has enough information about the factors that affect the WTP for waste management services, particularly in developing nations. Education, wealth, environmental and climate change beliefs, and gender have all been recognized as influential factors in different situations. Nevertheless, a dearth of context-specific research specifically examines the interplay of these elements in metropolitan areas of Bangladesh. This study seeks to fill this void by investigating the influence of education, environmental and climate change beliefs, income, and gender on WTP in urban Bangladesh. By doing this, it aims to support the creation of specific policies and initiatives that can promote waste management practices and improve the health and well-being of the people.

1.6 Significance of Research

WTP is an important aspect of individuals' and communities' willingness and ability to contribute towards enhancing SWM services. Considering the literature review of 75 articles on this topic, the following points out why WTP improvement is advisable and necessary for efficient waste

management. Firstly, WTP proves that the value of the households in SWM services can be improved because it will base policies that will be economically sound and fair price mechanisms that will be implemented. The WTP of households can enable the government to set the correct charges to encourage residents' use of waste management services and revenue collection to promote adequate services funding without overburdening the community. For example, different research conducted with the sample population of Ethiopia, Nepal and Ghana reveals that there always exists positive relationship between households' income and their WTP for better SWM, hence it would pay dividends if service providers implement differential pricing basing on the above factor (Mulat et al., 2019; Rai et al., 2019; Awunyo-Vitor et al., 2013). Second, knowing WTP allows us to define the characteristics that affect households' decisions to contribute to enhanced management of wastes. Of the variables of concern, awareness and attitudes towards the conservation of the environment have a considerable effect on WTP, and the studies above conducted in various regions support this (Afroz et al., 2009; Ray et al., 2023). Informative advertising and other health and sanitation promotion activities in the population are thus crucial to raise the WTP bar among the households due to the appreciation of the detrimental effects on human health and the surrounding environment. Besides, WTP is one of the overtures of WTP to support waste management interventions. Higher WTP signifies good support for the waste management policies among the residents, which is vital to guarantee the efficiency and continuation of the initiatives. Other ways to help boost WTP and ensure that the services delivered meet the anticipated population needs include community participation in planning and decision making (Shehu Usman Adam et al., 2015; Awunyo-Vitor et al., 2013). WTP data also help determine how different communities are willing to pay for services concerning socio-economic status, thus the affordability level of waste management services. By examining the WTP of the individuals within diverse categories, the policymakers can isolate the susceptible population, so that they can receive subsidies or other incentives to assist them in paying for better quality

services in waste management. There is also a need for a gender perspective in the studies, as women-headed households were found to be willing to pay a higher amount for efficient waste disposal since women are mostly charged with their household's waste disposal duties (Endalew & Tassie, 2018). WTP allows identifying the current waste management services' efficiency and the issues that should be solved. The WTP level may be affected by the satisfaction with existing services, including households' distance to waste disposal sites. Enhancing the quality and durability of waste management services enhances people's satisfaction with paying in Ghana and Nigeria (Nkansah et al.,2015). Therefore, WTP for better municipal waste management reflects the fundamental indicator that can be used effectively in planning efficient, fair, and sustainable waste management systems worldwide. It captures the demand for these services by households, influences the policy formulation and the pricing strategies, establishes different factors/ determinants and socio-economic inequalities, and quantifies the level of public support and satisfaction. Efficient use of WTP data empowers policymakers to set up suitable measures to improve waste management, which brings a better quality of living in society.

If two tons of organic waste are converted into compost, one 1 ton of CO2 will be reduced in the atmosphere. It is important to pay attention to the possibility of co-benefits resulting from a better waste management system (Zurbrügg *et al.*, 2005). The organizational flowchart reveals a waste management and treatment system with many categories for handling waste, such as thermal, biological, and recycling. It focuses on the aspects of waste-to-energy, materials, and landfills relevant to present-day waste management systems. If applied in the context of Bangladesh, such a structure would successfully handle many of the emerging issues related to urban waste generation, treatment, and disposal as listed by Ahsan et al. (2014).

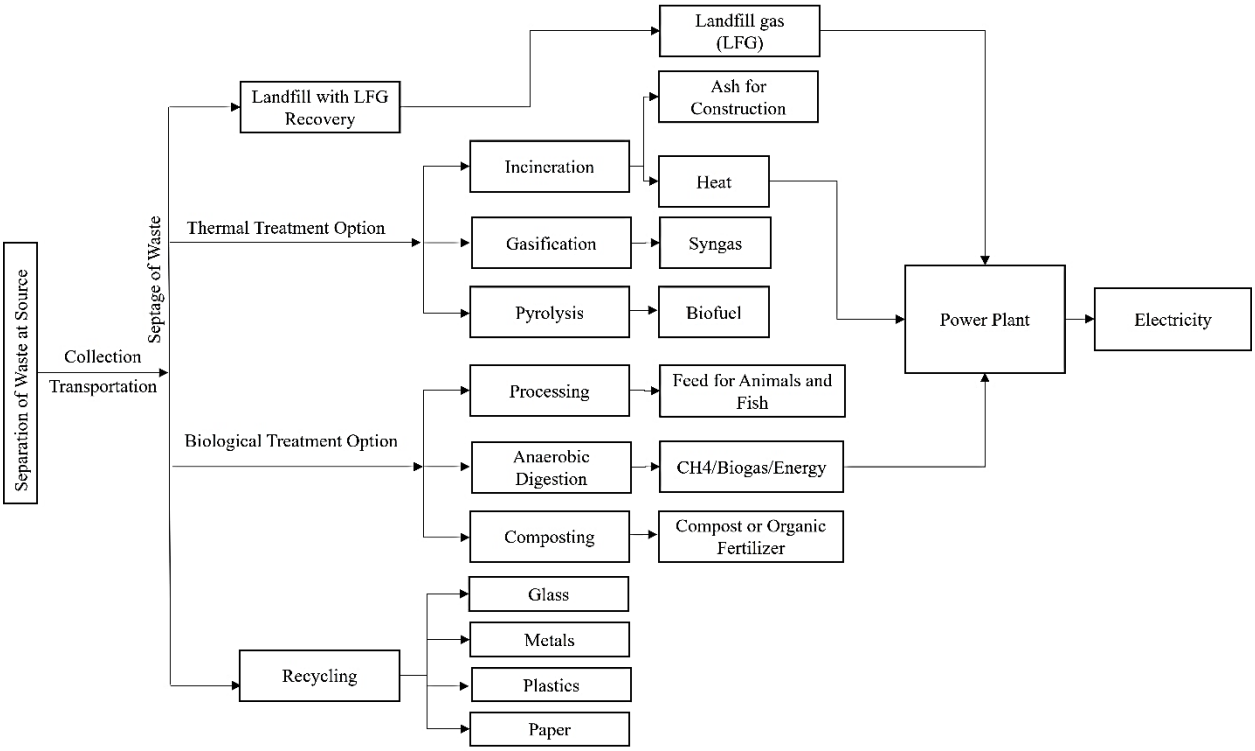
The problem of the absence of waste segregation at the source is one of the main challenges for waste management in Bangladesh. Based on this flowchart, waste should be collected in various streams, which is important in recycling and other biological approaches. In urban areas of

Bangladesh, waste is sometimes mixed in a way that makes recycling more difficult, creating opportunities for contamination. In addition, energy recovery from the waste is not as efficient. Introducing projects that promote and require source separation would probably be the first step toward further development (Islam & Saha, 2017). The above chart shows that recycling can be conducted based on recovering glass, metals, plastics, and paper. In Bangladesh, informal collectors collect, segregate, and recycle most of the waste generated from the city, specifically those wastes such as plastic and metals. However, this system is nonstandard and usually dangerous for workers (Haque et al., 2013). The procedures of recycling products could be ordered and inculcated in the structures of municipal waste disposal to increase effectiveness and protect the workforce. Advances in recycling structures, accompanied by the launch of consciousness programs, may increase the amount of collected materials (Ahmed & Rahman, 2018). The chart outlines some biological treatments, including anaerobic digestion and composting. Bangladesh produces a high percentage of organic waste, and the largest proportion of waste comes from food and agriculture. Anaerobic digestion can offer sustainability by decomposing organic waste into biogas or energy. As the flowchart shows, it can be used for power production as recommended by Rahman and Ahmed (2018). Likewise, composting could also assist in the proper handling of organic wastes, for it can turn the garbage into compost or organic fertilizer, which can be greatly needed in agriculture. These methods, however, need infrastructure, proper waste segregation, and incentives for industries and households to embrace the idea (Islam & Hossain, 2017).

The other presented thermal management techniques include incineration, gasification, and pyrolysis. Though Bangladesh has inadequate incineration facilities, these methods could be useful in dealing with the increased flow of waste, especially in urban areas such as Dhaka (Rahman & Ahmed, 2016). Technology such as incineration helps minimize waste volume and produce energy due to concerns of air pollution and high operating costs. Still, it has not been adopted fully (Ahsan et al., 2014). More complicated methods, such as gasification and pyrolysis technologies, can be

used to utilize Syngas and biofuels to manage non-recyclable waste and energy recovery (Haque et al., 2013).

Figure 3: Combined Waste Management Plan and Economic Product Generation



Source: author's own editing

The flowchart also indicates that issues regarding landfill management are crucial, especially concerning LFG recovery. In Bangladesh, unmanaged landfills are widely adopted, which contribute more to greenhouse gas emissions and local pollution (Islam & Saha, 2017). Some examples include the figure that illustrates the ways through which emissions of methane from landfills for energy purposes, which is a concrete renewable source, as pointed out by Ahmed and Rahman (2018). Fil and active energy recovery, besides the enhancement of the techniques of landfill management, can go a long way to minimizing the negative environmental impact of waste disposal in the country (Haque et al., 2013).

As highlighted in the chart, many of these processes to the utility or generation of electricity as indicated in the chart. None of the waste-to-energy solutions, such as anaerobic digestion,

incineration, gasification, or landfill gas recovery, can solve Bangladesh's energy deficit while decreasing waste disposal in landfills (Rahman & Ahmed, 2018). While these technologies focus on a power sovereignty model and offer consumers greater control of their energy use, they still require higher capital investment, technical knowledge, and facilities, which do not exist at the moment (Islam and Hossain 2017).

Finally, the waste management model flowchart indicates a clear solution with the mixture of waste-to-energy, recycling, and biological treatment. For Bangladesh to embrace such a model, there is a need to implement improvements in waste segregation, invest in recycling and energy recovery, and implement waste-to-energy policies. If these challenges are to be addressed, Bangladesh could then progress towards an enhanced waste management framework, which, in addition to reducing the impacts of waste on the environment, will also help create energy and resources (Rahman & Ahmed, 2018).

According to the calculations, co-benefits' savings in both the public and private sectors are frequently many times more than the current carbon price. According to a study that looked at Bangladesh's composting practices, composting municipal organic waste can result in as much as 93.82 dollars (US) per ton of CO2 equivalent. There are several co-benefits, such as creating new jobs and reducing the costs associated with solid waste management by the city authority. The savings result from the decreased use of chemical fertilizer in agriculture, and the savings result from increased crop yield and additional income. It is possible to generate four jobs by processing two tons of organic waste when considering employment creation.

Additionally, it will cut CO_2 emissions by one ton. It will save the cost of minimality from the consideration of waste disposal. Preventing 2 tons of organic waste from being dumped in a landfill resulted in a savings of US$ 23.36. Currently, the cost per ton is USD 11.68 (transportation and land filling cost). It will result in a 25 percent decrease in the utilization of chemical fertilizer.

Prices for animal and fish food in the Bangladeshi market are going up. Since feed and other costs increased, many farmers stopped fish and meat production. Food waste should be used as animal feed as much as possible. Anyone can give food scraps to animals if they do it safely. Farmers and businesses can save money by giving food waste to fish and animals. Feeding animal food scraps is often cheaper than sending them to a landfill (Makkar, 2018; Truong *et al.*, 2019).

1.7 Conceptual Framework of Research

The study design is guided and developed based on the concepts, assumptions, expectations, and theories outlined in the conceptual framework. A conceptual framework can be defined as a visual or written document that "tells, in words or graphics, the main things to investigate." According to Miles and Huberman (1994), a conceptual framework may explain the primary items to be investigated, the essential components, ideas, or variables, and the hypothesized relation among them. Several important factors will define households' ability and desire to pay for improved solid waste management services. In this study, the WTP of HH is posited as the dependent variable, and it is viewed as a dichotomous dummy variable, which implies that it can only have two values. Therefore, the study's conceptual framework revolved around the question of how the WTP of homes could be collected to enhance SWM in the study area. Which socioeconomic factors are most relevant to the willingness to pay farmers for better solid waste management services? The following conceptual framework for analysis was developed by the researcher from the related literature that was reviewed. It is important to note that municipal solid waste comes from various sources such as enterprises, institutions, commercial buildings, households, and other similar establishments. This study was conducted to improve waste management services in Bangladesh's major cities, and the WTP of families and the factors that influence the WTP of households were the main areas of interest in this study.

2. LITERATURE REVIEW

The willingness to pay (for better waste management services has been explored widely, especially in developing countries where the infrastructure and resources for waste management are scarce. Some of the most common factors that have been used in previous research to explain WTP include income, education, and awareness of the environment. Higher income group means higher ability to pay, hence the WTP for better services since they are in a better position to afford the extra costs (Mulat et al., 2019). In the same way, education is also significant, as people with a higher education level are more likely to support environmental activities, including the improvements in waste management, because they are more aware of the problem (Afroz et al., 2009).

2.1 Theoretical Review

The linear economy has a significant effect on economic progress. The linear economic model was crucial to growth. It has no concern about waste management and natural resources utilization (Barles, 2014). In the current model of linear production, waste and resource management do not have a plan that encompasses the entire production chain, beginning with the design of the product and continuing through the extraction of raw materials, the manufacturing process, the use of the product, and its eventual disposal (Singh *et al.*, 2014). Local administrations are generally in charge of trash management and must face the difficulty of establishing a system that is both efficient and effective for the people. They frequently encounter issues outside local jurisdiction, such as a lack of management and financial assets, and topic complexity and multiplicity (Yukalang, Clarke, and Ross, 2017). CE has evolved as a feasible approach in this setting, intending to end the product life cycle, like how biological cycles work. The goal of the CE is to limit the utilization of virgin unprocessed substances and increase the circularity and durability of the raw ingredients utilized by the end-of-life cycles of resource streams (Haas *et al.*, 2015).

The notion of a circular economy is closely connected to waste management, focusing on minimizing waste and maximizing resource efficiency through reducing, reusing, and recycling

resources. This creates a closed-loop system. Waste management is essential in a circular economy since it ensures that waste products are not simply thrown away but incorporated back into the production cycle. This helps to preserve resources and minimize the environmental consequences. The WTP for enhanced waste management services plays a crucial role in aiding the shift towards a circular economy. Increased WTP from individuals and companies can offer essential financial backing for developing sophisticated waste management infrastructure and technologies that encourage recycling and the recovery of resources. Increased investment can optimize the efficiency and efficacy of trash segregation, collection, and processing, facilitating the retrieval of valuable materials from waste streams. Communities can contribute substantially to the goals of a circular economy by endorsing sustainable waste management practices through WTP. This includes reducing reliance on raw materials, minimizing pollution, and promoting economic growth by generating green jobs and industries (Afroz et al., 2009; Shehu Usman Adam et al., 2015).

A recent study has gone into great detail on the environmental principles of the circular economy that are sustainable and environmentally friendly (Graedel, 1996; Andersen, 2007; Korhonen *et al.*, 2018; Pinheiro *et al.*, 2019). Industrial biodiversity and manufacturing symbiosis, which investigate the formation of competitive benefits via integrating industries through input exchanges, were initially explored in the 1990s and are still being studied today (Chertow, 2000). It was not until 2006 that industrial symbiosis began to gain traction in academic journals (Yu, Davis, and Dijkema, 2014). Social networking analysis and circular economy emerged around the same time and have a growing number of publications (Deus, Bezerra, and Battistelle, 2019). Natural economies are cyclical compared to human life, and their linearity offers challenging issues due to a lack of structural integration. For example, pollution and the bisphenol cycle have significantly impacted the environment locally and globally. An example of biosphere cycle instability points to the condition of organic waste as an example of consumption in towns and a

lack of re-emission in soil, resulting in deterioration of soil quality and organic matter. It has been suggested that service cycles would make available for increased product use by allowing for reuse, repair, reconditioning, and modernization of these possibilities (Bocken *et al.*, 2016). They suggest two major resource-cycling strategies: (1) Deceleration resource loops: product design and planning objective for a long product life; this expansion of the product's useful life outcomes in a slowing of resource flow. (2) Slowing resource loops: Secondly, resource loops are closed when the production and post-use stages are completed, allowing circular resources to circulate more freely. Both techniques are distinct from the strategy of controlling resource flows, which uses fewer resources per product than is typically done. Based on the CE perspective, China's embrace of CE results in developing great 21st-century strategies (Yuan, Bi, and Moriguichi, 2006). The European Commission (EC) supports the establishment of an industrial waste loop for eco-industrial initiatives (Mathews and Tan, 2011). This point of view allows for financial development that is equivalent to the environmental system regarding material and energy flows, but with fewer environmental limitations and less energy use. CE is significant in waste management because it stresses recycling energy and materials and converting these elements into valuable resources for yet another artist to work with (Zhu, Geng, and Lai, 2011). For municipal solid waste management to be effective, it is necessary to use and maintain an excellent urban infrastructure (Alm, 2015). It is difficult to achieve a sustainable treatment system because of obstacles in several sectors, including compilation, distribution, and final disposal, as well as the monitoring of environmental, economic, and social repercussions in each region (Sanjeevi and Shahabudeen, 2015; Deus, Battistelle, and Silva, 2017; DEUS *et al.*, 2017). Because it reduces adverse effects on multiple sustainability factors, including economic, social, and environmental issues, the integration of waste handling technologies results in the most effective waste management and recovery structure (Wilson *et al.*, 2012). Regarding the social component, citizens of the municipalities can undertake waste-reduction initiatives (Marino, Chaves, and Santos Junior, 2018). Organic waste has the

potential to produce sustainable energy in this approach while also assisting community-based businesses. This contributes to the closure of the organic waste resources food loop (Fuldauer *et al.*, 2018).

The specific sorting of material already present in trash sources for simple reuse and quality verification is recognized as a selective compilation of waste material. This strategy has been widely known and utilized in the United States and the EU since the twentieth century (Velis, Wilson, and Cheeseman, 2009). In underdeveloped countries, the informal sector recycles solid waste mostly via the work of garbage collectors (Gutberlet, 2012). It is because CE is being incorporated into solid waste management. It can positively affect environmental, economic, and social factors (Geng, Tsuyoshi, and Chen, 2010; Deus, Battistelle, and Silva, 2017). To completely understand the connection between CE and organic solid waste, it is essential to consider all three pillars. The value chain analysis method examines the points of intersection in a production chain between participants (Yu, Román, and Solvang, 2018). This kind of study allows for visualizing the unique responsibilities and linkages between actors in the supply chain and recognizing opportunities for development and innovation (Porter, 1998). Four key activities occur throughout the value chain: product invention and manufacturing, advertising/public relations, consumer design, and recycling (Kaplinsky and Morris, 2000). The authors offer research on the production of bioenergy from biodegradable trash and biomass and the environmental effects of this production. The authors also provide answers to the problems associated with the production of bioenergy.

The strategy of business models is typically marketable to contribute to sustainable development. An organization must deliver value to its stakeholders, consumers, sponsors, and the environment to make a sustainable development contribution (Manninen *et al.*, 2018). The bioeconomy is concerned with the long-term utilization of biological sources in producing biological commodities and processes, such as food, fertilizers, and bioenergy, using renewable biological

resources (McCormick and Kautto, 2013). Bioeconomy value chain analysis must satisfy the criteria for competitive and environmentally friendly fossil-fuel-based processes (Sheppard *et al.*, 2011). According to the principles of bio-economics, improving a functioning value chain necessitates expanding the system to include new actors and processes.

Bio-based circular value chains provide closure of materials and energy flows. This allows for the conversion of linear industrial processes into closed or circular processes, thereby reducing waste production. It would be necessary to develop complete biological value chains that would be included in value linkages to reach a flow of natural sources at all stages of the value chain (Zörb *et al.*, 2018). A key assumption of the cascade approach is that by improving the efficiency of biomass consumption, the socio-economic benefit may be maximized, beginning with a given quantity of biomass harvested. A cascade of materials and energy processes would be reused, reprocessed, and finally used (Haberl and Geissler, 2000). Making new, bio-based value chains will need cooperation across previously disparate businesses to cope with the unique features of the whole value chain derived from bio-based products. The bulk of these qualities is obtained as the fundamental biological source-making through the value chains. Decentralization, seasonality, and oscillations in basic quality due to environmental factors are all widespread aspects of such systems (De Meyer *et al.*, 2014; Ghosh, 2016) because of their low population density and high susceptibility to deterioration. Biomass has limited transportability due to its limited transportability. Regionalized treatment of large amounts of biomass should be carried out since several distinguishing features exist among the regions involved (De Angelis, Howard, and Miemczyk, 2018).

2.2 Willingness to Pay (WTP) for Waste Management

People worldwide and in developing countries have been dumping waste indiscriminately for a long time, even though they know the consequences. A lot of research has been done by scholars who want to know more about how households use waste management services, how they know

about WMS, and what their WTP is for better WMS. A non-market valuation method called the contingent valuation method has often been used to determine the advantages of environmental goods and services in urban areas in developed and developing countries because it can set up imaginary markets. In this market, people can say what they would be willing to pay for change. This can determine how much people would be willing to pay for those changes (Bishop and Romano, 1998; Carson, Flores, and Meade, 2001; Mitchell and Carson, 2013). CVM has thus become the simplest and direct way to find out how people feel about these issues, including how much they want to keep or develop existing options.

WTP is the amount of money people are willing to pay for a certain amount of public goods and services (Hanemann, 1991). Techniques based on revealed preference approaches, direct market valuation, and declared preference are some of the various options for assigning a value to items not currently for sale on the market (Damigos, Kaliampakos, and Menegaki, 2016). The contingent valuation technique (CVM) is one of the most frequently stated preference methods. It determines how much individuals would be willing to pay for a public benefit that has not yet been constructed (Eshet, Ayalon and Shechter, 2006b; Elimelech, Ayalon and Ert, 2018). To figure out what people want to pay for a certain good or service, CVM uses a hypothetical market system (Afroz and Masud, 2011; Q. Song, Wang and Li, 2012; Damigos, Menegaki and Kaliampakos, 2016). A survey is used in the hypothetical market to ask customers how much they are willing to pay for a certain thing, like a benefit. WTP is how much they would be willing to pay for this good or service. Some people do not like this method. Responses are based on what people might do in an ideal situation, not what they would do in the real world. For example, WTP may be overestimated (Breidert, Hahsler, and Reutterer, 2006; Afroz and Masud, 2011; Damigos, Kaliampakos, and Menegaki, 2016). However, in places without a real market, it can still be an excellent way to get information about how much something is worth if used carefully (Carson, 2000; Damigos, Menegaki and Kaliampakos, 2016).

Household income, education, and awareness of the environment had a major effect on WTP; household size harmed WTP at a 5% significance level for all variables (Yeung and Chung, 2018). It didn't matter the person's age, how many services they had, or if they were married. Study: It looked at what might affect WTP for waste disposal in Ekiti State, Nigeria, for both men and women. A total of 300 people were interviewed. Descriptive analysis and probit regression were used to look at the data. People who took the survey said that 85.5 percent agreed to WTP for a better waste management system, but 14.5 percent disagreed. The probit regression analysis ensured that WTP for waste management was influenced by their gender, the nature of the main job, level of education, marital status, and average monthly income (Adebo and Ajewole, 2012).

The earthquake and related nuclear plant crisis at the nuclear power plant in Fukushima, Japan, in March 2011 ignited a debate regarding the trade-offs involved in substituting nuclear power and renewable energy sources for fossil fuels to meet climate change targets. The change in sources of power brings with it perks and cons, which further complicates an already complicated process. Examples include nuclear power, which may be able to help us achieve our emissions reduction goals; nuclear power production involves risks such as the environmental effects of harmful waste and the potential harm to human health in the case of a disaster. Similarly to nuclear energy, renewable energy can significantly decrease greenhouse gas emissions while also providing other advantages, such as reducing the demand for imported energy sources, as shown in the case of nuclear energy (Ma *et al.*, 2015; Murakami *et al.*, 2015). Significant investment, inconsistent supply, and related negative local externalities such as changing landscapes, increased noise, and possible bird damage are all involved in the quest for renewable energy sources. As a result, getting customer feedback on the advantages and disadvantages of various power generation options is necessary. A prior sociological poll discovered widespread popular resistance to nuclear power, which coincides with widespread public backing of investments in clean, renewable energy sources (Greenberg, 2009; Ertör-Akyazı *et al.*, 2012).

Furthermore, a slew of empirical research has evaluated how individuals are prepared to pay a higher price for environmentally friendly power. Individuals prefer renewable energy over conventional energy. Consumers prefer to avoid the dangers associated with nuclear power generation and support the development of future generation systems of renewable energy. According to the recent data, the relative consumer is willing to pay for inadequate infrastructure and better waste management services (Goett, Hudson and Train, 2000; Menges, Schroeder and Traub, 2005; Menegaki, 2008; Grösche and Schröder, 2011; Zorić and Hrovatin, 2012). Neither the source type nor the qualities of the consumer are known to influence the amount of WTP. As a result of the Fukushima nuclear disaster, there has been a shift in consumer views regarding the mix of electric power generation, which includes alternative energy sources like nuclear energy (Kim *et al.*, 2012; Hartmann *et al.*, 2013; Kato *et al.*, 2013; Stoutenborough, Sturgess, and Vedlitz, 2013; Siegrist, Sütterlin, and Keller, 2014). In particular, the extent to which this impacts relative WTP is a critical question, and it supports additional research into consumer preferences. Customers' WTP for green power was the first to do so (Roe *et al.*, 2001).

According to the study's findings, a greater level of WTP for emissions cuts results from increasing dependence on renewable energy. However, the lower WTP for emissions reduction consequences increases dependence on nuclear power (Winneg *et al.*, 1998). The authors separately evaluate the WTP for each renewable energy source, including solar, wind, biomass, and farm methane. They conclude that solar energy is the preferred energy source for US families, even though nuclear energy was not included. US consumers' WTP differs based on the demographic group. For a limited number of sectors, higher payments may be achieved for emissions reductions that come with an increase in the use of sources for renewable energy (Roe *et al.*, 2001). Several recent studies, such as those conducted by Komarek et al. (Komarek, Lupi, and Kaplowitz, 2011) and Cicia et al. (Cicia *et al.*, 2012a), have investigated the preferences of individuals for different energy sources in the background of public policy and market segmentation for decision-making.

The research conducted by Komarek et al. (Korhonen, Honkasalo, and Seppälä, 2018) in the United States and the study conducted by Cicia et al. (Cicia *et al.*, 2012b) in Italy found that consumer WTP differs depending on socio-economic variables and environmental awareness.

Socio-economic development, population pressure, and urbanization have increased waste production and disposal in urban areas. In 2011, 2 billion tons of municipal solid waste were created globally (Amoo and Fagbenle, 2013). This amount is projected to rise to 9.5 billion tons by 2050 (Kaza *et al.*, 2018). According to the Taiwan Environmental Protection Agency, annual MSW generation in Taiwan is approximately 8 million tons on average (Taiwan Environmental Protection Administration, 2018). However, waste generation in urban areas in Taiwan has decreased by 2.0 million tons since 1990. It is currently approximately 0.8kg/day/capita in Taiwan. It is less than the global average of 1.20kg/day/capita (Hoornweg and Bhada-Tata, 2012). Homeowners mostly generate Taiwan's municipal solid waste (MSW); businesses generate just a tiny proportion. MSW is seen as an important resource. Much of this waste is handled for bio-energy production (Waste to Energy or WTE), which is facilitated in the surrounding area. This waste management practice reduces the amount of waste and generates electricity (Chen and Lo, 2016). WTE facilities worldwide incinerate about two hundred million tons of municipal solid waste (MSW) yearly to produce electricity (Stengler, 2005). Improvements in the MSW disposal system's pre-final treatment parts can potentially increase the lifetime of waste-to-energy (WTE) facilities. It has been shown that trash reduction, particularly at the source, and recycling are successful waste management methods (Tan et al., 2014), with recycling regarded as a priority technique (Vicente and Reis, 2007). It has been the subject of research to determine the effectiveness of recycling practices in reducing environmental impact. The United Kingdom has updated its approach to garbage recycling services to increase the efficacy of waste collection(Harder *et al.*, 2006). Reducing disposal efforts by recycling programs led to higher MSW separation behavior in Spain and the United States (González-Torre, Adenso-Díaz and Ruiz-

Torres, 2003). An extensive house-to-house campaign in Greater London to raise awareness of local recycling alternatives has resulted in good environmental outcomes (Robinson and Read, 2005). According to Ho (2011), cost is the most essential consideration when picking a waste management business, and it is also the primary worry of the majority of Taiwanese people (Chen and Wu, 2015).

Non-market valuation approaches may be used to determine a person's WTP for upgrades to a better waste disposal system. Using monetary values allows for evaluating different hypothetical programs that entail substitutes for the waste management system (Bengochea-Morancho, Fuertes-Eugenio, and del Saz-Salazar, 2005). The contingent valuation method (CVM) is a valuation method of public goods and services. In this method, participants are asked for their maximum and minimum WTP to take in compensation for the better quality of the environmental service (Mogas, Riera, and Bennett, 2002). The CVM was used to examine a waste recycling system in the United Kingdom. It was discovered that socio-economic determinants significantly influence respondents' WTP (Lake, Bateman, and Parfitt, 1996). Blaine et al. (2005) used referendum CVM and payment card approaches to estimate the WTP for curbside recycling. Both techniques demonstrated that public funding for waste recycling is very sensitive to changes in pricing structures. According to the findings of research conducted among Macao residents, values generated from the choice experiment (CE) and the CVM valuation methodologies revealed statistically significant variations for various waste management plans (Jin, Wang and Ran, 2006). The CE technique was subsequently used to evaluate the value of curbside recycling services in London and Korea's residential waste disposal system (Karousakis and Birol, 2008). Korea's population has shown a strong desire for clean facilities and the accumulation of small objects. Studies using the CE technique, on the other hand, seldom concentrate on municipal solid waste disposal techniques and combined waste management strategies when assessing the preferences of the respondents, even though waste management systems in many countries have been investigated (Ku, Yoo, and Kwak,

2009; Woon and Lo, 2016). Choice of Experiment (CE) is a use of the theory of value (Lancaster, 1966) in conjunction with random utility theory (Thurstone, 1927; Manski, 1977). This technique is promising for quantifying various external economic benefits and is often used to value non-market products. Natural economists have used the CE technique to assess consumers' preferences for resources that come from the environment and to assess the value of non-market products and services in number research in the area of environmental economics (Carlsson, Frykblom and Liljenstolpe, 2003; Ku, Yoo and Kwak, 2009; Susaeta *et al.*, 2011). Even though the CE technique does not directly get respondents' WTP, it enhances the quantity of information received, resulting in a smaller sample size and lower survey expenses. With the rising creation of waste throughout the globe, better waste management procedures should be re-evaluated to ensure that they comply with demanding regional and international norms before being disposed of in a landfill.

WTP is another important concept in environmental economics, especially for public goods such as waste management services. WTP represents the utility people assign to a better quality environment and public services, and knowledge of factors influencing WTP is crucial for policy making.

Some research has been conducted in developing countries on WTP for waste management. For instance, Jin et al. (2006) studied Yunnan, China, and established that income, education, and environmental consciousness were the key predictors of WTP. This study also pointed out that higher income groups would be willing to pay for the enhanced waste management services since they could afford them. In the same way, Ogunseitan (2005) also conducted a study in Nigeria where the households were willing to pay for the waste management services if they were to gain direct health and environmental benefits. However, WTP can be highly sensitive to local circumstances. These include cultural endowment, environmental consciousness, and perceived credibility of public institutions in managing public goods such as waste disposal. It is important

to understand these factors in the case of Bangladesh, where socio-economic inequalities are rather significant and public services are frequently underprovided.

2.3 Determining factors and challenges of waste management in developing countries

The effectiveness of waste management systems may be influenced by the level of public participation and their willingness to financially contribute to improved services. To successfully implement sustainable waste management strategies, policymakers need to comprehensively comprehend the factors that impact individuals' WTP within the economic and social circumstances of certain areas (Rahman and Akter, 2022). Identifying the variables that impact waste management is of utmost importance. This entails considering the individuals' socioeconomic conditions (Islam and Shams, 2021). The analysis of socioeconomic variables reveals that income and education are the main factors determining the WTP for enhanced waste management services in developing countries. Prior research has also demonstrated the importance of household income as the predominant determinant of WTP. Higher-income households are more inclined to be more willing to pay for enhanced waste management services, since they possess the financial resources to fund these services. This phenomenon is observed in other countries, such as Bangladesh, Nigeria, and Ethiopia (Ahmed et al., 2021; Aye & Widjaja, 2022; Teklehaimanot & Solheim, 2023). Education is a supplementary factor that impacts individuals' consciousness of environmental concerns and their inclination to allocate resources towards enhancing waste management systems. Individuals with higher levels of education often possess a more comprehensive comprehension of environmental subjects and are more likely to provide financial assistance for improving waste management systems. In Bangladesh, knowledge about the negative effects on the environment and health caused by improper garbage disposal has a substantial impact on the willingness of educated citizens to pay, as stated by Rahman and Akter (2022). A study done in Nigeria and Kenya found a similar result, indicating that higher levels of education were linked to a higher degree of environmental awareness and a larger readiness to pay

for enhanced waste management services (Okot-Okumu & Nyenje, 2019). Environmental concern and perception are other significant factors impacting the WTP for enhanced waste management services. The findings further demonstrate that persons with a higher level of knowledge regarding the detrimental effects of environmental mismanagement and those with a favorable disposition towards the environment exhibit a greater inclination to financially support improved services. A recent study done in metropolitan regions of Bangladesh has demonstrated that a heightened knowledge of environmental concerns and climate change correlates with an increased inclination to financially support trash management services (Islam and Shams, 2021). Similarly, in Ethiopia, those with a more comprehensive comprehension of the ecological ramifications of inadequate garbage disposal are inclined to financially support improved waste management services (Mengistie, 2020). The research conducted in Ghana and Tanzania demonstrates that individuals' environmental attitudes strongly influence their WTP. Specifically, individuals with a positive inclination towards waste minimization and recycling are more willing to pay a higher price for improved services (Oduro-Appiah et al., 2018; Kaseva and Mbuligwe, 2019). The quality and effectiveness of the current waste management services are additional elements that impact the WTP in developing nations. Individuals who perceive the existing waste management services as inadequate are prepared to pay a higher price for superior ones. In a research conducted in Dhaka, Bangladesh, participants expressed their displeasure with the infrequency of rubbish collection and the lack of cleanliness in public areas, which strongly influenced their WTP more for enhanced services (Haque and Hossain, 2021). Research conducted in Kenya and Nigeria has found that inadequate waste management services, such as irregular waste collection and a lack of proper waste management facilities, lead residents to be willing to contribute financially to improve these services, despite the additional costs involved (Mugisha and Nyangena, 2020; Adewuyi and Olorunfemi, 2021). The presence of services such as scheduled garbage collection and the availability of an adequate number of waste receptacles also influence the WTP. Residents are

eager to financially support improved services if they are certain their efforts will lead to positive outcomes (Anjum et al., 2019). The perception of local government and waste management institutions is an additional element that affects the WTP for enhanced waste management services. The degree of confidence in government institutions plays a crucial role in the capacity of the public to finance public services like waste management in several developing nations. In a study conducted by Ahmed and Rahman (2020), it was shown that individuals in Bangladesh who trust the local government and believe that their funds would be utilized effectively are more inclined to pay for enhanced trash management services. This is corroborated by research conducted in Nigeria and India, which found that the WTP for waste management services rises in tandem with the degree of confidence in local government authority (Onibokun and Kumuyi, 2021; Singh and Gupta, 2020). Conversely, in situations where individuals lack confidence in their government, they will be reluctant to make payments due to concerns about potential misappropriation of funds or doubts about the effectiveness of proposed reforms. Waste management services in developing nations are influenced by policies, culture, and societal attitudes, which affect the WTP. Societal factors, such as neighbours and leaders, can influence an individual's choice to invest in enhanced services. In certain cultural contexts, individuals are actively encouraged to reside in communal settings and provide mutual assistance, increasing the WTP for services that benefit the entire community. Therefore, Bangladesh stands out as a unique case among developing countries, where the WTP for enhanced waste management is closely linked to the specific socioeconomic and environmental conditions. Regarding the WTP, income and education level are significant indicators across different nations. However, the population density and urbanization rate in places like Dhaka provide a crucial challenge for waste management (Islam and Shams, 2021). Unlike several African nations that favor community-based methods, Bangladesh relies on municipal services, necessitating a strong institutional trust to handle garbage management. Similarly to Ethiopia and Nigeria, the WTP in Bangladesh is influenced by the amount of trust in the local

authorities. Doubts regarding the government's effectiveness might diminish public participation in Bangladesh (Ahmed and Rahman, 2020). Moreover, the research suggests that in Bangladesh, those with a greater understanding of environmental issues and climate change are more inclined to contribute financially towards improving trash management (Rahman and Akter, 2022). This aligns with research conducted in other developing nations; however, due to the unique characteristics of Bangladesh's urban environment and infrastructure, more targeted policy responses are necessary. The WTP for enhanced waste management services in developing countries is influenced by several aspects, such as socioeconomic position, environmental awareness, service quality, institutional trust, and cultural norms (Ahmed and Rahman, 2020). Income, education, and environmental views are crucial determinants that impact WTP in many contexts. Additionally, the quality of current services and the confidence level in local authorities exert a substantial influence (Islam and Shams, 2021). Due to its rapid urbanization and high population density, Bangladesh has unique challenges, making WTP a crucial component of its waste management system. On the other hand, the experiences of developed nations demonstrate that implementing legislative frameworks and financial mechanisms can enhance WTP and lead to more effective waste management. Understanding these characteristics is essential for decision-makers and urban planners to formulate effective waste management strategies that align with developing and developed countries' economic and social conditions (Rahman and Akter, 2022).

The waste policy was based on evaluations of the current waste management rules. It is a good practice to address climate change issues. Several studies revealed that policy greatly influences the responsibilities and roles of executive authorities in the Bangladesh government. The authorities are directly or indirectly involved with waste management in terms of their institutional capacity and the amount of work they do. This study looked into several relevant acts and regulations. These are the National 3R Strategy (2010) and Renewable Energy Policy (2008). None of these acts, regulations, or policies sets specific goals for eliminating waste. These laws, rules,

and policies didn't link the effects of climate change to how waste was handled. The private and public sectors need national policies that make it easier for businesses to help manage the environment (Behera, Meher, and Park, 2015). Bangladesh has different national laws and policies about how to deal with waste.

Some of these laws include the Factory Act of 1965, the Environmental Control Ordinance of 1977, the Environmental Control Ordinance of 2002, and the Dhaka Municipal Ordinance of 1983. Only in factories and mills is the Factory Act of 1965 linked to risk to worker health. The Environmental Pollution Control Ordinance of 1977 focused on stopping environmental problems caused by releasing liquids, gases, solids, radioactive materials, and other substances. The Dhaka Municipal Ordinance of 1983 gives the Dhaka City Corporation (DCC) the right to remove, collect, and get rid of waste, set up brick kilns, clean the streets, and do other things. The ordinance doesn't have a specific clause or section about how DCC or private businesses should store, handle, collect, transport, or eliminate industrial, clinical, or hazardous waste. The Environmental Policy of 1992 says that waste can't be moved during the day in an open truck and that agricultural, industrial, or municipal waste can't be dumped in any body of water. The Environment and Forest Ministry made the National Environmental Management Action Plan (NEMAP), which was discussed with many communities and stakeholders for 10 years (1995–2005). However, it has no particular goals for source reduction or waste recovery. The Urban Management Policy Statement of 1998, which the Bangladesh Government wrote, told the cities to privatize services and facilities for people living in slums, concentrating on how to get rid of solid waste. However, it mentioned what options for waste management should be used. National Agricultural Policy (1999) has put a lot of attention on sustainable agriculture practices, like using more Integrated Pest Management (IPM) and fewer chemical fertilizers, and growing different kinds of food to be self-sufficient and have food security.

To achieve efficient waste management in these areas, it is necessary to develop customized strategies that consider the specific geographical conditions and difficulties present. Effective waste management systems rely on the existence and implementation of comprehensive waste management legislation. Implementing sustainable waste management methods is hindered in many developing nations due to poor legislative frameworks and inadequate enforcement mechanisms. Enhancing legal frameworks and maintaining rigorous enforcement can greatly enhance waste management results. An example is the enforcement of the Solid Waste Management Rules (2016) in India, which has made it mandatory to separate waste at its origin and promote recycling. As a result, waste management practices in urban areas have improved (Ray et al., 2023). Successful waste management relies on robust institutional backing and coordination among government entities. Insufficient organizational capability and a lack of coordination frequently lead to fragmented and ineffective waste management systems. Waste management requires enhancing institutional capacity and promoting collaboration among government agencies, commercial sector entities, and community organizations. Government initiatives in Ethiopia have demonstrated potential in tackling waste management concerns through efforts to enhance institutional frameworks and foster public-private partnerships (Mulat et al., 2019). Taxes, subsidies, and incentives are important tools in influencing waste management practices. We may effectively promote positive transformations in waste management by providing incentives for trash reduction, recycling, and adopting eco-friendly materials. Implementing economic incentives for recycling enterprises and community-based trash management efforts in Nigeria has fostered the adoption of sustainable practices, resulting in enhanced waste management results (Shehu Usman Adam et al., 2015). Effective waste management relies heavily on the presence and utilization of contemporary infrastructure and technology. Underdeveloped countries frequently have obstacles associated with obsolete or inadequate waste management infrastructure, which hampers their capacity to effectively handle

trash. Waste management capacities can be significantly improved by allocating resources towards implementing contemporary trash collection, recycling, and disposal technologies. Implementing innovative waste processing facilities and recycling plants in metropolitan regions of Bangladesh has greatly enhanced waste management efficiency and environmental results (Afroz et al., 2009). Sustained innovation and research in waste management technology and methods are crucial for effectively tackling the ever-changing waste management challenges. Promoting research and development in waste management can result in the identification of groundbreaking solutions that improve effectiveness, lower expenses, and mitigate environmental harm. Research efforts in India have prioritized the development of sustainable waste management technology, leading to progress in trash treatment and recycling methods. This highlights the significance of innovation in waste management, as demonstrated by several projects (Ray et al., 2023). Cultural attitudes and habits substantially impact waste management behaviors and practices. Traditional traditions and cultural norms in many developing nations influence how waste is disposed of and how communities participate in waste management programs. By engaging in the community and providing knowledge, we can overcome cultural obstacles and encourage people to modify their behavior, improving waste management results. Community-based programs in Ethiopia that uphold and incorporate local cultural norms have effectively encouraged sustainable waste management habits (Mulat et al., 2019). The active participation and control of communities in waste management efforts are essential for their effectiveness. Initiatives that actively include communities and cultivate a sense of ownership and responsibility tend to yield superior results. Community-driven trash management projects in Nigeria exemplify the significance of local participation in sustainable waste management practices (Shehu Usman Adam et al., 2015). Overall, the factors influencing waste management in developing countries are complex and varied, including socio-economic, environmental, policy-related, technological, and social aspects. Developing sustainable and successful waste management systems requires addressing these determinants

through comprehensive and context-specific solutions. To improve waste management in developing nations, it is crucial to increase public awareness, enhance regulatory frameworks, invest in contemporary infrastructure and technology, and promote community involvement. Policymakers and stakeholders can build specific interventions to improve environmental sustainability, public health, and urban development by comprehending and addressing these factors (Afroz et al., 2009; Shehu Usman Adam et al., 2015; Ray et al., 2023).

Bangladesh is one of the most populous and fast-growing urbanization countries in Southeast Asia, where the proper management of waste has become a significant problem. The lack of an efficient waste management system has been an acute challenge over the years due to the country's steady urbanization and population increase, leading to environmental and public health crises. This essay will further elaborate on different factors and problems that hinder the improvement in waste management in Bangladesh, such as a lack of infrastructure, financial issues, people's awareness, and the informal sector. Among the issues that have been highlighted, one of the most important ones is the poor development of waste collection and transportation networks. Various cities, such as Dhaka, produce a lot of waste daily. However, the disposal mechanisms prove to be archaic and ineffective. The waste collection in many municipalities is poor, and only a small proportion of waste is collected, with most of the waste littering the streets and other public areas. This is partially because there is poor funding for modern technologies in waste management and disposal trucks that can effectively deal with the increasing amounts of waste (World Bank, 2018).

Besides, the disposal facilities are mainly open dumpsites, which are managed and lack the required precautionary measures against polluting the environment. They are mostly responsible for major environmental vices such as polluting the soil and water sources. For instance, leachate from these dumpsites pollutes the groundwater and the drinking water sources, leading to serious health consequences to the people in the surrounding communities, as observed by Hossain (2020). Lack of proper procedures, like leachate treatment and gas collection systems, to control pollution

from landfills contributes to these issues and results in greenhouse gas emissions and other detrimental environmental effects. Another major hurdle in managing waste properly is, again, the issue of a lack of funds in Bangladesh. Local authorities and rural councils are frequently financially constrained organizations that can provide the necessary funding to enhance the growth and development of infrastructure and services. Organic waste disposal, infrastructural waste disposal, and sophisticated waste disposal facilities like sanitary landfills, recycling plants, or waste-to-energy plants are still expensive for many local governments (Khan & Ahsan, 2019).

In addition, there is sufficient funding and financial resources for managing waste in Namibia. As we know, the world donor community and the private sector only partially join the solution, but do not fully address the issue. The downside of such approaches is that they make the projects depend on external funding, which can prove to be unmanageable in the future should the priorities of the funding agencies change, or the economic status of the project's funding source go down (Rahman, 2021). Thus, to establish a long-term effective waste management model, it is necessary to focus on forming domestic financing sources and introducing economic stimuli that would promote investment in managing the waste cycle. However, one of the biggest challenges to implementing proper waste management in Bangladesh is the lack of public knowledge and education on good waste disposal. Most people are ignorant of the principles of waste source segregation and the consequences of environmental and health deterioration due to improper waste dumping. Lack of awareness on how to dispose of waste appropriately results in littering around the environment and dumping of hazardous wastes in the normal waste streams, thus making waste management hard and exposing the environment to contamination (Hossain, 2020). This approach has been half-baked and haphazard at best and is not likely to significantly impact the community's awareness. HIV/AIDS, sexually transmitted diseases, and other health-related awareness creation and community mobilization programs are usually restricted to certain targeted groups and are usually conducted for a limited period, and therefore do not sensitize the entire population and

bring about behavioral change. For waste management to be promoted, several measures need to be adopted, such as incorporating waste management education in schools and launching long-term public sensitization initiatives (Ahmed et al., 2020). These regulatory and bureaucratic issues further hamper waste management in Bangladesh. However, a weak and fragmented legal regime regulates the management of waste in the country. This means that corruption within the municipal administrations can result in malinvestment in waste management policy, thereby hampering the effective implementation of policies on waste management. Moreover, duplication of responsibilities creates confusion between several ministries and departments, and thus coordination breakdown, and no one is held responsible (Rahman, 2021).

To these challenges, very practical measures call for the rationalization of regulations and enhanced coherence of agencies operating in the sphere. Policies are oftentimes written down but not implemented properly, and therefore, having proper enforcement measures of the set waste management practices can prove useful in ensuring that policies are implemented as set out. Moreover, improvements in transparency and combating corruption of the municipal administrations can contribute positively to the efficient utilisation of resources and enhanced service provision. The largest percentage of waste collectors in Bangladesh are part of the informal sector, which is characterized by unlicensed waste pickers. These workers, who sometimes work in very dangerous environments without any safety equipment, collect, sort, and sell materials that can be recycled from the waste. In a way, the informal sector positively impacts waste management and recycling efforts. Yet, they are frequently overlooked and excluded from government assistance and proper waste management systems (Kabir et al., 2020). There are many advantages involved with incorporating the informal waste sector into the overall waste management framework. By offering these workers training, protective gear, and wages, employers should be able to work more effectively and enhance the quality of their work. Furthermore, the official designation of such a position may help improve the waste sorting at the source, the efficiency of

recycling, and the overall utilization of inputs unsuitable for landfilling (Khan & Ahsan, 2019). Bangladesh's waste management practice has many adverse effects on the environment and health. The little control over waste disposal and the tendency to open dumpsites cause environmental pollution through air, water, and soil pollution. Incineration of wastes because of limited choice of disposal methods discharges hazardous gases into the environment, which has increased air pollution and diseases such as respiratory illnesses among the people (World Bank, 2018). Another problem is water pollution; garbage is discharged into rivers and other water reservoirs, affecting the availability of clean water for consumption and water systems for aquatic wildlife. The waste stream has various detrimental impacts on the health of the workers handling the waste and other members of the community, such as medical and industrial wastes that may contain hazardous materials. The health risks posed by chemical agents and environmental pollution exposure require adherence to appropriate waste disposal, handling, and treatment processes (Hossain, 2020). To overcome the difficulties in improving waste management practice in Bangladesh, it is essential to focus on developing infrastructure, monetary investment, raising awareness among citizens, revising policies, and organizing the informal waste sector. Therefore, the greatest challenge hindering adequate solid waste management services in Bangladesh is the issue of inadequate funds. However, it seems that the only viable option is to charge fees from the public to enhance the service quality. Most of this study was conducted in major cities of Bangladesh, where resources and waste management services are limited. Since the municipality and city corporations have only one or two tractors to collect rubbish for the whole municipality, the waste collection service is available only to the residents near the main road within the municipality. For a city with such a large population, this is not adequate. Until now, this service has been free of charge; therefore, the most effective way to improve the existing service is to introduce charges for waste collection. This would enable the coverage area of waste collection and services to be extended to as many households as possible. As for the second question, whether families are willing to pay

for such a service is still open because it depends on many factors, including the family's financial situation and the extent to which they appreciate the importance and role of such a service. The CV approach can be used to estimate the WTP for particular commodities or services, especially when the goods exchanged are not traded in the market. Since the WTP applies to both marketable and non-marketable goods and services, such as the cost of travel, reduction in the probability of mortality, enhancement of air quality, sanitation, water supply, and other environmental services, the CV method is a widely used and accepted methodology. This means that it is impossible to deduce WTP from the conditions that are currently available, since such conditions are not available on the site that is being targeted. It is a direct assessment technique that measures the expected amount of the project in monetary terms by directly asking those who will benefit from the services under hypothetical circumstances through a questionnaire survey, assuming that it will be implemented soon. In such a case, a "stated preference" technique like CV and a "stated preference" technique like CV is used. This approach is a form of direct assessment. Therefore, this study aims to estimate the WTP for improved SWM services of garbage collection and the factors affecting it. The outcome of this study will be useful to the local government and other stakeholders concerned in understanding the relevant characteristics of homes and coming up with the right price for garbage collection service. This will, in the long run, help in enhancing the situation of solid waste management in general. Moreover, this study can act as a directing instrument for conducting WTP investigations in other municipalities of Bangladesh and poor nations where there is no price set for garbage collection.

The problem of waste disposal is acute in developing countries, where the urbanization and population growth rate are high, but the infrastructure cannot cope with the challenges (Alam & Ahmade, 2018; Ahsan et al., 2014). Most of the time, waste disposal is done haphazardly, without proper guidelines and with little or no efficiency, and this has caused a lot of harm to the environment and public health (Rahman et al., 2020; Satterthwaite, 2013). Waste management is

a major problem in Bangladesh because of high population density and fast urbanization. Alam and Ahmade (2018) have stated that the urban areas of Bangladesh produce a massive amount of waste daily, most of which is not properly disposed of. Problems include inadequate funding, weak infrastructure, and the absence of sound municipal waste management policies. These lead to open dumping, waste burning, and waste disposal in water bodies, leading to pollution, floods, and health effects (Rahman et al., 2020).

The problem of poor waste management in Bangladesh is further worsened by low public awareness and participation. The informal sector is usually involved in waste collection and recycling, but it is characteristically unstructured and therefore not very efficient and health-compromising for the workers (Ahsan et al., 2014). Such challenges call for determining the factors that may motivate the population to pay for and support improved waste management services.

2.4 Relationship Between WTP and Contingent Valuation Method (CVM)

CV Methods are a practical way of obtaining data on preferences for delivering public goods and services in developing countries (Whittington, 2004). This is so even though several validity and measurement concerns have been noted in the literature (Carson & Czajkowski, 2014). Some of the recent studies that have been conducted on CV in developing countries include Niringiye (2010) in Uganda, Pek and Othman (2010) in Malaysia, and Afroz et al. (2009) in Bangladesh. All these studies were carried out in the backdrop of developing countries. Many of these studies provide empirical support for the notion that families are willing to pay significantly for efficient trash disposal. When using the CV technique, it is important to develop the survey properly, choose the survey mode, and select a random sample (Whittington, 2002). According to D. A. Hoyos and P. Mariel (2010), the Contingent valuation technique (CVM) is defined as the economic valuation of natural resources that utilizes stated preference information. CVM is one of the strategies most often applied to achieving environmental resource value. Bogale and Urgessa (2012) and Kasaye

(2015) have stated that the compound valuation model (CVM) is one of the stated preference valuation techniques. It is derived from the actual monetary amount people are willing to pay (WTP) or accept (WTA) in return for any shift in environmental quantities, qualities, or both. As Albertini and Cooper (2000) pointed out, CVM is a method that elicits WTP for nonuse values without having to infer them from observed behaviors in conventional markets. It is possible to value a wider variety of nonmarket commodities and services using the CV approach than using any indirect procedures. This is because the CV technique is very flexible in its approach and can be adapted to suit any need. Khalid (2008) notes that in CV studies, values are usually obtained using WTP which is the amount of money people are willing to spend to prevent harm to natural resources or restore damaged natural resources. Researchers have developed various techniques for asking evaluative questions to get more truthful answers from the respondents. Some of these approaches include Open-ended questions, Bidding games, Payment cards, and Dichotomous option format (Chien et al., 2005). Dichotomous choice CV format (single bounded, double bounded, and one and one-half bounded) has been widely adopted in the past few years because of the stated advantages of avoiding many of the biases inherent in other formats used in the CVM. This is because the dichotomous choice CV format is available in three different bounds: single, double, and one and a half. The National Oceanic and Atmospheric Administration (NOAA) panel protocol on CVM research has suggested the dichotomous choice format, which is a binary question posed at a specific price (Jantzen, 2006; Rahji and Oloruntoba, 2009). This format is characterized by presenting two options of what might happen. In their study, Jones et al. (2010) found that the double-bounded CV format is more efficient than the single-bounded CV format in terms of statistical properties. This is believed to be one of the strengths of the dichotomous choice forms. The second price in a double-bounded CV depends on the subject's reaction to the first price based on the answer given by the subject. The subject's first response is 'no', which means that the second price is some amount less than the first price; however, if the subject answers 'yes' to

the first price, then the second price is some amount more than the first price (Ezebilo, 2013). On the other hand, there has been some controversy over double-bounded CVM because evidence shows that responses to the first price can sometimes be inconsistent with the responses to the second price, which in turn leads to a lower price (Mulat et al., 2019). For this reason, a half-bounded convolutional neural network (CVM) was employed to reduce the likelihood of response biases due to the follow-up bid in a double-bounded CV format (Cooper et al., 2002). Oerlemans et al. (2016) pointed out that the one-half bounded CVM is used to identify the bounded and unbounded WTP of the respondents, but it does not quantify the WTP of the respondents. When used in conjunction with an open-ended question, a one-and-a-half-page bounded CV format provides more information than a CV format used for only one and a half pages. In line with the explanation given by Marta-Pedroso et al. (2012), the follow-up open-ended question is used to identify the unbound WTP of the respondents. Based on the above-stated rationale, this research employed a one-half bounded CVM that was succeeded by an open-ended question in a bid to establish the maximum WTP of the families.

2.5 Systematic Review

This section presents the methods adopted in executing the systematic review of the research articles for WPt for waste management services in the urban areas of Bangladesh with special reference to CVM. This was followed by a step-by-step approach to ensure that only the appropriate literature that examines WTP via CVM and other related approaches was included.

The research aimed to investigate factors influencing WTP for waste management services in urban Bangladesh, specifically focusing on: (1) To what extent do consumers value the enhanced waste management utility and general Waste MSD Services? Hence, what are the factors influencing WTP in Improved waste management services when valued through the Contingent Valuation Method (CVM)? (3) What patterns of WTP can be identified for the selected socio-economic status groups in urban Bangladesh, and how can CVM be used to estimate WTP?

Only articles, conference papers, or reports that met specific keywords and have been published in the last 10 years were included in the study. The specific search strategy was used to include only studies that used the Contingent Valuation Method (CVM), which is considered to estimate WTP for public goods like waste management services. The following primary search terms were used: "Willingness to Pay" OR "WTP" AND "Contingent Valuation Method" OR "CVM" AND "waste management" AND "urban areas" OR "cities" AND "Bangladesh" Other related terms, namely “environmental valuation”, “urban waste” and “solid waste management” were also used for the search. To ensure the relevance of the selected studies, specific inclusion and exclusion criteria were developed, focusing on studies applying CVM: Research works that employ CVM to estimate individuals’ WTP for waste management services. Research was conducted in the urban setting of Bangladesh or other countries with similar developing statuses. Literature review of previous research work and empirical papers constituting both qualitative and quantitative research on WTP. Original research is available in English and written as full-text articles.

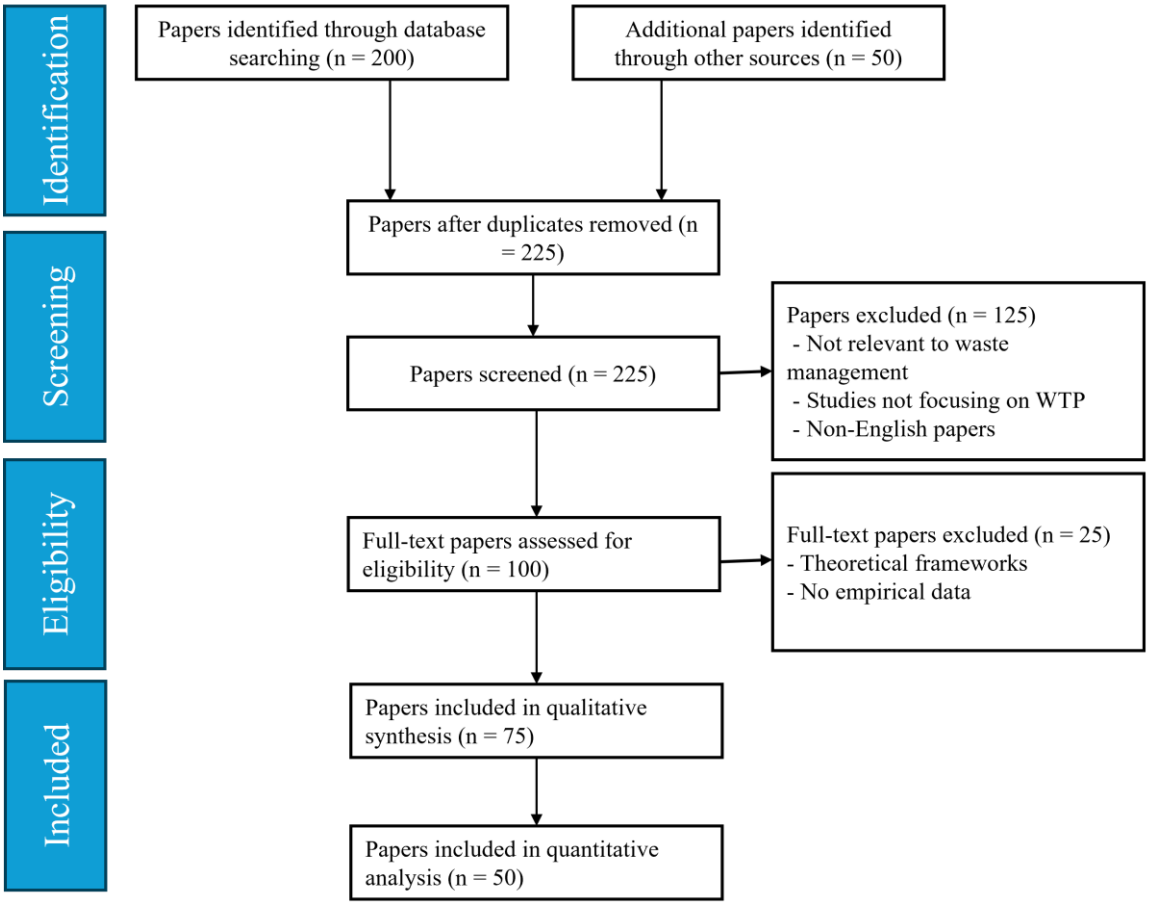
Research that investigated general, rural, or any form of waste management other than in the urban context. Articles that did not use CVM or some other valuation techniques. Replication of articles or papers containing no new experimental data. These shall include opinion articles/ editorials, theoretical papers inter alia, and papers that do not contain empirical studies. The search of Google Scholar was conducted by entering the keywords, and then the titles and abstracts of the relevant articles were scanned by hand. This step, therefore, ensured that only articles related to WTP and those that adopted CVM were included. Studies that were not set within an urban framework or that did not consider waste management were not considered.

The flow chart illustrates the systematic process followed to identify, screen, and select the 75 articles for the literature review on WTP for improved waste management services. The process began with the identification phase, where 200 papers were identified through database searching, and an additional 50 papers were found through other sources, making a total of 250 potential

papers. After removing duplicates, 225 papers remained for further consideration. Factors influencing households' WTP for enhanced waste management services. These 225 papers were reviewed in the screening phase for relevance to waste management and WTP. During this phase, 125 papers were excluded for reasons such as not being relevant to the topic, not focusing on WTP, or being non-English papers.

Following screening, the eligibility phase involved a detailed assessment of the remaining 100 full-text papers to determine their suitability for inclusion in the review. At this stage, 25 papers were excluded because they only provided theoretical frameworks or lacked the empirical data necessary for the review.

Figure 4: Flow Chart for Systematic Review Process



Source: author's own editing

Finally, in the included phase, 75 papers were selected for qualitative synthesis, providing a comprehensive understanding of the determinants and implications of WTP for improved waste management services. Additionally, 50 papers were deemed suitable for quantitative analysis, allowing for detailed statistical evaluation and comparison.

This structured approach ensures that the review is based on relevant, high-quality studies, providing robust insights into the next table, which was produced with the help of a perfect systematic process, its structure, and coordination. First, all sourced articles that were in some ways related to the WTP for improved SWM services were compiled. First of all, the articles not related to this study were excluded according to the titles and abstracts of the articles found in the initial search. Then, the assessment aimed to gather all-around data of the acquired articles, but for this, a full text review was done. We also extracted elements from the articles such as author(s) and the year of the article, geographical location, the method of conducting the study, sample size, factors affecting WTP, and the mean WTP in cases where it is present in the article. All of this extracted information was recorded neatly on an ethnographically generated table. Subsequently, the data was sorted to identify basic tendencies of the relationships between the key determinants in different studies, and the data was grouped where necessary with the help of similar studies. The data rows were merged with similar main drivers of countries.

Last of all, we aggregated all the analysis outcomes to generalize the conclusions and presented policy implications and recommendations based on the integrated data. Therefore, the table included all the essential measures and criteria and facilitated the presentation of a clear and comprehensive understanding of the general conclusions of the studies of WTP for improved SWM services and their comparison. The consolidated table contains information from 75 different studies and aims at households' WTP , which indicates their desire to improve the SWM services. They were clear about the authors, the study site or area, the study methods, the sample size and characteristics, the determinants of WTP, and the amounts of WTP recorded. This table

distinguishes works with similar outcomes and notes and groups them according to the income, education, awareness, sex, and number of persons in the household. That is, it establishes that income and education levels, awareness of the product, and proximity to waste dumps have a positive and significant impact on WTP. The following table provides useful information for policymakers to enhance the awareness & packaging, ICP, and community participation for utilising the optimum contribution of households in waste management and mainstreaming gender for enhancing the sustainability of waste management towards the sustainable development throughout the world.

Table 5: Findings from Systematic Review

Author(s) and Year	Location	Methodology	Sample Size	Key Determinants	Average WTP
Ray, Ryngnga, and Chetia (2023); Altaf and Deshazo (1996); Afroz, Hanaki, and Hasegawa-Kurisu (2009)	Cooch Behar, India; Gujranwala, Pakistan; Dhaka, Bangladesh	CVM	304, 500, 500 households	Income, Education, Awareness	Not specified
Mulat, Worku, and Minyihun (2019); Endalew & Tassie (2018); Tassie & Endalew (2020)	Injibara, Ethiopia; Bahir Dar, Ethiopia	CVM, Tobit Model; CVM; CVM, One and One Half Bounded CVM	903, 600, 400 households	Income, Education, Gender, Age, Satisfaction, Distance to Dump Site, Awareness	20-30 ETB/month ($0.74-$1.10)
Khattak and Amin (2013); Whittington (1998)	Peshawar, Pakistan; Various developing countries	CVM	600 households; Various	Income, Education, Awareness	150 PKR/month ($0.90); Not specified
Awunyo-Vitor, Ishak, and SeiduJasaw (2013); Padi et al. (2015)	Kumasi, Ghana; Sekondi Takoradi, Ghana	CVM	700, 350 households	Income, Education, Awareness, Distance to Dump Site, Satisfaction with Existing Service	5-10 GHS/month ($0.86-$1.72)

Ezebilo (2013); Banga, Lokina, and Mkenda (2011); Niringiye (2010)	Port Moresby, Papua New Guinea; Kampala, Uganda	CVM	400, 800, 600 households	Income, Education, Awareness	20 PGK/month ($6.00); 500 UGX/month ($0.14)
Nkansah, Dafor, and Essel-Gaisey (2015); Ogawa (1989); Boyle, Desvousges, and Johnson (1994)	Tema, Ghana; Asian metropolises; USA	CVM	700 households; Various	Income, Education, Awareness	10 GHS/month ($1.72); Not specified
Seth, Ansari, and Datta (2009); Venkatachalam (2004)	Rajasthan, India; India	CVM	700 households; Various	Income, Education, Awareness	200 INR/month ($2.40); Not specified
Xiong, Kong, Zhang, Lei, and Sun (2018); Alberini and Chiabai (2007); Franzen and Vogl (2013)	Ganjiang River Basin, China; Italy; Switzerland	CVM	600, 800, 700 households	Income, Education, Awareness, Health Risk Perception, Acquiescence Bias	Not specified
Kassahun Tassie, Anteneh Mulugeta, Yenesew Sewunet & Getenet Asifaw (2024); Shehu Usman Adam, Mad Nasir Shamsudin, Shaufique F. Sidique, Khalid Abdul Rahim & Alias Radam (2015)	Gondar, Ethiopia; Lagos, Nigeria	Double-Bounded CVM; CVM	700, 1000 households	Income, Education, Awareness, Family Size, Privatization Impact	30 ETB/month ($1.10); 700 NGN/month ($1.94)
Arimah (1996); Braga and Starmer (2005); Carlsson and Johansson-Stenman (2000)	Ibadan, Nigeria; UK; Sweden	CVM	1000, 500, 400 households	Income, Education, Awareness, Risk Perception	Not specified
Carson and Groves (2007); Carson, Flores,	USA	CVM	Various	Income, Education, Awareness,	Not specified

and Meade (2001); Cummings, Harrison, and Rutström (1995)				Environmental Awareness	
Dupont (2004); Hanemann (1991); Hanemann and Kanninen (1999); Hausman (2012)	Ireland; USA	CVM	Various	Income, Education, Awareness, Environmental Awareness	Not specified
Hoehn and Randall (1987); Kahneman and Knetsch (1992); Kanninen (1995); Loomis and González-Cabán (1998); Loomis, Kent, Strange, Fausch, and Covich (2000)	USA	CVM	Various	Income, Education, Awareness, Environmental Awareness	Not specified
McConnell (1997); Mitchell and Carson (1989); Nunes and Schokkaert (2003); Portney (1994)	USA; Belgium	CVM	Various	Income, Education, Awareness, Environmental Awareness	Not specified
Ready and Navrud (2006); Rollins and Lyke (1998); Schläpfer and Fischhoff (2012); Schläpfer and Hanley (2003)	Norway; USA; Switzerland	CVM	Various	Income, Education, Awareness, Environmental Awareness	Not specified
Schultz, Lisle, and Kihm (2007); Spash (2000); Stevens, DeCoteau, and Willis (1997); Stevens, More,	USA; Australia	CVM	Various	Income, Education, Awareness, Environmental Awareness	Not specified

and Glass (1994)					
Sutherland and Walsh (1985); Whitehead (2006); Whittington, Smith, Okorafor, Okore, Liu, and McPhail (1992)	USA; Nigeria	CVM	Various	Income, Education, Awareness, Environmental Awareness	Not specified
Whitehead and Blomquist (2006); Wiser (2007); Andereck, Valentine, Knopf, and Vogt (2005); Blomquist, Newsome, and Stone (2003)	USA	CVM	Various	Income, Education, Awareness, Environmental Awareness	Not specified
Bowker, English, and Donovan (1996); Brouwer, Langford, Bateman, and Turner (1999); Choe, Whittington, and Lauria (1996)	USA; UK; Philippines	CVM	Various	Income, Education, Awareness, Environmental Awareness	Not specified
Hanley, Wright, and Alvarez-Farizo (2006); Loomis and Ekstrand (1998); Moran (1994); Munro and Hanley (1999)	UK; USA; Ireland	CVM	Various	Income, Education, Awareness, Environmental Awareness	Not specified
Ready, Navrud, and Dubourg (2001); Richardson and Loomis (2009); Roe, Boyle, and Teisl (1996);	Norway; USA; Spain; Switzerland; Australia	CVM	Various	Income, Education, Awareness, Environmental Awareness	Not specified

Saz-Salazar and García-Menéndez (2001); Schläpfer, Roschewitz, and Hanley (2005); Silva, Nayga, Campbell, and Park (2007)					

Source: author(s) creation, 2024.

Waste management is a significant sub-sector of integrated environmental management, particularly in fast-growing developing Cities. Sustainable asset management is necessary for providing appropriate living standards, environmental sanitation, and quality of life in urbanized regions. The nature of these prices is known as WTP , which is crucial for formulating long-term and financially sustainable enhanced waste management systems. This study pulls together the literature and presents an original analysis of its material to establish the findings that inform determinants of WTP and their relevance to policy and practice. SN and SWM are positively influenced by income, showing that people are willing and able to spend money to receive better services. To begin with, high-income consumers have adequate resources and a higher level of waste production, hence their WTP for better designs in the waste management industry. The findings of the studies done in Ethiopia, Nepal, and Uganda reveal that the income of the samples positively impacts the WTP level. For instance, in Injibara-Ethiopia and Bharatpur-Nepal, the increasing income category showed a higher WTP for improved waste management services (Mulat, Worku, & Minyihun, 2019; Rai et al., 2019). Another important determinant of WTP is the educational level of the respondents. The educated individuals who are employed in households are more sensitive to the environmental and health consequences of improper waste disposal and are, hence, willing to pay for better services. Theoretical and empirical pieces of evidence from different countries, including India, Ghana, and Bangladesh, reveal that education

strongly influences WTP. A cross-sectional investigation of households' WTP for SWM services was conducted in Dhaka Bangladesh, and Cooch Behar, India where higher education was found a significant predictor of WTP for SWM services (Afroz, Hanaki, & Hasegawa-Kurisu, 2009; Ray, Ryngnga, & Chetia, 2023). An understanding of the chosen type of environmental conservation by the public and appreciation towards it are the key factors influencing WTP. In the context of SWM, the more informed the households are about the ramifications of poor waste disposal and the benefits of some effective methods, the more they are willing to fund the improvements. Ethiopian, Nigerian, and Ghanaian research also insist on having awareness to influence WTP. In Kumasi, Ghana, and Lagos, Nigeria, awareness campaigns considerably raised households' WTP for improved WSMs (Awunyo-Vitor et al., 2013; Shehu Usman Adam et al., 2015). Households with more members usually produce more waste, so they need better waste management. Thus, since larger households require more disposable cash, the Herfindahl-Hirschman Index (HHI) positively relates to WTP. Studied Ugandan and Ethiopian research proves that the WTP for enhanced SWM services is higher with large households, as they produce more waste. WTP was relatively higher than in the smaller households (Niringiye, 2010; Banga, Lokina, & Mkenda, 2011). This research also reveals that WTP for waste management services varies with gender. In this respect, female-headed households appear to possess a higher WTP because they are most likely to be directly involved in waste disposal, sanitation of their families, and disease control. Research in different parts of the world, like Ethiopia and Ghana, points to the fact that female-headed households tend to pay more for better quality waste management services. A similar pattern was revealed by Endalew and Tassie (2018) when they studied a sample of Female-Headed Households (FHHS) in Bahir Dar, Ethiopia, where women are ready to pay for better places to dump their refuse. A study shows that the WTP of households concerning better SWM services depends on the proximity of disposal sites. Industries nearer to these waste disposal sites or industries experiencing poor waste disposal are willing to pay more to get better services. This is

due to their direct experience with the consequences of poor waste management. Studies conducted in Ghana and Nigeria reveal that the households living close to dumpsites or non-controlled sites are willing to pay a premium to obtain better services that will help reduce the impacts of environmental and health hazards related to DNC (Nkansah, Dafor, & Essel-Gaisey, 2015; Ogawa, 1989). The reviewed studies mainly employ the CVM to assess consumers' WTP for enhanced waste management services. CVM entails actively probing the respondents with questions to determine the amount they would be willing to pay for enhancements in waste management services. CVM and its modified models, such as binary logistic regression, Tobit models, and double-bounded CVM, form a reliable method to estimate the data. (1) CVM, Binary Logistic Regression: Utilised in research by Ray, Ryngnga, and Chetia (2023) to estimate the likelihood of WTP as reliant on socio-economic characteristics to some extent. (2) CVM, Tobit Model: Used in works such as Mulat, Worku, and Minyihun (2019) to accommodate data restrictions in event scenarios where WTP amounts are partly revealed or have a ceiling or a floor value. Double-Bounded CVM: In research, as employed in Kassahun Tassie et al. (2024), it assists in enhancing WTP estimates by asking respondents follow-up questions concerning their WTP answers (Kassahun Tassie, Anteneh Mulugeta, Yenesew Sewunet, & Getenet Asifaw, 2024). WTP for improved SWM services varies significantly across different regions, reflecting diverse economic conditions, cultural attitudes, and local waste management practices: (1) Various research conducted in Ethiopia especially in Injibara and Bahir Dar indicate WTP values of 20 to 30 ETB monthly ($0. 74 to $1. 10) with variation according to the income, education and awareness level of the respondents (Mulat, Worku & Minyihun, 2019; Endalew & Tassie, 2018). Some Asian determinants like income, education and awareness are illustrated in the research done in Cooch Behar, India and Rajasthan, India courtesy Ray, Ryngnga, and Chetia (2023) and Seth, Ansari, and Datta (2009) respectively though individual WTP" values are not well articulated. Kumasi and Sekondi Takoradi households are willing to pay about 5 to 10 GHS/month ($ 0.86 to $1.72)

(Awunyo-Vitor et al., 2013; Padi et al., 2015). In Dhaka, the self-reported WTP is around 50 BDT/month, which, with the exchange rate of £1=$1.67, comes to $0. 59 (Afroz, Hanaki, Hasegawa-Kurisu, 2009). Detailed survey research in Lagos and Ibadan revealed that income and education level significantly impact WTP, and the WTP amount varies (Shehu Usman Adam et al., 2015; Arimah, 1996). Migration towards better quality and reliability of waste management services makes those customers happier, and thus, you can obtain higher WTP from them. This involves undisputed practices of picking up waste recurrently, cleaning disposal facilities, and ensuring the availability of waste containers and recycling centres. This paper aims to establish the factors influencing household WTP for enhanced waste management services to promote effective waste management, mainly within developing countries. The main idea derived from the reviewed literature is that there is adequate evidence that socio-economic factors, awareness, and attitudes are key determinants of WTP. This paper argues that any policy interventions regarding SWM need to encompass elements of public awareness, fair pricing strategies, and increased community involvement significantly. That is why regulating these key determinants will help policymakers initiate, effectively model, and implement waste management solutions that are equally economic and societal for a clean and healthy livable urban environment.

2.6 Importance of Better Waste Management in Bangladesh

The collection, sorting, and disposal of waste is still a big challenge in cities worldwide, especially in the rapidly expanding cities in developing countries (Seik, 1997). A lot of solid waste is being made because many people are growing up and having more money. This is bad for the environment and people's health (Snigdha and Sarkhel, 2003).

Dhaka, the capital city of Bangladesh, has a huge problem with solid waste, even compared to many cities in developing countries. This is even worse than the problem in many other cities. Daily, three thousand five hundred tons of solid waste are generated in Dhaka. The Dhaka city corporation (hereafter: DCC) picks up 1800 tons and dumps them. Nine hundred tons end up in

informal landfills and backyards, four hundred tons end up on open space and roadsides, three hundred tons are recycled by the Tokais (slum children), and 100 tons are recycled (DCC, 2005). DCC oversees the disposal of the city's waste. However, DCC can only collect about 40% of the total solid waste generated. Regardless of how well the city's government can collect this waste, the collected waste is a big problem for the residents. The population is becoming larger. It will be challenging to dump the waste in the future (Matter *et al.*, 2015; Rahman, Azeem, and Ahammed, 2017; Jerin *et al.*, 2022).

It is still a big problem in developed and developing countries. Many negative environmental effects come with waste management systems that do not work well. These include the emission of air pollutants and greenhouse gases, land pollution, surface and groundwater, soil, and degradation of the environment. They also pose a risk to human health and safety, such as fires that aren't controlled and the spread of disease vectors, such as mosquitoes (Ghanbari *et al.*, 2012). These negative consequences are linked to a decrease in the condition of life, which, in turn, leads to extra expenses for the people who live there (Eshet, Ayalon, and Shechter, 2006a). A well-managed waste system could turn these negative effects around and help the community in many ways, such as reducing the environmental impact and providing secondary resources from recycling. It also creates employment and reduces poverty. However, these advantages come at a price. Better collection systems, waste management infrastructure, and campaigns for public awareness can be costly. It is at least more expensive than conventional waste management practices (Jamasb and Nepal, 2010; Weng and Fujiwara, 2011). It should be kept in mind that better waste management practices are expensive. It will be difficult for society, especially in countries with less per capita GDP, like Bangladesh. Private investment and allowances alone would not be enough to show how much better waste management would benefit the whole community, mostly because of the extra costs and benefits that come with it. Determining the social and environmental costs and benefits of what people do is necessary. Then, they must be ensured that they are

considered in decision-making (Lah, 2002; Lam *et al.*, 2018). However, the challenge is twofold: first, it must determine how to get the money. Before we can figure out how unconventional waste management possibilities affect the well-being of human and animal life, we need to figure out how much these changes are worth. We can do this by using a variety of different valuation methods. In other words, the accuracy of economic valuation is based on how well you can identify and measure the environmental change, as well as how well you can figure out what people want or don't want (Pearce and Howarth, 2001). As highlighted by Foo (1997), the management of solid waste is still a challenge in most metropolitan areas across the globe, more so in the cities of the developing world that are experiencing rapid social and economic transformation. CVM has therefore become the most rudimentary approach to assessing the public's attitude to these issues, and their willingness to contribute towards the maintenance or expansion of existing programs. In the context of this study, we employed dichotomous choice CVM to determine the WTP of the respondents to improve the garbage collection system in Dhaka City, Bangladesh. The distribution of DCC-approved NGOs and CBOs for the primary collection. These organizations sometimes convene conferences and seminars to sensitize citizens on the effects of improper disposal and management of solid waste on their health and the environment, the process of managing the waste, and the recycling processes. Currently, in the areas with a door-to-door garbage collection system, every family is obliged to turn over their trash to the waste collectors and pay for the collection service. To provide this information for Dhaka, it is important to understand the role of WTP in measuring the success of a garbage collection effort. We conducted an economic analysis to determine household demand for enhanced municipal solid waste management. In more detail, the study focused on the respondents' knowledge, beliefs, and expectations concerning enhancing the waste management system in Dhaka. We also computed the t-test on the respondents' WTP between those receiving door-to-door garbage collection services and those not.

2.7 Institutional and Legal Framework for Waste Governance in Bangladesh

Waste management in Bangladesh operates under a complex and evolving mix of institutions and legal structures. The Ministry of Local Government, Rural Development and Cooperatives (MoLGRDC) plays the lead role in urban sanitation and waste policy. Under its authority, City Corporations and Municipalities handle waste collection and disposal locally, as outlined in the Local Government (City Corporation) Act of 2009 and other municipal laws. Additional responsibilities for waste governance are distributed across several legal documents. The Environmental Conservation Act of 1995 and the Waste Management Rules of 2021 set environmental benchmarks and encourage practices like resource recovery and reduced landfill reliance. The National 3R Strategy (Reduce, Reuse, Recycle), adopted in 2010, supports public engagement and private-sector participation in waste solutions. From a financial perspective, no nationwide policy currently mandates a universal fee-for-service approach. Instead, City Corporations can levy waste service fees based on local regulations, but these charges are applied inconsistently. For instance, cities like Dhaka North and Chattogram include waste fees in property tax bills, yet actual collection rates remain low (World Bank, 2021).

Bangladesh's Public-Private Partnership (PPP) Authority has encouraged private-sector involvement, particularly in waste-to-energy and landfill upgrades. While donor-supported programs—like the World Bank's CASE initiative and composting pilots by GIZ—show growing interest, overall PPP activity is limited by weak regulation, political instability, and capacity shortages at the local level. Non-governmental organizations (NGOs) such as Waste Concern and BRAC also contribute by managing small-scale waste collection and testing community-driven models. These groups often work with local councils or ward committees, but their roles remain informal and under-regulated. No national law requires citizens to express or act on their WTP for waste services. Still, recent discussions around urban resilience and climate adaptation push for co-financing models and tiered pricing. International frameworks, such as the World Bank's Urban

Sanitation Policy Framework (2020), recommend WTP studies as a starting point for fair and effective cost recovery. Overall, Bangladesh's waste governance is a hybrid system: led by national policy but implemented locally, with growing—but still limited—involvement from the private sector and NGOs. Ongoing issues like overlapping laws, inconsistent regulation, and limited local autonomy continue to challenge the system's efficiency and financial stability.

2.8 Empirical Studies

Littering is not a phenomenon that has recently emerged, but has been seen globally and in developing countries. This has persisted until now, although the effects have been well-documented for quite some time. To this end, researchers have researched the following aspects: the level of households' engagement in SWM services, households' perception towards SWM action, households' WTP for improved SWM, and factors influencing the WTP value of households for improved SWM services. Therefore, the results of the analyzed publications are summarized and presented in the form of a narrative and tables. The study that was conducted by Han et al. (2011) applied CVM to estimate the WTP for the protection of the environment. About 73% of the respondents stated that they were willing to pay for the preservation of the forest, with a mean WTP of 8.03 USD. On the other hand, 27% of the respondents said they were unwilling to pay for anything.

In the research by Kalbali et al. (2014), the authors employed the CV and Tobit model to analyze the factors that affect the WTP of visitors and the amount of WTP they have for the forest park. Also, they estimated the mean WTP that visitors had for using the park. According to the survey, the total annual recreational value of the forest park was estimated to be 4 billion Rials, and the average WTP per visitor for each visit was estimated to be 2623 Rials. Furthermore, Cho et al. (2005) employed CVM to estimate the average WTP of rural homeowners for the land conservation easements. Based on the anticipated result, the WTP of a family to participate in an easement program could be as low as 10.97 USD to as high as 21.79 USD per household per year.

In Uganda and Kampala, households' WTP was determined for improved municipal solid waste management services by Ojok et al. (2014). A dichotomous choice CV technique was employed to ascertain the WTP of families. A systematic sampling approach was used to obtain the WTP of the homes, and the logit regression model was used. The sample size was 4015 households. The mean monthly WTP was UGX 5,382 (USD 2.91), and more than 48 percent of the families in Kampala stated that they would be willing to pay for better municipal solid waste management services.

Furthermore, a study on the factors that influence the households' WTP for solid waste collection services in Oyo state, Nigeria (Basiru, 2017) was carried out using the dichotomous choice CV approach to estimate the WTP. In this study, 140 houses that were part of the sample were selected using systematic random sampling, and a structured questionnaire was used to collect data. The data were analyzed using the logit regression method, and the study established that the average WTP of households for improved SWM was N 1240.92. As Ezebilo and Animasaun (2011) pointed out, the study was based on an economic valuation of private sector waste management services that comprised a contingent value survey in Ilorin state in southwest Nigeria. After dividing the study region into layers, the study was conducted on 224 randomly chosen families. A censored Tobit model was employed to analyze the findings. The survey results show that over eighty percent of the respondents supported the home garbage management services. The respondents had an average annual income of 3,660 Nigerian Naira, equivalent to 24 US dollars. The respondent's WTP was also influenced by income, education, type of house, and the respondent's satisfaction with the private sector's involvement in providing solid waste management services. A study on the WTP for solid waste management services in Islamabad, Pakistan, by Anjum (2013) was also done, and a sample of 500 respondents was selected using the stratified random sampling technique. The questions were in the form of a double-bounded dichotomous choice question, which was then followed by an open-ended question. The logistic

regression estimation reveals that 65.4% of the total respondents have WTP, and the multiple regression shows that the mean WTP per month is Rs. 289.15. This number is susceptible to household income, education, and environmental awareness factors, which were positively and significantly correlated with WTP. Also, the household size had a negative and significant effect on the WTP of the households at a 5% significance level for these variables. However, the respondent's age, availability of services, and marital status did not influence the results.

The study aimed to identify factors that could affect the WTP for waste management among male and female individuals in Ekiti in Nigeria (Adebo & Ajewole, 2012). In total, 300.00 respondents were interviewed. The present study used descriptive analysis and probit regression to analyze the collected data. 85. The study found that 5% of the respondents were willing to pay for better SWM, while 14.5% were not willing to pay for better SWM. It was also found that the WTP for waste disposal depended on gender, the type of main employment, marital status, education level, and average monthly income based on the probit linear regression analysis results. However, WTP has an inverse relationship with family size, household headship, and the distance from the dump site where the respondents reside. WTP of families in urban areas of Peshawar, Pakistan, for improved solid waste management services (Khattak et al., 2009). In the context of this study, the CVM was used to assess the factors that influence WTP for improved water services using an open-ended value elicitation method. To collect cross-sectional data, 216 houses were selected by a systematic random sampling method. Logit regression yielded significant results, suggesting that 49 percent of the households in the sample were willing to pay a premium for better SWM services. The study also reveals that the size of the household, the income of the household, and the level of education of the household have a positive and significant influence on the WTP for improved services at 10%, 5%, and 1%, respectively. Murad et al. (2007) conducted research in Kuala Lumpur, Malaysia, where the poor were asked about their WTP for improved SWCD services using CVM. The two types of stratified quota random sampling methods were used, and the features of the

households that were deemed to be the most important factors for stratification were also used. Three hundred homes were used for the sample, and several linear regression equations were used to analyze the data. The average WTP identified in their study was MYR 13.00. As per their study, the key factors that affect WTP include the satisfaction level of the respondents with the existing trash collection services, income of the respondents, gender, duration of stay in the region, and number of children below 12 years. The study of the management of municipal solid waste in Tinsukia Municipality of Assam in India has now been done (Das and Das & Gogoi, 2014). The researchers also found that the probability of people supporting cost-sharing rises by 13% if the family's income rises. In addition, the study established that the quantity of garbage that is generated every month per family influences the WTP for solid waste management. This literature review identifies several critical gaps: (1) Lack of integrated models combining socio-economic, behavioral, and institutional determinants of WTP; (2) Limited studies that quantify the impact of environmental awareness and climate change concern on WTP in South Asia; (3) Absence of evidence-based policy insights on differentiated pricing, targeted subsidies, and citizen trust-building mechanisms.

This thesis addresses these gaps by employing a mixed-method approach across seven urban centers in Bangladesh, assessing both quantitative and qualitative drivers of WTP. It also evaluates how attitudes toward climate change and environmental degradation interact with income and education to shape willingness to financially support improved waste services.

3. MATERIALS AND METHODS

3.1 Study Research Design

This systematic review aimed to establish the determinants of Willingness to Pay (WTP) for better waste management services in emerging countries. The review analyzed WTP's socio-economic, environmental, and institutional determinants, based on the empirical literature published between 2010 and 2023. The study established that the following are the influential factors that explain WTP: Household income, education level, environmental consciousness, distance to the waste disposal sites, and the level of dissatisfaction with the existing waste service provision. That knowledge could be used to advance policy approaches for developing fair and sustainable waste management solutions in emerging markets.

Based on the findings from a systematic review, this study employs a mixed-methods research design to comprehensively investigate the determinants of individuals' WTP for better waste management. The mixed-methods approach integrates both quantitative and qualitative data collection and analysis techniques, allowing for a nuanced understanding of the research problem.

The quantitative component involves the administration of structured surveys to a sample of residents in urban areas, especially seven major cities in Bangladesh. The survey instrument will include standardized Likert-scale items and closed-ended questions to assess respondents' demographic characteristics, attitudes towards waste management, perceptions of the current system, and WTP for improved services. The survey data will be analyzed using statistical techniques such as regression analysis to identify significant predictors of WTP, including demographic factors, environmental attitudes, and perceived benefits of better waste management. The qualitative component consists of semi-structured interviews conducted with a subset of survey participants. Through qualitative interviews, deeper insights into individuals' motivations, values, and decision-making processes related to WTP for waste management will be explored. Open-ended questions encouraged participants to elaborate on their perspectives, experiences, and

concerns regarding waste management practices. Thematic analysis will identify recurring themes and patterns in the qualitative data, providing rich contextual information to complement the quantitative findings. The quantitative and qualitative data were triangulated to provide a comprehensive understanding of the determinants of WTP for better waste management. Triangulation involves comparing and contrasting findings from different data sources to validate and corroborate key insights. Integrating quantitative survey results with qualitative interview findings enhances the depth and validity of the research findings, offering a holistic perspective on the factors influencing individuals' WTP behavior. Overall, the mixed-methods research design allows for a multi-dimensional exploration of the research problem, capturing quantitative trends and qualitative nuances in individuals' attitudes and behaviors toward waste management and WTP. The study was conducted using the contingent valuation (CV) method.

The CV method is one of the most used approaches to estimate the monetary value people assign to non-market goods and services, including environmental quality and public services, such as waste management. This technique consists of asking people how much they are willing to pay (WTP) for certain improvements or services through well-structured questionnaires. Realizing the WTP for waste management enhancement is crucial for developing efficient waste management systems in Bangladesh.

3.2 Contingent Valuation (CV) Method

Contingent valuation is an economic survey approach that gathers people’s choices by putting them in hypothetical contexts and asking them how much they would be willing to pay for certain services or enhancements. This approach assists in putting a value on the items that people hold dear but do not buy in the market (Mitchell & Carson, 1989). Concerning waste management, contingent valuation can help establish the monetary worth residents assign to enhanced waste collection, recycling centers, or cleaner cities. As mentioned earlier, in a typical CV survey, the respondents are given a clear description of the proposed waste management improvement and the

gains that will likely be realised from the process. They are then required to estimate their WTP for these improvements – the maximum amount. The summed up responses give an impression of the total WTP for the proposed changes in the community, which is important in policy making and resource allocation processes (Carson, 2012). Evaluating WTP for waste management services is especially important given that waste management facilities in many developing countries, such as Bangladesh, are still in their developmental stages. At the same time, the population of urban residents continues to grow. Analyzing WTP can assist local governments and policymakers in identifying the amount of funding that residents are willing to commit to improving waste management services, thus aiding in identifying funding sources and developing funding structures. Some of the previous research works conducted in Bangladesh using the CV method have estimated WTP in different aspects of waste management in the following range. For instance, a study that was conducted in Dhaka revealed that people were willing to incur extra charges for regular and efficient waste collection services. The authors stated that the respondents with high income and those with a higher environmental concern were willing to pay for better services (Alam et al., 2013). This implies that there is potential for raising public support and consequent contributions through educational campaigns that promote proper waste management.

However, the WTP data can be useful in developing fairness in pricing structures for waste management services. Therefore, understanding the WTP across different socio-economic groups will help policymakers set tiered prices to allow the poor to afford the product. At the same time, the prices set will enable revenue generation enough to cover the costs of the improved waste management systems. It can also help to foster social justice in the community and make it possible for all the residents to contribute fairly in terms of money (Whittington et al., 1990). Hence, the WTP data obtained through the contingent valuation method can be quite useful for formulating waste management policies and plans in the context of Bangladesh. These facts can be helpful to policymakers in explaining the need to invest in proper waste management systems like sanitary

landfills, recycling plants, and waste disposal facilities like waste-to-energy plants. Quantified WTP clearly indicates public support, making it easier to attract funds from the government and international organizations to support sustainable waste management systems. Also, understanding WTP can help in designing the PPPs for waste management because the WTP is a potential indicator of the people's WTP for the services of the private sector in managing the waste. Private companies are more likely to invest in waste management projects if the data showing people's WTP for better services is accurate. This data is useful in formulating PPP agreements that meet the public interest requirement while simultaneously having the capacity to make the private partners profitable (Cointreau-Levine, 1994).

Even though WTP studies offer various benefits, several issues may influence the credibility of CV surveys. A major limitation is that most of the analysed questions are hypothetical, which may cause biases in the WTP stated by the respondents. Hypothetical bias arises when respondents are willing to pay more than they would be willing to pay in the actual market since they are not parting with their cash (Bateman et al., 2009). On the other hand, strategic bias occurs when respondents understate their WTP due to future costs that they may be likely to incur (Arrow et al., 1993). The researchers use procedures like follow-up questions, calibration studies, and validity tests to reduce these biases. This is because not all respondents can be expected to clearly understand the scenarios presented to them and the context required for accurate valuation.

Nevertheless, certain drawbacks make CVM an effective instrument for studying the public's preferences and implementing waste management policies (Carson & Hanemann, 2005). The WTP for improved waste management is therefore an indication of the willingness of the residents to pay for a better environment and their understanding of the health implications of poor waste disposal. The common waste disposal practices include open dumping and burning, which cause pollution of the environment through air, water, and soil pollution, consequently affecting people's health. Properly managing waste minimizes the instances of diseases associated with waste

pollution, like respiratory diseases and waterborne diseases (World Bank, 2018). For example, through proper waste management and disposal, such as providing well-designed and effective waste bins, municipalities can help avoid water pollution and the spread of diseases. This promotes better physical health and decreases expenditure on health, which indicates the economic and social efficiency of the improvement in waste management services. These broader benefits are captured by the contingent valuation method because it measures the community's WTP for a healthier and cleaner environment (Hossain, 2020). The contingent valuation method and the assessment of WTP for waste management are important in establishing how much the public values improving waste management services. These methods can help policymakers in Bangladesh, as waste management is a major issue in the country, and they can help formulate the right strategies for waste management. It becomes easier to mobilise resources, develop fair pricing strategies, and encourage the formation of public-private partnerships as one learns the amount of economic value that can be derived from waste management improvements and the public's preparedness to fund such improvements. All the same, the contingent valuation method is a crucial approach in providing solutions to waste management problems and improving the quality of the environment, notwithstanding the potential biases.

3.3 Sampling Strategy

The sampling strategy involves a systematic approach to ensure the selection of a representative and diverse sample of participants. Drawing from urban areas within the major cities in Bangladesh, the sampling frame was constructed using available population data, such as census records or municipal listings. Utilizing a stratified sampling method, the population is divided into distinct strata based on key demographic factors, including age, gender, income level, and education. A systematic sampling technique was employed within each stratum to randomly select participants, ensuring proportional representation across different demographic groups. Efforts were made to achieve a sufficient sample size, calculated based on statistical considerations to

ensure the study's power and precision. By implementing this comprehensive sampling strategy, the study aims to capture diverse perspectives and experiences related to WTP for improved waste management services, facilitating robust and generalizable findings. Using stratified random sampling, the research was certain to include a diverse socio-demographic group. This study took place in the following cities in Bangladesh: Dhaka, Chittagong, Khulna, Rajshahi, Sylhet, Rangpur, and Barisal. The selection of these cities was based on how many people live there, the diversity of the economy, and how waste is handled.

The metropolitan regions of Bangladesh produce a variety of waste due to their high population density. These include leftover food (77.70 percent), plastic (7.35 percent), electronic waste (0.64%), textiles (2.56%), papers (4.84%), wood (2.72%), metals (0.44%), and miscellaneous materials (3.74%). Organic materials make up a significant portion of waste. It has a low calorific value while having a high moisture content. For the generation of bioenergy, this approach has the potential to be both suitable and cost-effective. The urban area produces 223,688 tons of waste daily, but only 50 to 60 percent of this waste can be collected by the authorities (Pourosava and City Corporation). The remaining waste is not collected. The remaining mixed waste is dumped daily in the city's drains, roadsides, lakes, and rivers.

3.4 Study Area

Research on major cities in Bangladesh requires an efficient data collection plan. An explanation of how data will be used to identify the factors that affect WTP for improved waste management services is outlined in this section. In this study, we will target the seven largest cities in Bangladesh: Dhaka, Chittagong, Khulna, Rajshahi, Barishal, Rangpur, and Sylhet. These cities are chosen because they are densely populated urban centers with a high waste generation rate. The study will need household data to comprehensively depict expenditure across WTP waste generators. A structured method of random selection of the respondents will be adopted for the

study involving socio-economic classes, areas of residence (urban and peri-urban), and waste-discharging firms.

Figure 5: Study area

Source: BSS census data 2021

The sample size will be determined by the overall population of the selected urban sample so that the confidence level will be 95%, and the margin of error is 5%. Several organizations, including the Bangladesh Bureau of Statistics (BBS), the Rural Development and Co-operatives of Bangladesh, and the Ministry of Local Government, have estimated that Bangladesh has 532 urban centers. City Corporations govern 11 cities in Bangladesh under the local government. We have chosen seven city corporations for our study. Dhaka, Rajshahi, Chittagong, Khulna, Sylhet, Rangpur, and Barisal.

3.5 Method of Data Collection

There are several questions regarding the validity and accuracy of the measurements (Carson and Czajkowski, 2014). The survey is suggested to use the Contingent Valuation Method (CVM). It is a practical method for collecting information on people's preferences regarding the distribution of public goods and services in developing countries (Whittington, 2002). In this study, we will use a dichotomous choice CVM to determine the WTP of people in major cities in Bangladesh and change how waste is collected. Numerous studies demonstrate that families are prepared to spend a large sum on effective waste management. It is a widely used approach for valuing natural resources. CVM is one of the strategies for expressing preferences. It is based on the respondent's WTP's direct opinion to change the environment's quality and quantity (Bogale and Urgessa, 2012; Kasaye, 2015). CVM requires individuals to express their WTP for nonuse public goods and services in real-world markets (Alberini and Cooper, 2000). This extremely versatile approach allows for the valuation of a broader range of nonmarket commodities and services. The CVM method generates values by stimulating respondents' WTP (Khalid, 2008). In this method, researchers have created a variety of techniques for conducting evaluations, including bidding games, open-ended questions, a dichotomous choice format, and payment cards (Chien, Huang, and Shaw, 2005). Among the CVM forms, the dichotomous choice CV format has gained favor in recent years due to its alleged benefit of avoiding many of the biases associated with other CVM formats. The dichotomous choice format entails a binary response (yes-1, no-0) to a given price. It does not ensure the actual quantity of WTP of the respondent (Oerlemans, Chan, and Volschenk, 2016). According to the description presented earlier, the research conducted in Bangladesh utilized one and a half-bounded CVMs followed by open-ended questions to obtain the highest WTP possible from the respondents.

Primary Data Collection

Face-to-face interviews were conducted using a structured questionnaire among households in the selected cities. Questions in the questionnaire targeted socio-economic factors including income, level of education, number of people in the household, distance of the respondent's home to waste disposal sites, levels of satisfaction to the current waste management services, level of environmental consciousness and the willingness of the respondent to be charged more for better waste management services. This survey was carried out using face-to-face interviews with the help of trained interviewers to increase the response rate and the validity of the data collected. From the contingent valuation method (CVM), the respondents will be asked a hypothetical maximum amount they would be willing to pay for an improved waste management system. Semi-structured interviews will be undertaken with city corporation officials, waste management contractors, and environmentalists to understand how waste management works in these cities and how WTP could inform the future strategic directions of waste management. These semi-structured interviews concern waste management costs, revenues arising from fees for certain services, or citizen engagement in waste programmes. It involves reporting on the waste generated and the cost incurred in managing it. National data on urbanization, the average wastage ratio and any details of economic progress. Journal articles and past research or resources in the context of WTP for waste management services in Bangladesh and other emerging countries. The secondary data are collected to give background information and an update on the current scenario of waste management in these cities, as well as to triangulate the findings gathered from the primary data collection.

However, the questionnaires and interview guides used in data collection shall first be pretested in a less populated community in Dhaka. The first pretest was designed to check the clarity of the questions, the length of the survey, and the extent of the respondent's understanding. The collected data was then keyed into a data management system (for instance SPSS or STATA) for cleaning

up & analysis. Central tendency and variability measures will be employed to describe the study variables and determine WTP for enhanced waste disposal services. The variables of interest under socio-economic factors, environmental consciousness, and satisfaction with existing services, would be used to explain variation in WTP among the respondents.

3.6 Questionnaire Formation

The questionnaire administered to collect data on WTP for Better Waste Management in major cities of Bangladesh was developed after properly considering various questionnaire design elements for determining WTP for better waste management services. The questionnaire is divided into several parts reflecting main variables, which include Socio-economic characteristics, Waste management practices, and WTP for improved service. Well-structured questionnaires are designed to pick up the most accurate data for analysis. The survey was carried out at the end of December 2023 and the questionnaire will be translated into the local language, “Bengali”, for better comprehension by both enumerators and respondents. We will carry out a pilot study to circumvent minor problems with the questionnaire before finalization.

A survey starts with an introduction that explains what's going on and how the decision will be made. We will give the respondents details about this study. It also asks why the respondent answered certain questions about the better waste management system and what they did. Respondents are asked to indicate the trade-offs they would be prepared to make due to WTP for waste management. A well-structured questionnaire was made for the face-to-face survey. The questionnaire's first section enquired about the participant's socioeconomic situation, including age, gender, educational attainment, employment, marital status, and monthly family income. The second part of the survey gathered information on respondents’ attitudes and perspectives on climate change and climate policy problems, which includes their concerns about climate change, the importance of mitigation policies and efforts, and the environmental and climatic imprint.

Each participant was asked to complete a survey; before that, they could read the information regarding the purpose of the study and were given an option to provide their consent in writing. All the answers were collected anonymously, and individual participants had the right to discontinue the survey whenever they felt like it. We collected data on 11,00 respondents, using 1069 responses for our analysis.

3.7 Analytical Method

The mean WTP is a commonly employed approach to calculating the weighted average of the responses on the WTP for enhanced Waste Management Services. The enumerator will ask the respondent “yes" or "no" questions about their WTP to assess their WTP. A particular monetary value was obtained for "yes" responses using the threshold decision-making theory to assess their WTP (Hanemann, Loomis, and Kanninen, 1991). Responses from the respondents' WTP figures can be simply a means to obtain a WTP estimate, as seen in the example below.

$$WTP = \frac{\sum Ti}{n} \qquad (1)$$

Where,

Ti = maximum willingness to pay (WTP) by respondent

N = Number of respondents.

Breakdown of the Approach:

The enumerator asked respondents about hypothetical changes in the quality of the waste management services, including questions about better waste collection frequency, proper recycling, and overall better waste disposal. To do so, respondents are asked whether they would be willing to pay a certain amount, for example, BDT 50/month, for the improved services. If the respondent replies “yes,” he or she is asked if they would be willing to pay a higher amount for this product: in this case, the amount is gradually increased until the respondent says ‘no’. This is

done repeatedly until the respondent responds “no”, at which point the amount is diminished to determine the amount of dollars or cents the respondent would be willing to pay.

This paper uses the concept of the threshold decision-making theory. It postulates that the respondents have a threshold level of WTP depending on their socio-economic status, income, awareness of the environment, and satisfaction with existing services. If the monetary worth offered to the enumerator surpasses this value, the respondent will say “no”. On the other hand, they will say ‘yes’ if the proposed value is below their ‘No’ threshold. However, the peak WTP per respondent would have been estimated through the constant iteration of the monetary values of the attribute through a sequence of diverse questions. So, for example, if five respondents are asked what price they would be willing to pay for better waste management services. Their maximum WTPs are as follows: Respondent 1: BDT 70; Respondent 2: BDT 50; Respondent 3: BDT 60; Respondent 4: BDT 80; Respondent 5: BDT 55.

Using the formula for mean WTP:

$$WTP = \frac{70 + 50 + 60 + 80 + 55}{5} = \frac{315}{5} = 63$$

This paper shows that the mean WTP approach is a suitable technique to employ to estimate the average WTP of households regarding enhanced WMS. They use it in decision making in such areas as user fees, policies on waste management, and in improving on the services to be offered. However, it should be used in conjunction with other inferential tools like regression analysis to get a full appreciation of factors that are more likely to influence WTP.

3.8 Econometric Modelling

Choice models were used to look at the relationship between the chosen socioeconomic factors and the household WTP for a better waste management system in Bangladesh. They use a linear probability model to show or estimate the statistical relationships between independent and

dependent variables. These models are called binary logit, linear probability, and probit models. There are two types of probability models: probit and logit. The estimated probability of the dependent variable in a model of binary linear probability is outside of the range 0 to 1 when the model is binary linear (Cameron and Trivedi, 2005). The majority of the research on WTP aimed at improving waste management services employed either a probit model or a logistic regression model (Hagos, Mekonnen, and Gebreegziabher, 2012; Seth *et al.*, 2014; Sinha, 2014; Lunojo, 2016) or a logit model (Addai, 2012; Ali *et al.*, 2012; Dauda, Yacob, and Radam, 2015; Dhokhikah, Trihadiningrum, and Sunaryo, 2015) to figure out what factors influence WTP for a better waste management system (Bhattarai, 2015). Probit and logit models are two different types of models. (Park, 2015; Gujarati, 2021).

Each case has a big difference in how the error term is spread out. Within the framework of the logit model, it is presumed that the error term will maintain continuity with the standard logistic distribution. The error component is assumed to follow the conventional normal distribution when analyzing data with the probit model. Despite this little distinction, binary logit is superior to binary probit regarding how straightforward it is to comprehend and apply in mathematical contexts. After this, a binary logit model was used to determine how probable it is that individuals will pay more for better waste management services as a function of the independent variables. This will be done in order to better understand the relationship between these two factors (x). The empirical strategy that was used looked at a binary logistic regression model that was estimated in sequence with different model specifications to find out what factors influenced people's preferences for their choices. The model looks at how likely it is that someone will purchase organic food if it could cut down on the environmental impact of making it. As a way to measure the independent variable, we used a 5-point scale. Using the Likert scale, each model's dependent variable was made into a two-way choice by setting the highest values (4 and 5) as "yes" (1). 1 and 3 stand for "no" (0) in the scale. Even though dividing things into two groups could mean that some

knowledge could be lost, this approach is justified on both functional and empirical grounds (Verbeke, 2015; Coderoni and Perito, 2020; Ali, Akter, and Fogarassy, 2021).

The threshold decision-making theory was utilized in the research since it was shown that heads of households were willing to pay extra for improved waste management services (Kau and Hill, 1971). There is a point at which a person cannot decide whether or not to pay more money for better waste management. Things that make up this threshold are used to determine how high this level should be. You don't feel anything if you get a lot of stimulation below the threshold. At the threshold, though, you feel something caused by the stimulus.

$$Y_i = \beta x_i + \mu_i \qquad (2)$$

The above equation states that when people are willing to pay for better waste management services, Yi = 1, and if they don't, Yi = 0. Equation (2) is a binary choice model in which the probability of WTP for better waste management services 'Y' is estimated as a function of the independent variables 'X'. Mathematically, this is shown as

$$P_i(y_i \neq 0 I X_i) = \frac{exp(X_i\beta)}{1 + exp(X_i\beta)} \qquad (3)$$

where,

i =1, 2, 3, ……*n*;

Pi = is the expected likelihood of a given option being made by person *i*.

βi = is an undefined parameter vector, and *X* is a vector of explanatory variables representing the individual's characteristics and choices that are supposed to affect the respective option. Equation (3) shows the approximate conditional logic models. The binary choice modeling makes it easier to look at the results.

Equation (2) shows the logistic regression model.

$$\text{WTP} = \alpha + \beta_1 Gd + \beta_2 Ed + \beta_3 MI + \beta_4 HS + \beta_5 EI + \beta_6 CCI + \beta_7 HA + \mu i \quad (4)$$

where,

WTP (willingness to pay) is the dependent variable.

Gd is Gender

Ed is the level of education.

HS is Household Size

MI Monthly Income

HA Household assets.

EI is awareness of environmental issues.

CCI is an awareness of climate change issues.

μi is the error term

The theoretical structure will be investigated with the help of Stata version 15. First, the measurement model was used to test the validity and reliability of the model. Then the later statistical model was used to analyze the model's fit and the validity of the hypothesis.

4. ANALYSIS AND RESULTS

4.1 Descriptive Analysis

Table 6 shows the comparative view of several vital socio-economic indicators between the respondents willing to pay for private operators and those reluctant to do so.

Table 6: Descriptive Statistics

		Willing to Pay (WTP)		Unwilling to pay	
Variable		Frequency	Percentage	Frequency	Percentage
Gender	Male	798	74.65	244	73.94
	Female	271	25.35	86	26.06
Age	20-24	54	5.05	68	20.61
	25-29	47	4.40	58	17.58
	30-34	176	16.46	90	27.27
	35-39	493	46.12	89	26.97
	40-More	299	27.97	25	7.58
Monthly Income BDT (USD)	15 K-20 K (120-165)	29	2.71	55	16.67
	21K-25K (121-205)	85	7.95	89	26.97
	26K-30K (206-250)	282	26.38	80	24.24
	31K-35K (210-290)	481	45.00	83	25.15
	36K-More (300 More)	192	17.96	23	6.97
Level of Education	Primary	23	2.15	83	25.15
	Secondary	45	4.21	36	10.91
	Higher Secondary	224	20.95	80	24.24
	Graduate	514	48.05	76	23.03
	Postgraduate	263	24.60	55	16.67
Household Size	2	138	12.91	35	10.61
	3	496	46.40	168	50.91
	4	395	36.95	111	33.64
	5	36	3.37	12	3.64
	6	4	0.37	4	1.21
	0-50K (0-400)	0	0	12	3.64
	51K-100K (401-825)	0	0	41	12.42

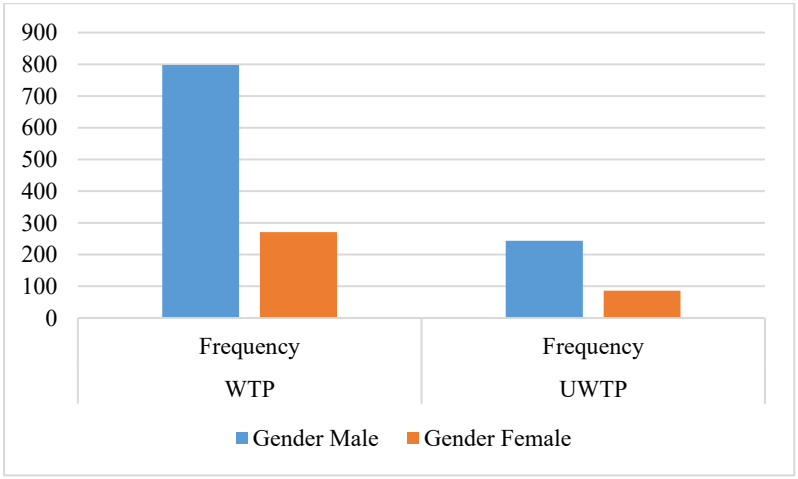
Value of the Asset BDT (USD)	101K-150K (826-1240)	2	0.19	86	26.06
	151K-200K (1241-1650)	177	16.56	56	16.97
	201K-250K (1650-2066)	369	34.52	63	19.09
	251K-More (2070 More	521	48.74	72	21.82

Source: author(s) own calculation

Values in the brackets of Monthly Income and Asset are equivalent to BDT in USD. BDT/USD = 1/121

The table also provides a precise analysis of demographic and socio-economic determinants affecting the individuals' WTP for an improved waste management system in Bangladesh. The table affords a detailed and multifaceted description of demographic and socio-economic variables that would help differentiate the WTP and UWTP populations for private service delivery. Such research discoveries are relevant in counting the number of contributions, considering the determinants of people's willingness to fund service delivery. Let's delve into a discussion based on the data presented in the table: As demonstrated by the data, there is also a significant inequality regarding the gender of people willing to pay: the number of males dominates with 74,65% while females comprise 25,35%. On the other hand, regarding the males' unwillingness to pay, the percentage of females is almost equal to that of males.

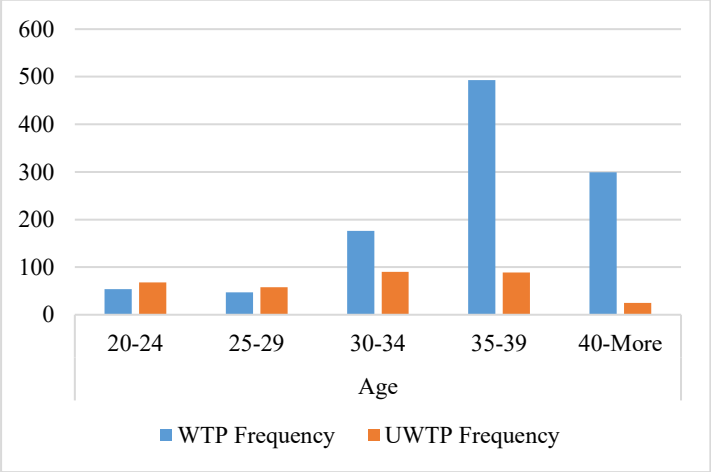
Figure 6: Gender distribution of the respondents



Source: author's own editing

This could be attributed to the socio-cultural factors and economic demographics since males will likely have higher independent purchasing power and decision-making powers regarding service outlay. Another factor that leads to a clear distinction between the two groups is their ages. The WTP target group consists mainly of people in the specified age categories of 35-39 and 40 + years, of which people in the age category of 35-39 represent 46.12% of the respondents, and people in the age category of 40 years and above represent 27.97% of the respondents. In contrast, the rest who are unwilling to pay comprise a relatively younger population, with the largest bracket being the 20-29 year olds. These differences could be related to age differences, life events, roles, and available resources, which can explain why some are willing to pay for such services while others are not.

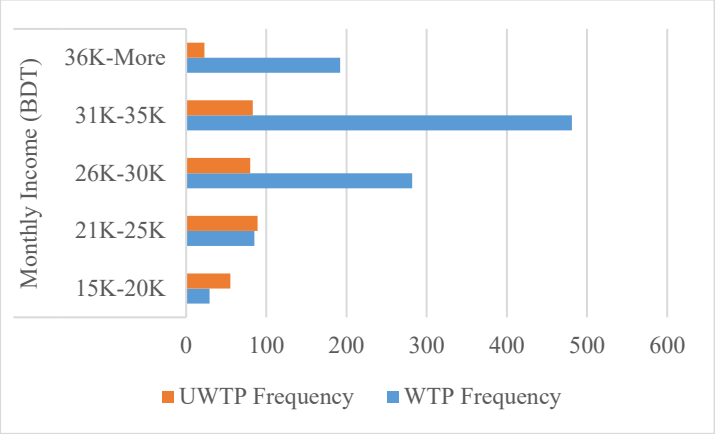
Figure 7: Age Distribution of the respondents



Source: author's own editing

Table 1 presents the actual socio-economic characteristics of the respondents; in the same table, there is an outlook for the respondents. This suggests that consumers' WTP for a product is closely related to their monthly income, effectively defraying the product costs. Looking at the demographics, we find that the privates with more income willing to use the paid services are more inclined toward those earning between 31 K- 35 K and 36K or more. On the other hand, the results indicate that those individuals with lower income, such as those earning between 15K-20K and 21K-25K, show a higher tendency of financial constraint resistance.

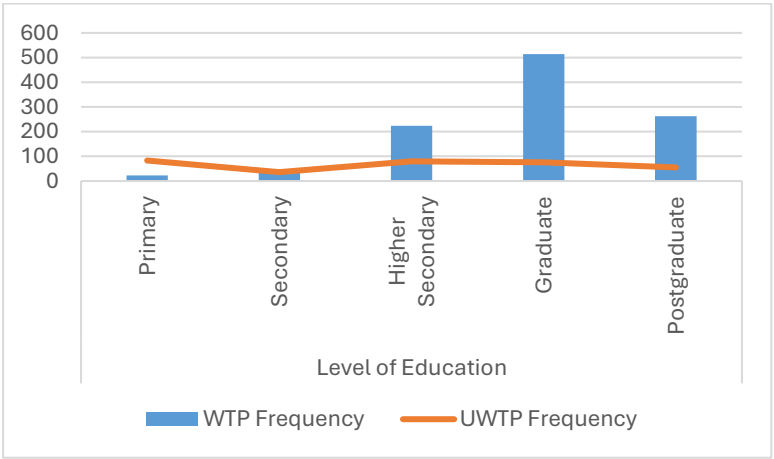
Figure 8: Frequency distribution of the income



Source: author's own editing

Education level also plays a central role in influencing citizens' decisions regarding their WTP. The data also reveal that people with higher levels of education are more willing to pay for services than people with low levels of education; this increases from the graduate and postgraduate levels to the primary and secondary levels of education.

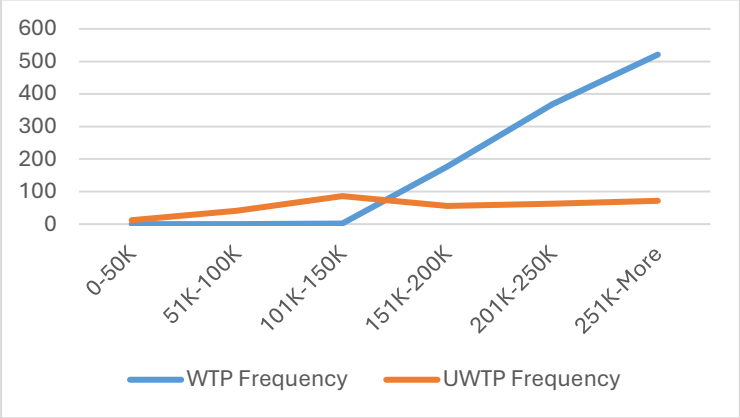
Figure 9: Level of Education of the respondents



Source: author's own editing

The line chart outlines the relationship between assets and willingness or unwillingness to pay for waste management services. A clear positive relationship exists between how much people are willing to pay and the asset's value. Those with assets above 150,000 BDT show a higher desire to spend more, as shown in recent data. Most WTP respondents reported having more than 250,000 BDT in assets, which reached over 500 people in this category. This relationship is visible: individuals with more assets are more likely to use waste services.

Figure 10: The relationship between having assets and being willing or unwilling to pay



Source: author's own editing

The line stays almost constant from 50,000 BDT until it rises above 150,000 BDT. Even though asset value goes up, people's desire to pay rarely drops greatly, which suggests other aspects like trust and cultural beliefs affect their unwillingness to pay.

Table 7: Disposal area in different cities

Disposal Area	Rajshahi	Dhaka	Chattogram	Sylhet	Khulna	Rangpur	Barisal	Total
Municipality/City Corporation Recycle Collector	188	206	117	104	121	93	109	938
Empty Plots	30	66	51	72	37	78	27	361
Highway Side	1	2	0	8	3	3	1	18
Recycle Collector	7	8	0	12	9	3	1	40
Private Farm	6	3	2	7	3	3	0	24
Drainage	4	2	0	6	2	4	0	18
Total	236	287	170	209	175	184	138	1,399

Source: author(s) own calculation

What is also striking is that the distribution of the size of households also appears to be comparable between the two groups; in fact, the largest segment of both groups turns out to be in houses with 3-4 members. Thus, while 39 percent of the population is unwilling to pay, there is a somewhat higher percentage of bigger houses in this segment, meaning that house size may be a factor in

issues about spending money on services. Moreover, users are those with higher asset values who are willing to pay dominantly, more commonly ranging from 251K to More. On the other hand, users who are not willing to invest can have lower asset values, which means a relationship exists between the ability to earn money and the WTP for technology services.

The Municipality/City Corporation Recycle Collector serves as a primary waste collection point in all cities, with high utilization rates: Rajshahi (188 respondents), Dhaka (206 respondents), Chattogram (117 respondents), Sylhet (104 respondents), Khulna (121 respondents), Rangpur (93 respondents), and Barisal (109 respondents).

Table 8: Comparative Analysis of the Willingness to Pay (WTP)

	Willing to Pay (WTP)		Unwilling to pay	
Price/Month BDT (USD)	Yes	Percentage	No	Percentage
100 (0.80)	2	0.19	13	3.94
150 (1.25)	6	0.56	58	17.58
200 1.65)	141	13.19	146	44.34
250 (2.06)	296	27.69	73	22.12
300 (2.47)	187	17.49	29	8.79
350 (2.89)	223	20.86	7	2.12
400 (3.30)	43	4.02	2	0.61
450 (3.71)	108	10.10	2	0.61
500 (4.13)	63	5.89	0	0

Source: author(s) own calculation

*** Values in the brackets are equivalent to BDT in USD. BDT/USD = 1/121**

Empty plots are also commonly used for waste disposal, indicating informal dumping practices: Rajshahi (30 respondents), Dhaka (66 respondents), Chattogram (51 respondents), Sylhet (72 respondents), Khulna (37 respondents), Rangpur (78 respondents), and Barisal (27 respondents).

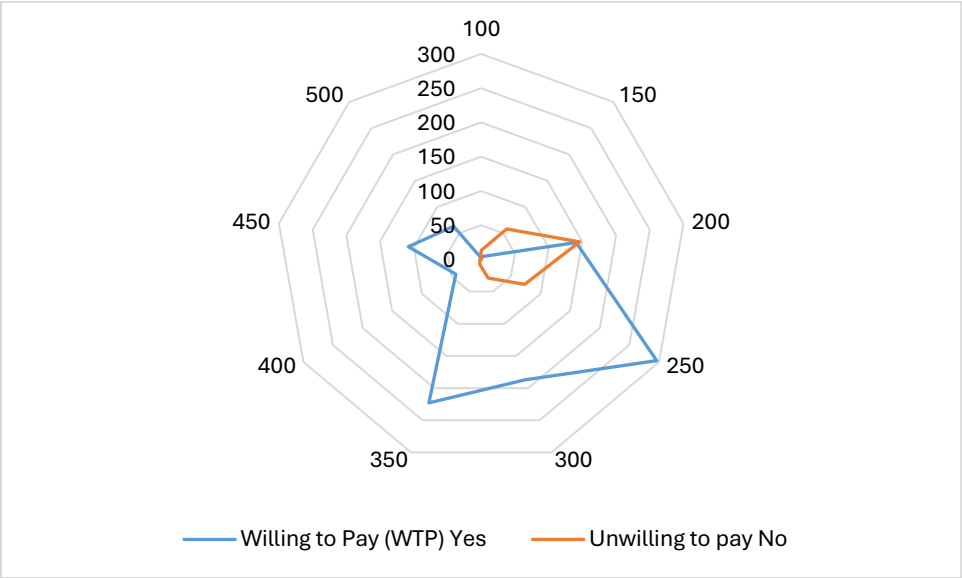
Other disposal areas, such as Recycle Collectors, Highway Sides, and Private Farms, show varying utilization across cities, with smaller numbers reported.

In summary, while formal waste collection services provided by Municipality/City Corporations are widely utilized, there's also a significant reliance on informal disposal sites such as empty plots across all surveyed cities.

Table 8 provides a comparative analysis of the WTP for better waste management in Bangladesh, delineating the monthly payment amounts in Bangladeshi Taka (BDT) for two groups: those willing to pay for the content and those with no intention of paying for the content. The first column also considers individuals' WTP for the amount in BDT, which is depicted below for each month and is analyzed for a better waste management service. On the other hand, the second bar shows a lack of constructive indication of WTP, as portrayed by the low means with no amounts stated under the monthly payment. Indeed, out of all the respondents willing to pay, there is quite an evident split towards how much people would be willing to pay monthly, which is between BDT 100 and BDT 500. Specifically, BDT 250 attracts the highest percentage of respondents, as 296 (27.69%) are willing to pay by providing their figured responses. Respondents belonging to the BDT 200 and BDT 300 categories constitute other large proportions, comprising 13.19% and 17.49% respectively, with 141 and 187 participants. As for the results of the product's popularity with the monthly payment amount, the data totals 60%, reflecting a gradual decrease in the number of respondents falling within the range of BDT 250 to BDT 500. The radar diagram compares Willing to Pay (WTP) and the unwillingness to pay group. The blue line (Yes) shows a strong peak at BDT 250 and BDT 350, indicating these are the most commonly preferred contribution levels among willing respondents. Values drop significantly below BDT 150, suggesting that very low payment offers are not perceived as credible or sufficient to support meaningful service. The line extends up to BDT 500, with a small representation, showing some high-income respondents' support for premium-level services. The blue line indicates that those unwilling to pay tend to

justify their position by citing affordability or dissatisfaction with low-value services. The line remains close to the center beyond BDT 250, implying little to no interest in higher payment tiers among this group.

Figure 11: Comparative Analysis of the Willingness to Pay (WTP) of the respondents



Source: author's own editing

Similarly, rare was the revelation of a willingness to contribute financially for enhanced waste management services among those unwilling to pay; all the monthly payment amount categories will offer an amount for enhanced waste management services. It has eight members, which is still over the willing to pay group, with the majority stating that they are not willing to pay.

Table No. 8 indicates the classifications of the households as per their WTP at different tariff/price structures. Thus, even when asked at what price a monthly subscription of BDT100 is viable for them, all the households responded positively, being 100%. About 74 percent of the households said they would pay BDT150 monthly to watch programs on the Digital System. From the value of BDT 50 each month, the percentage dropped to 63% for each of them. About 48% of the participants provided feedback stating their readiness to spend at least BDT200 per month. Therefore, from the results of the present study, there was a decrease in the extent to which the study participants reciprocated the increase in the price of the service above. Similarly, the results

of this study show that the level of demand is proportional to the cost of the service, and the discovered increase in the price after having a considerable number of participants conditionally suggests a reduction in the number of clients. The logit model was chosen to identify the factors that affect WTP for the service. To control the explained variability, the Pearson chi-squared ($\chi 2$) statistic was used to examine the model's goodness of fit. Based on the likelihood ratio test, the value is calculated to be 226.3052, higher than the critical values at the 5% and 1% significance levels of 124.3420 and 135.8070, respectively. When taking this test, we can see that the vector of coefficients of the elements in the model greatly differs from zero at 5% and 1% levels of significance, respectively. As another measure of fit, default coefficients of estimation P are calculated with the help of the following formula. A chi-square test can also be used in regression analysis, where the value of $P < 0.15$ indicates a lack of fit. The value of p, according to this ratio, should be greater than or equal to 0.15. According to the model, these models present a satisfactory fit. By examining the regression output, it is seen that the value of P is greater than 0.05 and equals 0.6315, which means that the model fits well. Therefore, in the study, the difference between the number of individual factors perceived by the two groups was determined using the t-test, as Table 4 shows. The results of this study, based on the logit model, confirm that the age of the respondents, the average amount of money they were ready to spend, and the collector's brand significantly and negatively influenced their WTP. T-ratios of the variables indicated that age had a p-value equal to 0.10, thus indicating that this variable was significant at a 10 percent level. In contrast, the average quantity and kind of collector had p-values of 0.01, implying that these variables were significant at a 1 percent level.

4.2 Model Evaluation

The logistic regression analysis done for this study was to identify the factors that determine the probability of people having a favorable perception towards enhancing the waste management system in Bangladesh. The intercept coefficient (-9.19) shows when all the given predictor

variables are equal to zero. H4 states that the odds ratio is 0.00, indicating a slim possibility of supporting better waste management if other predictors are omitted. Based on the estimated gender coefficient (-0.03), we can confidently assert that gender has a marginal impact on predicting the odds of supporting better waste management in Bangladesh. Here, the odds for males have been calculated to be 0.97, though insignificant, implying that males are slightly less inclined towards better waste management (p 0.879). This implies that larger households have a slightly higher probability of supporting better waste management (odds ratio = 1.10), given the coefficient of household size (0.10). Still, this effect is insignificant (p = 0.361). The coefficient of the monthly income (.30) implies that greater amounts of monthly income have a positive correlation with supporting better waste management.

Table 9: The result of logistic regression for a better waste management system in Bangladesh

Variables	Coefficients	Odd Ratio	t-statistics	p-value
Constant	-9.19	0.00	-12.25	0.000
Gender	-0.03	0.97	-0.15	0.879
Household Size	0.10	1.10	0.91	0.361
Monthly Income	0.30	1.35	3.41	0.000
Value of the Asset	1.19	3.31	13.72	0.000
Level of Education	0.37	1.45	4.45	0.000
Awareness about Environmental Issues	1.27	3.56	4.39	0.000
Awareness about Climate Change issues	1.33	3.79	7.16	0.000
LR Chi2	595.35			
Pro>chi2	0.000			
Pseudo R2	0.3895			
Log Likelihood	-466.58			

Source: author(s) own calculation

The odds ratio equals 1.35, meaning there is a 135 percent probability of better waste management services with a higher monthly income. The difference between the two groups is highly significant (X2 = 47.64, p <0.000) and, therefore, corroborates the inference that persons from the high-income groups are more likely to approve of better waste management. The coefficient of the Value of the Asset (0.19) in Table 4 shows a positive relationship between the asset's value and the participant's support for better waste management (odds=3.31). The above regression results show a significant and positive relationship between the number of assets and the perception of waste management, where higher asset values are likely to support enhanced waste management practices in the country (p = 0.000). The difference between the two groups is highly significant

(X2 = 47.64, p <0.000) and, therefore, corroborates the inference that persons from the high-income groups are more likely to approve of better waste management. The coefficient of the Value of the Asset in Table 4(0.19) shows a positive relationship between the asset's value and the participant's support for better waste management (odds=3.31). The above regression results show a significant and positive relationship between the number of assets and the perception of waste management, where higher asset values are likely to support enhanced waste management practices in the country (p = 0.000). The odds ratio of 1.45 depicts that the level of education is positively related, and higher levels of education are likely to support better waste management (Coefficient 0.37). This made it easier for researchers to determine the respondents' education level, with the results representing a statistically significant correlation at 0.000, indicating that people with higher education levels support improved waste management. The Awareness about Environmental Issues has a coefficient of 1.27; this shows a significant positive effect, meaning that awareness about environmental issues affects the level of support for improved waste management (odds ratio 3.56). Alternatively, the difference could still be attributable to chance, which is unlikely to the extent of p = 0.000. Also, attitudes towards climate change issues positively impact support for improved waste management with a coefficient of 1.33 and an odds ratio of 3.79 at p 0.0. The confirmation of the overall model fitness was considered using the likelihood ratio chi-square test equal to 595.35, which test was proved statistically significant beyond 0.05 (0.001), therefore inferring that the proposed model accounts for a significant proportion of the variance in the study's outcome. The pseudo-R2 of 0.3895 indicates that the current model explains about 38.95% of the variation in the probability of supporting a better system for waste management.

4.3 Assessing Hypotheses Using Logistic Regression Findings

The research tries to fill the existing gaps in knowledge about the major factors determining people's WTP a premium for better waste management services in Bangladesh. It is noteworthy that through these determinants, the policymakers, urban planners, and waste management authorities can develop better policies and practices that will enhance sustainable waste management, hence enhancing the health and well-being of the people. Table 9 below shows the results of the logistic regression analysis, which can be used to understand the factors that influence the WTP for better waste management in the metropolitan areas of Bangladesh. As hypothesized in H1, the level of education is a significant determinant of WTP for improved waste management.

The findings indicate that the relationship is positive and statistically significant with a coefficient of 0. 37, and a t-statistic of 4. 45, and a p-value of 0. 000. The odds ratio was 1. 45 suggests that people with higher education achievement are one and half times more likely to engage in the practice. This means the respondents are 45 times more likely to pay for better waste management services, rejecting Hypothesis 1. Hagos et al. (2012) also observed the same results, whereby educational level affects the willingness of households to pay for better solid waste management in Ethiopia. Ju et al. (2016) also pointed out that education is a significant factor influencing environmental consciousness and readiness to pay for green initiatives. Furthermore, Guagnano et al.'s (1995) study reveals that educational campaigns can change environmental behaviors by as much as 50%, including waste disposal. Torgler and García-Valiñas (2007) have pointed out that people with higher levels of education are more conscious about environmental issues and are more willing to pay for waste management services.

Likewise, Hypothesis 2, which stated that there is no significant relationship between environmental attitude and WTP, is dismissed. The results indicate that the coefficients of environmental awareness and WTP are positively correlated and statistically significant at 1.27, a t-statistic of 4.39, and a p-value of 0.000. The odds ratio of 3.56 further implies that people with higher levels of environmental awareness are 3. Twice as likely to pay for the enhanced waste management services. Afroz et al. (2009) also pointed out that environmental awareness is one of the significant determinants of WTP for enhanced waste management services in Malaysia. This is also in line with the study by Amoah and Kosoe (2014), which shows that a higher level of environmental awareness among the residents was associated with a higher WTP for enhanced waste management in Ghana. According to Schultz et al. (1995), environmental concern is one of the most important factors influencing pro-environmental behavior, including the readiness to spend money on waste disposal. In addition, Wang et al. (2018) have supported the findings by

stating that environmental attitudes are key predictors of sustainable behavior and WTP for environmental services.

The research also refutes Hypothesis 3, which stated that there is no relationship between climate change attitudes and WTP. The results show evidence of a significant effect of climate change awareness on WTP with a coefficient of 1. 33, a t-statistic of 7. 16, and the p-value of 0. 000. The odds ratio of 3. 79 shows that people with a higher level of awareness of climate change problems are 3. Seven times more likely to be willing to pay for better waste management services. This aligns with Lee and Lim (2018), who revealed that awareness of climate change is a strong determinant of environmental behaviour, including the WTP for sustainability. Furthermore, Li et al. (2019) note that increased knowledge of climate change and its effects affects people's environmental actions and their readiness to participate in sustainability initiatives. O'Connor et al. (1999) discovered that climate change knowledge affects the public's propensity to fund environmental policies and contribute to environmental enhancement. Semenza et al. (2008) also establish that knowledge about climate change influences pro-environmental behaviour, including that of waste management programmes.

As discussed in Hypothesis 4, income level is also positively related to WTP. The findings show that the probability of paying for improved waste disposal goes up with monthly income, with the coefficient being 0. 30, t-statistic of 3. 41. The p value of 0. 000. The odds ratio of 1. 35 also shows that people with higher income have a lesser probability of being in the lower end of the income distribution. Hypothesis 4 is refuted since the respondents are 35 times more likely to pay for improved services. This finding is in concordance with Torgler et al. (2012), who established that income influences the WTP for environmental enhancement. Similarly, Viscusi and Huber (2016) revealed that higher-income people are willing to pay more for risk reduction and environmental quality enhancement. Dasgupta et al. (2006) also concluded that income levels play a role in determining WTP for environmental quality improvement in developing countries. Martinez-Alier

et al. (1998) also substantiate that economic capability increases the probability of investing in environmental services.

On the other hand, Hypothesis 5, which deals with gender, is true. The research does not establish that gender affects WTP, with a gender coefficient of -0.03, a t-statistic of -0.15, and a p-value of 0.879. The odds ratio of 0.97 substantiates that gender differences do not significantly influence the propensity to pay for enhanced waste management services. Grafton and Kompas (2007) also observed that gender differences in WTP for environmental quality were relatively small in their study of water quality in Australia. Carlsson and Johansson-Stenman (2000) also found that gender does not impact WTP for environmental goods.

Furthermore, the study conducted by Tindall et al. (2003) also affirms that gender differences in environmental attitudes and behaviour concerning the financial aspect of environmental concern are negligible. Jones and Dunlap (1992) study also corroborates that gender does not significantly influence environmental concern and WTP for ecological services. The logistic regression analysis reveals four variables: education, income, environmental awareness, and climate change knowledge, which play crucial roles in the WTP for enhanced waste management services in Bangladesh's metropolitan cities. However, gender does not seem to be a factor here, in the sense that the female participants are not more prone to the condition than the male participants. These findings imply that raising public awareness on environmental and climate change information and economic development will improve WTP for improved waste management services. This, in turn, can bring about sustainable waste management and better health and environmental status in Bangladesh.

5. DISCUSSION

Waste management is a central constituent of governance and the ecology of inhabitants' cities, affecting both the developed and developing countries of the world. Since wastage increases with urbanization and industrialization, the increasing size of cities puts a lot of pressure on the existing infrastructure concerning waste management. Such a problem has great social and economic consequences, as poor waste management results in health risks, pollution of the environment, and great financial losses for city councils.

This paper finds Bangladesh in the middle of these issues, just like most developing countries today. The population of this country has increased greatly, and the concentration of this population in cities like Dhaka and Chittagong has accelerated urbanization, which in turn has raised the issue of waste. These urban centers fail to have efficient solid waste management; hence, there is so much uncollected waste, and some of the worst disposal methods include open dumping and burning. These practices are dangerous to people's health, especially in crowded city settlements, as they spoil the land, water, and air.

WTP is a monetary value that the stakeholders or users can pay to enhance the delivery of a specific service, such as waste management. For a country like Bangladesh, which lacks well-developed waste management services, evaluating the factors that may determine WTP can offer valuable guides for policymakers in formulating a more efficient and sustainable waste management system.

This discussion synthesizes the literature reviews on WTP of Bangladesh, focusing on the overview of socio-economic, cultural, and environmental factors affecting public attitudes and behaviours towards waste management. It also puts Bangladesh in a global perspective and discusses the relevant policy themes for Bangladesh, as well as outlines potential research areas for future investigation. Last, the discussion brings some recommendations for enhancing waste

management systems in Bangladesh: Practicing Social Marketing Effectively, Developing Public Awareness about Waste Management, and Investing more.

Environmental managers and city planners point to waste management as one of the biggest concerns due to the increasing amount of waste generated in cities worldwide. The growing population, urbanization, and industrialization trends in developing countries have resulted in an increasing amount of waste. There are projections that global municipal waste generation will rise to more than 2.2 billion tons yearly by 2025 due to population growth and urbanization. This poses a big problem in most developing countries where infrastructure to manage waste is almost negligible, hence the observed environmental and public health impacts.

Waste management systems are well-developed in developed countries like Germany, Sweden, and Japan. Such countries employ various policies of waste management and recycling, the use of energy from waste, and the volume of waste allowed to be disposed of. Public involvement in the management of waste is also enhanced in these nations. People are willing and able to pay for services that guarantee a cleaner environment and improved health standards. In these contexts, WTP depends on the gross income of waste management services, the environmental consciousness level, and perceived utilities.

However, the scenery is different in the developing world, especially Bangladesh, where there is always a great challenge with waste management systems that are underfunded and poorly managed. The amount of waste in Bangladesh is worse in urban areas, especially in densely populated cities like Dhaka. Daily waste produced in the city is estimated to be 6500 tons, projected to increase to 8500 tons per day by 2032. Still, only around 55% of such waste is collected, with the remaining uncollected waste potentially causing many more health and environmental problems.

Several factors make the issues of waste management in Bangladesh difficult. First, the public has insufficient knowledge regarding waste disposal and the consequences of poor waste management on the environment and people's health. Many people in urban regions expect the government to be in charge of handling waste, and they are not willing to pay anything extra for enhanced services. Secondly, the civil structure for waste management is insufficient, and resources for waste collection, transportation, and disposal are scarce in Bangladesh. This has resulted in inefficient systems that engage in open dumping and other environmentally unfriendly activities. Third, there is little spending on waste management infrastructure, including proper recycling facilities or facilities that turn waste into energy.

In this regard, the public WTP has to be enhanced to address the inherent challenges in waste management services. In light of this analysis of the determinants of WTP, such specific policies should be formulated to increase the amount of public participation in these functions and ensure that a sustainable stream of funding for the (currently inadequate) waste management services is available.

The main focus of this study is to determine the factors that affect the WTP of the community on upgraded waste management services in Bangladesh. Namely, the study investigates how socio-economic and environmental factors influence WTP, including income levels, education, attitude, and knowledge toward the environment and climate change. Furthermore, the study aims to employ the identified factors to understand the complex relationships between them and to explore if some groups of consumers are more likely to pay for waste management than others, for example, citizens with higher household incomes or individuals with higher levels of education.

The secondary purpose of the research is to offer policy implications for the observed phenomena. It is thus important that decision makers give special attention to the determinants of WTP to formulate tools that help the public fund waste management, hence relieving the current strain on

the local authorities and enhancing the delivery of efficient waste management services. The research puts more information into the existing literature on WTP for environmental services in developing countries, where, relative to developed countries, values, behaviors, and perceptions are more influenced by the economic, social, and cultural factors.

This study used a multiple-methodology design that included SRL and quantitative research methodologies. It helped to consider various international tendencies concerning waste management and the situation in Bangladesh simultaneously.

SLR, which forms a part of this research, captures the synthesis of international studies in relation to establishing the factors that affect WTP for better waste management services, focusing on the developing world, including Bangladesh. From a synthesis of many papers, they highlight crucial factors of WTP, difficulties experienced by developing and developed countries in waste management, and lessons that could be learnt from the Bangladeshi context.

The review focused on several key areas: socio-economic factors influencing WTP and environmental awareness, policy and regulatory systems on waste management, and public participation. The following discusses the literature review findings and their implications for Bangladesh, the study's conclusions, and policy implications. However, one of the most obvious findings from the SLR is exploring socio-economic factors as major predictors of WTP for waste management services; these comprise income and education levels. A lot of literature reveals a positive correlation between income level and WTP. It is evident that with the higher disposable income, more income-earning households can pay more for the desired improvement in public services such as waste management. The same holds for the case of the U.S. and other developed and developing countries. Observances made in some Asian countries, such as Thailand, Pakistan, and African countries like Ghana, as well as other developed countries, have discovered that the higher income group can and is willing to pay for waste management services more than the lower

income group. The rationale is that higher-income consumers are concerned with health and the environment, which shows that an improved urban environment will improve society's health. Income inequality, however, poses some restraints in several low-income earner households, particularly in developing countries, in that such households have fixed expenditure needs such as food and shelter. Therefore, expenditure on waste management has become a low priority among them. The relationship between education levels and WTP is listed below because educated people know the effects of poor environmental management, such as on health. The research carried out with reference to Nigeria and India in particular suggests that highly educated people prefer such an approach, as they comprehend the advantage of improving waste disposal and recycling in the long run. The formally educated people are also likely to know international environmental issues, such as climate change, which affects their WTP of services that can handle such risks.

For Bangladesh, the implication of these findings is clear: any change that seeks to enhance WTP cannot ignore the divergence in status of the inhabitants of these urban regions. Due to the high extent of income disparity and differential literacy levels in cities such as Dhaka and Chittagong, the sustained support in financial incentives and awareness creation, especially among lower-income and less educated populations, will be crucial to their involvement in improving waste management services.

The literature review also found that environmental attitude and public awareness influence WTP's waste management services. Environmental consciousness is significantly well developed in some countries, and people there can clearly understand the necessity of paying for those services, which would result in cleaner environments and enhanced public health. It is more relevant, especially in those countries' recycling and waste management practices, such as Germany, Sweden, and Japan.

Some of the studies suggested that individuals with a pro-environmental stance are willing to pay for improved waste management services. These people have decided to be environmentally

conscious to minimize their environmental impact, become cleaner themselves, and embrace things such as recycling and composting. Education surveys done in Europe and North America proved that while investing, people with high internalization of environmentalism prefer services with value-consistent environmentalism.

Indeed, most effective waste management programmes are underpinned by vigorous public sensitization programmes that inform the public on the importance of recycling, segregation of wastes, and efficient waste disposal practices. For example, as the waste management systems in countries such as Japan are very advanced, people there are educated on whether or not to sort the waste and recycle it, leading to a high level of compliance. The review identified that many countries in the Global South have inefficient waste disposal systems with limited public awareness of how poor waste management affects the environment and increases health risks. Lack of such awareness dramatically minimizes WTP because people are unaware of the positive change a well-developed waste management service would make.

Specifically, in the case of Bangladesh, the SLR raises the argument that increasing WTP is pre-conditioned by raising public awareness of waste management's environmental and health implications. Environmental education and public awareness on appropriate waste management measures remain relatively low. Consequently, public awareness initiatives must remain a vital component of any intervention effort towards enhancing waste management in the country, especially when these initiatives link waste management, health, and climate change.

The quantitative part of the study consisted of a questionnaire, which was carried out in Dhaka, Chittagong, and Sylhet- the three principal cities in Bangladesh. The survey and the WTP questions sought to obtain information on the respondents' income, education, environmental concern, and awareness about climate change. They were asked to give details of their outstanding current

systems for managing waste, their satisfaction with the services offered, and their readiness to pay for better waste management systems.

The data collected from the survey were regressed on econometric models to test WTP about other independent variables using logistic regressions. Logistic regression was used to deal with the binary response, WTP for waste management services, controlling for income and education level. The study also entailed comparing the research findings of Bangladesh with the trends developed from other countries in the literature review, which further enriched the understanding concerning the problems & opportunities vis-a-vis Bangladesh only.

The investigation of WTP determinants showed that income and education are the two strongest predictors of WTP. As seen in earlier research, the high-income respondents were willing to pay for better waste management services. This can be attributed to the realization that the wealthier households' sector normally has higher disposable income and hence, can purchase the public services. In addition, the rich may be more sensitive to the positive impacts of enhanced waste collection practices, as well as the risks of illnesses arising from poor waste disposal that come with enhanced waste collection services, and thus, they can afford to pay for these services.

On the other hand, the inhabitants of Bangladesh with low-income levels were either reluctant or could not afford to pay for waste management services. This is not very surprising because households with lower income cannot afford to think about investing in such luxuries as innovation, most of their time is spent trying to put food on the table, a roof over their heads, and paying for their children's education. Thus, these households may have lower capacity or willingness to invest in waste management because to them it is an obligation or the last on their list of priorities. This has brought the need to develop special incentives or financial support schemes to help the poor engage in waste management activities without necessarily putting them in a more vulnerable position than other social programs.

Returning to education, this cultural factor also influenced the decision, as far as WTP was concerned. Households with more education know the negative environmental/health consequences of poor waste management and are willing to pay for enhanced services. The implication of this finding supports the theory of planned behavior, given that individuals with better knowledge of an issue are more likely to exhibit behaviors that deal with that issue. Here, educated people become aware of the advantages of proper waste management, and to this degree, they will be willing to spend cash on enhancing those services.

The study also included the subject of environmental attitudes in connection with WTP. Environmental attitudes may be defined as people's mental processes and personal convictions toward the environment and its protection. According to our findings, adopting positive environmental attitudes raises WTP for environmental services, such as waste management, in many developed countries.

However, the analyses carried out in this study indicate that environmental attitudes have a relatively small influence on WTP in Bangladesh. There is, however, emerging proof that people with an environmentally positive attitude are willing to pay towards waste management, but not to the level observed in other countries that have achieved developmental status. The reasons for this might be a lack of knowledge of environmental issues and their impacts, owing to the low literacy level of such families, particularly in Bangladesh. Even physical needs such as food and shelter can overshadow environmental concerns in many situations. Thus, tapping into WTP for waste management services would not be easy based only on environmental perceptions.

This suggests that cultural factors have a role in constraining the impact of environmental attitudes in shaping WTP in Bangladesh. This is the case with most developing countries, such as Bangladesh, where waste management is viewed as the government's responsibility. Such perception may demote the willingness of people to contract personally the services in waste

management since they think that the government should offer the services without any charges. The second variable analysed during the study was climate change awareness. Waste management is strongly connected with climate change since the incorrect disposal of waste, especially organic waste, produces greenhouse gases, including methane. Therefore, anybody with information on climate change and its effects is likely to be willing to pay for enhanced waste management services to reduce such effects.

Based on the research, insight shows that despite the increasing concern about climate change in Bangladesh, especially in the urban centres, this concern does not affect WTP for waste management services. This might be the case because the subject of climate change remains relatively unfamiliar and distant for many citizens of Bangladesh, and its links with waste disposal are not apparent. In addition, short-term economic self-interest begets environmental self-interest, meaning it is almost impossible to convince people to invest their money in waste management services based on awareness of climate change.

Therefore, there must be public enlightenment on the effects of climate change on the proper disposal of waste, especially in urban areas where the effects of poor waste disposal are well felt. These campaigns can therefore play a great role in improving the public perception towards 'waste management' and perhaps more investment in such services, because they inform people about the environmental and health effects of proper or improper disposal of waste.

Another variable of interest in the study was gender, given previous studies showed females' propensity to be concerned with environmental matters and their possible WTP for environmental products or services compared to their male counterparts. In Bangladesh, however, the study results reflect that gender does not have such a significant influence on WTP for waste management services. For instance, although women, especially those who head families, urged the need to pay for improved services to avert the nuisance impacts of poor waste management on

health, many among them were constrained due to poor economic activities in the following capacity factors: Low-income levels, poor access to credit, among others. This is like cross-country comparisons, which show that although women may have higher perceived environmental awareness, their understanding of environmental issues is tempered by their ability to pay for environmental goods and services. Consequently, although gender has the potential to affect attitudes towards the environment in Bangladesh, it does not affect WTP practically, especially where economic factors are considered.

Nevertheless, some significant differences can be identified if one compares the results gathered in Bangladesh with the findings available in the global context. WTP by the people of developed countries for waste management services depends on income level, demographic factors such as awareness of environmental issues, and confidence in the government's ability to address the waste issue. Well-designed information campaigns, functional recycling systems, and favorable legal measures to protect the environment influence choices and lead to higher WTP in countries such as Germany, Sweden, and Japan.

However, the situation in Bangladesh differs from that of Western countries due to different social and economic conditions. Thus, the identified factors of WTP for waste management services are the income and education levels; nevertheless, there are hardly adequate abilities and public concern concerning the impact of efficient waste management on public health and the environment in low-income households. Also, the WTP is low due to low public confidence in the efficiency of the government in managing waste effectively. The difference relates to everyday environmental attitudes and climate change awareness. In most developed societies, such factors determine public WTP for waste management services. However, in the case of the Bangladesh environment, the correlation between environmental attitude and WTP is not very high because, in such a country, immediate market priorities will generally supersede environmental causes.

Public awareness of climate change has risen slightly, but it has not yet attained a standard that could ensure behavioral change on waste-related issues.

These findings indicate the possibility of getting context-specific policy interventions in Bangladesh. The best practices in waste management from across the world may be useful to Bangladesh; however, these best practices should not be imposed without considering the social, economic, and cultural disparities in Bangladesh's society regarding waste management. The literature study indicated that legislative and regulatory considerations significantly influence consumers' WTP for waste management services. This concept is substantiated by the observation that adversarial environments demanding adequate waste disposal practices and improved pollution management typically achieve greater compliance and WTP. This is particularly accurate in nations where waste management policies are developed within the context of environmental and public health policies. Research on European countries, including Germany, the Netherlands, and Sweden, indicates that elevated WTP and adherence to waste management legislation necessitate rigorous formal legislation and effective enforcement mechanisms. These countries implement regulatory measures such as 'source separation' of garbage, waste-to-energy projects, and landfill taxes, which incentivize citizens to adhere to disposal guidelines. Such methods are effective since they establish laws that must be adhered to, with noncompliance resulting in fines; this facilitates the assessment of residents' accountability regarding trash management. The survey indicated that Public-Private Partnerships (PPPs) effectively improve waste management facilities, particularly in developing nations. Comparable public-private partnerships have been implemented in nations such as India and Brazil, enhancing waste collection and processing services. These alliances occasionally secure funds and technologies from private entities that improve the technologies and sustainability of waste management systems. The efficacy of PPP arrangements is contingent upon well-defined legal frameworks that provide advice on trash collection, treatment, and disposal. Bangladesh presently possesses a very recent regulatory

framework for the garbage sector, accompanied by a feeble enforcement mechanism. Evidence from the systematic literature review suggests that augmenting the current rules of waste-to-energy technologies and expanding their enforcement are crucial for increasing WTP and promoting the long-term sustainability of waste management services. Policymakers in Bangladesh should also evaluate the implications of Public-Private Partnerships (PPP) for attracting new investments and improving technical expertise in trash management. Another significant insight derived from the examination of this material is the involvement of the community in trash management. Community-based waste management methods have improved numerous nations' recycling, trash minimization, and disposal practices. They all pay significant attention to the engagement of community members and can foster collective responsibility for the cleanliness and overall welfare of the communities. Research conducted in Kenya and the Philippines demonstrates that community-based trash management has improved WTP by involving community members in the planning and execution of waste management systems. In these circumstances, local community members were educated about the environmental and economic implications of proper garbage disposal and recycling. Participation in such initiatives increased WTP and instilled a sense of responsibility among residents regarding proper trash management. The review emphasized that cultural and socioeconomic elements influenced the public's approach to proper trash disposal. Waste management is, to a certain degree, influenced by a particular country's culture and society, which inspires others to emulate positive practices in recycling and garbage management. Conversely, when individuals view waste management as the responsibility of the central government, community engagement is insufficient, and WTP is diminished.
The literature review analysis about Bangladesh suggests that community-based waste management initiatives could enhance involvement levels and WTP. This method posits that the government can solely motivate district inhabitants to participate in trash management and ensure their contribution to environmental cleanliness. Such programs may be most beneficial in

metropolitan settings due to the heightened population density and garbage generation in these areas. The results of the systematic literature analysis provide some significant insights for Bangladesh as it endeavors to enhance its waste management systems and elevate willingness to pay for trash services: Given that income and educational attainment significantly affect WTP, it is imperative to implement policy interventions that are attuned to the income levels within society. Individuals with low income may require subsidies to participate in trash management, whilst those with high income can be incentivized to pay for enhanced services through suitable rewards. Consequently, to augment WTP, it is essential to elevate public understanding regarding the repercussions of inadequate resource management on the environment and human health. Promoting sustainable public awareness of the importance of efficient garbage disposal, recycling, and waste-to-energy initiatives is crucial for securing the necessary funding to support these services. Bangladesh must enhance its regulatory requirements and fines to ensure compliance with waste management standards. If individuals are informed about the protocols for waste segregation, collection, and disposal, and face penalties for non-compliance, the efficiency of waste management systems could be augmented, and public willingness to invest in these services may be increased. The utilization of PPP holds potential, since it can attract essential financial investment and expertise to enhance the waste management sector. Social sustainability can be achieved by waste management initiatives that engage local communities, thereby fostering a sense of responsibility towards trash management. Measures such as recycling bins, garbage segregation, and composting by community members

The results of this study have important policy, environmental management, and economic strategy implications in influencing the WTP for improved waste management services within urban areas of Bangladesh. There are apparent trends in socio-economic differences between willing and unwilling clients for private service delivery. The stampers, as those willing to pay, include mostly males, an older generation, and those with higher income, education level, and value of personal

assets. On the other hand, the unwilling users are more likely to be females with lower average and median income, educational attainment, and asset value, but those with higher age and usage frequency. It, therefore, indicates that more attention should be paid to demographic and socio-economic factors when developing service delivery strategies that would enhance substantive and effective service delivery in society. These findings are worthy of consideration for providers and policymakers in protective services. In this light, knowledge of the demographic and socio-economic drivers of WTP can encourage relevant and timely marketing, product positioning, and policy pertinent to affordable and quality accessibility for common human rights like health and education. Similarly, efforts to tackle persisting issues of poverty and inequality in terms of income, education status, and access to assets can also help improve socio-economic status and the overall equitable share of the benefits of services accruing to different parts of the population pyramid. More importantly, identifying Recycle Collectors under the Municipality/City Corporation as the major waste collection means indicates a formal garbage disposal system. As noted throughout the study, many respondents within the surveyed cities brought their waste to formal service providers. This gave a sneak peek into the functions of proper waste management systems, especially in combating the upsurge in urban waste. This can be further explained by the fact that proper waste collection services are available, but empty plot areas are still high, showing that informal dumping is still being practiced. This points to inadequate waste management facilities for proper disposal or a lack of knowledge of better environmental waste management practices, hence resorting to landfill sites. Eradicating these informal practices is central to reducing environmental pollution and prolific communal health hazards compounded from unmonitored waste disposal. Although more and more households use waste collection services, there are several ways for informal disposal. Some could involve expanding the population's access to standard waste disposal services, organizing public awareness programs for effective disposal techniques, and imposing sanctions against individuals unlawfully engaging in waste

disposal. To a certain extent, proper financing of waste treatment plants and investment in recycling facilities will also reduce landfill dependency by encouraging the recycling of waste materials. Disposal systems' differences also present the importance of integrated resource management and waste management systems that must respond to cities' socio-economic and infrastructural contexts. There are many studies on the effectiveness of interventions that have been designed at the city level. Still, it was realized that what may work in one city may not work in another, making it very important to make any intervention based on the context at hand. As the case may suggest, the responsibility of designing and implementing WMR strategies cannot be the preserve of individual governments, communities, or other related stakeholders but a collaborative function that involves the people, the various county governments, and organizations, among others. It can be inferred that respondents' WTP amounts demonstrated in the study indicates different levels of commitment towards crowdfunding. A small number of passengers are ready to pay a relatively low amount of money, 100 BDT which equivalent to USD 0.80 in this case, for one month only (0.19%); at the same time, a rather significant percentage of respondents is interested in paying more, with the most popular options being above 200 BDT (USD 1.65) up to 350 BDT (USD 2.90), which covers about 60% of the passengers willing to pay. Based on the distribution evidence, consumers are willing to pay more for improved capacity for handling waste, thus showcasing an appreciation for the noble cause of waste management practices and environmental consciousness. Such willingness of the public to give their cash towards the cause demonstrates the possibility of supporting advanced waste management endeavors as well. Data derived from the study also reveal variations in the amount of WTP from one income category to another. Affected individuals may be willing to dig deeper into their disposable income to pay for better quality waste management services. More so, those with higher income standards may find it easier to make these enhanced payments than those in lower income brackets.

A key insight from this study is that households in the lowest income quartile showed a notably lower WTP, even though they expressed moderate to high levels of concern about environmental issues. This supports prior assumptions that willingness does not necessarily equate to financial ability. As a result, although WTP data can guide the development of funding strategies, applying uniform cost-sharing models could unintentionally marginalize low-income households, exacerbating existing inequalities. This dilemma highlights the nature of waste management as a public good, where promoting social welfare might require redistributive approaches.

Furthermore, the study found that institutional trust and perceptions of fairness in pricing had a strong impact on WTP across all income levels. Consequently, beyond offering subsidies, enhancing transparency and accountability in how services are delivered could help boost participation among diverse socioeconomic groups.

To meet the needs of these population segments and avoid increasing the economic inequalities mentioned above, people require improved waste management solutions. When the data were analyzed using the logistic model, they showed some important factors in the following sections regarding enhancing a better waste management system in Bangladesh. Regarding the country's waste management practices, these results are quite revealing for Bangladesh. The significant correlations between the selected demographic variables, such as monthly income, asset value, and level of education, with the support for the enhancement of better waste management, point to the fact that SEP indicators affect their perception of environmental issues. Educational campaigns and programs must be improved, as well as general economic conditions. An increase in educational levels is expected to help raise support for better waste management. The results presented, which point to the positive effects of awareness about environmental and climate change issues on the support for better waste management, suggest that effective methods of environmental education and environmental promotion efforts should be pursued. Promoting knowledge of the effects of poor waste management on the environment and health is a crucial

strategy that can contribute to changing behavior, policy formulation, and enactment. The major actions could be proposed to the leadership of Bangladesh, and they are as follows: The leadership of Bangladesh should design policies that would improve waste management from the viewpoint of the socioeconomic status of citizens, promote education on the environment and climate change, and encourage citizens to expand their knowledge on these topics.

Therefore, the findings of this study offer significant knowledge of WTP determinants for better waste management services in metropolitan cities of Bangladesh. A clearer view of several crucial factors has been unveiled by this logistic regression test, such as the educational level, environmental attitude, level of awareness on climate change, and the income level of the individual respondents and other variables of the study; gender being one of them, which has not emerged to have any significant effect on the intentions towards environmentally friendly energy. The findings align with the literature, thus supporting socio-demographic factors concerning environmental behavior. Firstly, the correlation between the subjects' education level and WTP proves the significance of educational activities in terms of sustainable beliefs and cognitions. Educational attainment is postulated to enhance environmental consciousness and the efficiency of waste disposal, as supported by Afroz et al. (2009) and Hanaki & Hasegawa-Kurisu (2009). Based on these findings, it can be inferred that improving education programs may boost people's support for environmental activities in Bangladesh.

It's important to differentiate between a household's WTP and its actual ability to pay. WTP reflects the household's attitudes and the value they place on waste services, while affordability depends on their real disposable income. Many low-income participants supported paying, but lacked the financial means to do so. This highlights the importance of incorporating targeted subsidies and cross-subsidization into tariff structures to ensure fairness (Mitchell & Carson, 1989; Whittington, 2010). Creating lasting behavioral change in waste management goes beyond just raising awareness—it requires a combination of environmental education, subtle behavioral

nudges, and legal enforcement. Incorporating waste literacy into school programs and using symbolic rewards, like clean neighborhood awards, has shown success in Indian cities through the Swachh Bharat Abhiyan campaign (MoHUA, 2020).

Additionally, gentle penalties for non-compliance, such as fines for failing to separate waste, can strengthen a sense of civic duty and support voluntary willingness-to-pay (WTP) efforts (World Bank, 2018). With around 74% of Bangladesh's urban waste being organic, there's strong technical potential for waste-to-energy (WTE) solutions, especially through biogas production and composting (Waste Concern, 2021). However, scaling up to large thermal WTE plants presents significant hurdles, such as the need for substantial capital, limited land availability in crowded cities, and a lack of cohesive governance. Pilot initiatives in Dhaka and Narayanganj highlight the urgent need for more robust public-private partnership (PPP) models, long-term operational agreements, and stronger environmental protections (ADB, 2020; UNESCAP, 2019).

Environmental attitudes and climate change awareness are significant for WTP, pointing to people's increased concern about environmental problems in the urban setting. According to Carson et al. (2001) and Franzen & Vogl (2013), awareness of the environment and climate change encourages people to embrace waste management services. This means that public education campaigns about the effects of environmental and health costs of poor waste management could go along with improving community engagement and funding contributions towards waste management. The results also revealed that annual income was a significant variable for WTP, and people with higher incomes were willing to pay more for waste management services. This supports the research works of Awunyo-Vitor et al. (2013) and Altaf & Deshazo (1996) that distinguish financial capability as one of the features that enhance support towards environmental services. The implication for policymakers is the necessity to develop pricing policies that will address the unequal distribution of income regarding the provision of waste management services. Surprisingly, gender was found to have no influence or effect on WTP, indicating no difference

between the two groups: male and female, in the WTP for waste management programs. The present study does not concur with some prior research works where gender disparities in environmental behaviors were noted (Dupont 2004). This means it is time to develop other demographic and socio-economic factors, different from gender, as the key waste management strategies. The study also shows that the objects disposed of depended on the official waste collection services Municipalities & City Corporations offer, but informal dumping still exists. This may be due to infrastructural problems, or the public does not know what to do with their waste. It is possible to minimize informal dumping and the subsequent negative impacts if those problems are solved with the help of better infrastructure, increased control of waste management legislation, and large-scale public awareness.

To sum up, these observations identify the need for integrated solutions to address waste issues in Bangladesh. Thus, promoting education programs, raising awareness, adopting low-income tariffs, or implementing improved infrastructures provides policymakers and service providers with strategies for engaging the public and supporting sustainable waste management activity. Thus, future studies should further examine these factors in various settings to identify relevant interventions suited to the contextualized issues affecting different populations in this country. Research has shown that providing sufficient waste management structures and recycling facilities, as well as increased public awareness measures, would help improve the present conditions of waste management and the overall state of the environment in Bangladesh. In summary, the study hence points out the complexity of waste management issues in Bangladesh and the indispensability of employing strategies that address social and economic development and environmental enlightenment as policies that will improve waste recycling standards and environmental health in Bangladesh.

6. CONCLUSIONS AND RECOMMENDATIONS

This study emphasizes the necessity of implementing comprehensive strategies to improve waste management systems, focusing on socio-economic and demographic factors in Bangladesh. Higher income, education levels, environmental consciousness, and the perceived benefits of payment influence WTP for quality waste management services. Policies addressing these factors can support sustainable waste practices. Policy recommendations include expanding environmental education efforts to improve awareness, introducing differentiated charge systems designed to ensure affordability, addressing gender inequalities in household financial decisions, and stepping up public information campaigns on the benefits of good waste management and investment in infrastructure such as recycling centres and energy-from-waste plants. All these measures can collectively reduce the growing waste problem, improve public health, and build a more sustainable environment in Bangladesh.

6.1 Conclusions

The hypotheses formulated in this study investigate the sociodemographic factors influencing the willingness of individuals to pay for better waste management in urban areas, mainly in Bangladesh. Altogether, these hypotheses are instrumental in explaining what makes the public embrace or reject waste management practices, which is the information base for developing appropriate policies and interventions. The first hypothesis is that education level has no influence over WTP for improved landfill management in Bangladesh. This hypothesis assumes that education might not necessarily mean environmental awareness or issues related to proper waste management disposal. It has chosen Bangladesh as a less developed country to test this hypothesis. Indeed, as evident from the estimation results presented in this paper, WTP is positively related to education levels. This implies that college-educated students are more likely to support intensified levels of waste management improvement, probably due to self-awareness, knowledge, and understanding of the environmental effects. Just as in the first hypothesis, the second and third

hypotheses also establish no correlation between the environmental attitudes and the climate change attitudes, respectively, and the WTP is higher for the improved waste management of urban Bangladesh. These hypotheses run counter to other perceptual-attribute ideas regarding the impact of environmental awareness and consideration toward climate change on people's propensity to spend on waste management enhancements. However, the results from the analysis give more support to the opposite, deciding that environmental consciousness and concern for climate impact have a positive relationship with WTP for enhanced waste disposal. This finding thus has implications for the need to promote environmental awareness and concern in the face of increasing climate change influence on public acceptance of waste management practices, which is even relevant amongst the less developed nations. Additionally, the fourth hypothesis states that the income level is not likely to affect the WTP of the people in the urban area of Bangladesh. This hypothesis assumes that socioeconomic status may not significantly affect people and their commitment to invest in improving waste management, especially in a country with high income inequality. Nevertheless, an analysis of the results demonstrates that the two hypotheses are accurate, as the data points to a positive relationship between equity values, an indicator of income level, and WTP for the enhancement of waste management services. This implies that people with high SES are more likely to support measures that address waste management problems. Saying this, measures requiring financial support to address waste and management problems may likely be supported by persons with high SES, as the former can fund such measures.

Lastly, the fifth hypothesis indicates that WTP in the urban areas in Bangladesh is not significantly differentiated according to gender. This hypothesis raises the issue of whether sex factors differentiate people's perception of waste management and the need to change it. However, in this study, the panel data regression model fails to establish a considerable and consistent relationship between gender and WTP. Hence, one can argue that the gender of a respondent may not be a major factor influencing WTP in improving the waste management system in the urban

Bangladesh context. When comparing them with the findings in developed countries, where the management of wastes, human awareness, and accumulations of infrastructures may be somewhat higher, nearly similar results are revealed. In developed countries, there can be a few other factors, like education level, environmental attitude, income level, and gender, that might still affect the WTP for waste management improvements. However, the direction and importance of those factors may spin differently. For instance, the effects derived from education on WTP may be even higher in developed countries with higher levels of education, and powerful environmental groups and people are more concerned with environmental issues and willing to pay for sustainable solutions. Likewise, the cross effect of income level might depict a different picture concerning WTP, as people in the higher income bracket might be willing to spend more money to enhance waste management services due to affluent disposable income as well as a higher level of concern with environmental issues as compared to people below them on the socio-economic ladder.

However, information from comparing the findings with those of other LDCs can help further explore the contextual influences of public perceptions of waste management. In the context where waste management facilities could be poorly developed, and knowledge and attitudes towards the environment could also differ from country to country, the findings of this study could have more generalized implications, especially in less developed countries like Bangladesh. For example, policymakers in other LDCs may be able to mimic the results to develop better interventions that will help increase awareness of environmental issues, enhance the physical facilities for waste management, and engage communities in waste management activities. Moreover, international coalitions and knowledge-sharing platforms may help identify and determine possible approaches to proper waste management and share international experiences regarding effective achievements and failures within environmental conservation and sustainable development.

In conclusion, the present research has underscored that the choice of HWTL, and hence individuals' WTP for better waste management in the urban areas of Bangladesh, is determined

by various socio-demographic factors. By comparing knowledge from the present studies with that in developed countries and other LDCs, some useful lessons are learned about the nature of the contexts concerning waste management and public attitudes, and the possible consequences for policy intervention and policies. It can be used to develop relevant strategies or programs that can be implemented to facilitate successful WMMR and environmental sustainability goals in the region and the world at large. To sum up, efforts to address some of Bangladesh's principal waste management issues must be multi-faceted and engage policymakers, service providers, and communities alike. At a more structural level, policy improvements, advances in the development of talents and structures in organizing formal waste management structures and recycling facilities, and an increase in public awareness campaigns for the existence of better and adequate waste management practices all have the potential to reduce waste-related pollution significantly. Although this study examines household WTP, it does not suggest that waste services should be privatized or entirely outsourced. Instead, the findings on WTP are meant to support—not replace—the government's essential role in providing public services. This perspective aligns with principles from New Public Management and public finance theories, which advocate for shared financial responsibility between the state and its citizens (Osborne & Gaebler, 1992; Musgrave & Musgrave, 1989).

In conclusion, addressing Bangladesh's waste management challenges requires coordinated efforts from policymakers, service providers, and communities. Formal waste management infrastructure investments, public awareness campaigns, and targeted policy interventions are essential for promoting sustainable waste management practices and enhancing environmental quality. By prioritizing equitable access to waste management services, addressing informal disposal practices, and raising public awareness, Bangladesh can pave the way toward a cleaner, healthier, and more sustainable future.

6.2 Recommendations and Implications

It is recommended that the service providers and policymakers involved in marketing strategies and price-setting mechanisms consider some crucial demographic and socio-economic factors that motivate the individual to pay for the service. Customized communication strategies can help increase awareness in different population segments, whereas varied prices may create better access to the desirable services for groups with different incomes. Remedial measures should be taken to reduce inequalities in income, literacy, and capitalized assets to avail the services of waste management organizations equally competitively. Another gender consideration for affordable housing relates to affordability hindrances in marginalized communities that policy measures, including subsidies and support programs, can reduce. This is where the effectiveness of the present systematic waste collection services needs to be emphasized, giving people the significance of advancing the proper and systematic waste disposal system. To address this need, authorities and policymakers should provide more funding to improve and increase municipal waste collection services. Corrective measures should be implemented regarding informal dumping practices, including opening spaces or plots. It will include areas such as publicity, policy enforcement, and the development of proper infrastructures for waste treatment and recycling rather than dumping, which is commonly done informally. To overcome the differences in waste disposal practices across Bangladesh's different cities and regions, targeted efforts are required that can only be provided by international organizations. Waste management is a local issue and multi-sectoral commitment that needs active participation from local government, stakeholders, and other interested organizations in developing and implementing sustainable measures that suit a given area’s socio-economic and structural characteristics. People’s inclination to donate money to enhance waste management services shows the public’s desire for environmental protection. From the findings, targeted policies oriented towards public WTP should be based on initiatives that support environmental education, awareness campaigns, and community involvement in waste management. It could be seen that the measures focused on economic activities that would create

more opportunities for people, and concentrating on the higher education level can contribute to more support for the better appreciation of the enhanced waste disposal systems. Appropriate improvements in socioeconomic status, education, and throwing habits, as well as public health interventions, might help to close the gap between high and low-income countries in terms of their relation to waste management. To gain people's support for environmental and climate change issues and to be able to help support proper waste management, some awareness must be created. Therefore, better environmental education programs should be adopted into the education systems and made part of community health programs to bring more effective behavioral changes throughout generations. Through these policy implications, Bangladesh will be able to effectively address the challenges related to waste management with convenient pro-development measures that support environmental conservation. The study suggests the following policies. (1) Public Awareness Campaigns: This paper has found that several strategies can be employed to encourage people to pay more for better waste management; these include crusades. This ought not to underscore the importance of proper waste management in preserving the environment, promoting the populace's health and well-being, and developing economies. To ensure such campaigns have a wider reach in society, it is recommended that the government departments spearhead these campaigns in collaboration with environmental NGOs. (2) Education and Training Programs: Funding education and training endeavors involves both professionals and the public to increase their understanding and capability in environmentally compliant waste management practices. Government policymakers should implement the following study recommendations. The government should ensure that adequate funds are dedicated to developing comprehensive capacity-building mechanisms and workshops, including waste collectors, local government officials, and community members. (3) Incentive Mechanisms: Reporting to the favorable study on behavior modification, tax breaks, or other forms of subsidies to encourage the adoption of eco-friendly waste management strategies is feasible to increase WTP. Policymakers need to ensure

that the incentives formulated are financially sustainable in the long term and that fairness ensures everyone, or different sectors of different societies get what is proportionate to their socioeconomic status. (4) Infrastructure Development: Waste management means implementing changes on how waste is collected, separated, recycled, and disposed, costs money to be incurred on necessary structures. Policymakers should ensure adequate funding and support for infrastructure development projects in the form of finances, personnel, and resources that can be used for constructing and maintaining these waste treatment facilities, dumpsites, and recycling plants. The following projects can be achieved with support from foreign donors, other related private sector organizations, and government authorities. (5) The key to better waste management practices is to invest resources, time, and effort in the waste collection, sorting, recycling, and disposal infrastructure. Infrastructure development should also be given premium policy attention, as well as adequate funding and support in putting up and maintaining structures that can channel all managed wastes for proper treatment, disposal, and recycling. These initiatives can be carried out with the assistance of foreign donors, private sector institutions, and relevant government bodies. (6) Community Engagement and Participation: The commencement of people in waste management projects will enable a lot of them to take responsibility with pride, thinking they are responsible for the projects. Top-down approaches should be resolved in bottom-up approaches by aiding in creating neighborhood committees or community-based groups centered on waste management and providing support for locally integrated solutions and tools. (7) The insights into household WTP can help shape fair, tiered pricing systems. These models would enable municipalities to charge moderate fees, such as BDT 250 per month, to households that can afford it, while offering subsidies to lower-income groups. Since more than 60% of surveyed participants expressed WTP at this level, city governments can use this data to estimate potential revenue, supporting informed budget planning and the development of cost-recovery strategies (World Bank, 2020; UN-Habitat, 2018). International development organizations like the World Bank, the

Asian Development Bank (ADB), and UNDP can be key in driving Bangladesh's waste management reforms. Their contributions might include technical support for designing infrastructure, financial aid to cash-strapped municipalities, and promoting institutional changes to strengthen accountability and improve public-private partnership (PPP) frameworks. Aligning these efforts with climate finance sources, such as the Green Climate Fund and Sustainable Development Goal (SDG) investments, can further boost the long-term sustainability of urban sanitation systems (UNDP, 2022; World Bank, 2020).

To promote fair participation in WTP-based systems, governments should implement tiered pricing models where fees are adjusted based on income levels or the amount of waste produced. Countries like Germany already utilize such systems, allowing households that generate less waste to pay lower fees, thereby encouraging sustainable consumption habits.

Additionally, targeted subsidies should be extended to impoverished households, taking inspiration from Brazil’s Bolsa Verde initiative, which provides financial incentives to families who engage in environmental preservation. In Bangladesh, a similar approach could be integrated with community-driven recycling programs, especially in urban centers like Dhaka and Chittagong.

India’s Swachh Bharat Mission serves as a successful example of how national-level backing, paired with municipal efforts, can enhance sanitation and waste management. Adapting this framework in Bangladesh through localized campaigns and conditional cost-sharing could safeguard economically vulnerable groups while still securing necessary resources for service improvements.

Moreover, grassroots collection systems found in Kenya and the Philippines—where low-income residents oversee local sorting and waste collection in return for service credits—could be tested

in densely populated city neighborhoods. These initiatives would not only reduce operational expenses but also foster stronger community involvement.

At the same time, the Stakeholder Community and the Local Authorities of various affected communities have the potential to enhance cooperation and group work most effectively. These are mainly the domain of national and local government bodies with the power to establish and implement waste management policies. In addressing waste management, they're crucial in defining the legislation, funds, and goals needed. This includes public or private companies that engage in picking up, transporting, treating, and disposing of garbage. This means that service providers are responsible for delivering services that enable informed communities to address waste management issues effectively and efficiently, not only in compliance with the law but also focusing on the quality of services delivered. Community Organizations: Employing constituents to seek resources, develop awareness, and promote the cause of their people, local community organizations, non-governmental organizations, and civil society groups can also take an active role in waste management projects. It follows that the Bangladeshi needs and circumstances will dictate the form that these actions should take. Policy modernization, development, introduction, implementation, infrastructure development, personnel training, partnership with companies, local organizations, and community-based initiatives suitable for the local environment could be the components of sustainable development.

6.3 Limitations and Future Research Directions

One of the study's major limitations is that it only considers the urban environment and has left out what rural people might be able to say about waste disposal. Last, but not least, it is revealed that there are some limitations in applying the logistic regression model for the investigation of WTP since many factors, including cultural or psychological factors, that are potentially able to influence the decision-making process of individuals may not be necessarily reflected when using this model. It is worth further research to investigate certain conditions that lead to waste disposal

practices and the extent of their positive or negative effects on the environment and the community. Prospective cohort or panel studies designed with a focus on changes in overall waste management structures and individual behaviors across time may offer useful lessons regarding the success of such interventions. Nevertheless, cross-sectional comparisons of cities can also reveal precise points of success and pitfalls that may be implemented and avoided in other contexts correspondingly. It could also analyze factors that create people's perception and WTP waste management fees. Hedonic motivations, cultural differences, and self-organizing maps will likely have confounding influences on the WTP for each decision and should be explored further.

7. NEW SCIENTIFIC RESULTS

The present investigation of the WTP for enhanced waste management services in Bangladesh reveals several original scientific insights and observations that enrich our understanding of the key socio-economic and demographic factors that determine people's attitude towards the environment and their preferences regarding related services. The following are the primary findings and their results:

1. This study offers the first broad, data-driven evaluation of how much people are willing to pay for solid waste management across multiple cities in Bangladesh. Surveying 1,069 households in seven different urban areas delivers strong and widely applicable insights, overcoming the limitations of earlier research focusing on single locations.

2. A stand-out feature of the study is the inclusion of climate change awareness as a new and powerful factor in predicting WTP. The data shows that individuals concerned about climate change are nearly four times more likely to be willing to pay (odds ratio of 3.79, $p < 0.01$). This underscores the value of incorporating environmental messaging into local government strategies for service delivery.

3. One of the key findings is that people's environmental attitudes significantly influence their WTP. Those with a stronger environmental mindset were more likely to contribute financially, regardless of their income or education level. This supports the idea in behavioral economics that personal values and civic duty play a crucial role in funding public services.

4. The research develops and tests a comprehensive behavioral model that blends economic (income, education) and non-economic (environmental attitude, climate awareness, trust in institutions) factors. This integrated approach challenges the traditional income-only models by showing that attitudes and trust also matter.

5. Findings also support the practicality of a tiered pricing model for waste management services. Most participants who expressed willingness to pay favored a monthly contribution between BDT 250 and 350, offering clear guidance for setting service fees.

6. Trust in institutions emerged as a key condition for WTP. People were more willing to pay if they believed the service providers were transparent and accountable. This finding highlights the importance of involving citizens and maintaining open communication in managing public funds.

7. The study translates its findings into actionable insights for municipal budget planning. Estimating potential revenue from households willing to pay (e.g., 60% at 250 BDT/month) supports the design of realistic subsidy plans and co-financing models.

8. Finally, the study introduces a new tool for urban policy: behavioral segmentation. By blending data on demographics, attitudes, and economic status, policymakers can design targeted strategies that improve service delivery and promote fairness.

9. These findings add valuable perspective to the global conversation on waste management by placing urban behavior in South Asia within a broader international context. The study's approach—combining contingent valuation with behavioral insights—is particularly useful for other developing cities facing similar urban waste challenges.

10. The research outlines actionable policy strategies to enhance urban waste services. Key recommendations include promoting environmental education, implementing reforms to build public trust, and introducing adaptable pricing models. These suggestions are backed by strong statistical evidence of how households behave.

Table 10: The validation of each hypothesis tested

Hypothesis	Validation (Statistical & Literature)	Validation (Survey Findings)
H1: Education level affects WTP	✓ Fully verified	✓ Confirmed
H2: Environmental attitude affects WTP	✓ Fully verified	✓ Confirmed
H3: Climate change awareness affects WTP	✓ Fully verified	✓ Confirmed
H4: Income level affects WTP	✓ Fully verified	✓ Confirmed
H5: Gender has an effect on WTP	✓ Not verified	✓ Confirmed

Source: author's own estimation from the results

8. NOVELTY OF RESEARCH

This study introduces several fresh contributions to the fields of environmental economics, public finance, and sustainable urban governance, especially relevant to the context of developing nations:

1. First Nationwide WTP Assessment in Bangladesh

This is the first study to assess Willingness to Pay (WTP) for enhanced waste management services across seven key urban centers in Bangladesh. Earlier research focused mainly on Dhaka, but this broader geographic coverage ensures that the results are more representative and applicable nationally.

2. Climate Change Awareness as a Behavioral Driver

The study breaks new ground in South Asia by empirically linking climate change awareness to WTP. Including these variable bridges a critical gap by showing how environmental awareness can influence financial decisions in urban service delivery.

3. Integrated Behavioral-Economic Model

The research builds a comprehensive model that combines economic indicators (like income and assets), behavioral attitudes (such as environmental concern and climate change awareness), and trust in institutions. This approach moves beyond traditional income-based models and offers a more rounded framework for policymaking in low- and middle-income settings.

4. Tiered Pricing as a Policy Innovation

The study recommends a tiered pricing approach for municipal waste services using data on preferred WTP levels. This context-sensitive strategy balances revenue generation with fairness, making it both sustainable and equitable.

5. Institutional Trust as a Conditional Factor

The findings show that public trust in service institutions significantly affects WTP, but only under perceived transparency and accountability conditions. This insight deepens our understanding of behavioral drivers and suggests targeted reforms for building public confidence.

6. Turning WTP into a Planning Tool

Finally, the study takes WTP beyond theory, demonstrating how it can be used for practical budgeting. City governments can develop more accurate financial plans, cost-recovery strategies, and subsidy models by estimating potential revenue from household contributions.

9. SUMMARY

The study investigates the factors influencing urban residents' willingness to pay (WTP) for enhanced waste management services in Bangladesh, aiming to inform policies that improve environmental sustainability and public health. The research objectives include identifying the determinants of WTP for better waste management, exploring the relationship between socio-economic status, environmental awareness, and WTP, and providing policy recommendations for effective waste management. Utilizing quantitative and qualitative methodologies, the study conducted surveys across seven major cities in Bangladesh, analyzed through regression models, and semi-structured interviews with selected participants, analyzed thematically. Key findings indicate that higher income, education levels, and environmental awareness positively correlate with higher WTP, while larger household sizes and gender (with men being more willing) influence WTP due to socio-cultural and economic factors. The perceived health and environmental benefits also significantly determine WTP. Policy recommendations include enhancing environmental education, implementing tiered pricing structures, addressing gender disparities, promoting public awareness campaigns, and investing in recycling facilities and waste-to-energy plants. The study underscores the need for comprehensive strategies addressing socio-economic and demographic factors to improve waste management in Bangladesh. By promoting environmental education, addressing income inequalities, and enhancing public awareness, policymakers can foster a supportive environment for sustainable waste management practices. This research provides valuable insights for policymakers, urban planners, and waste management authorities in Bangladesh and other developing countries, offering a framework to enhance environmental sustainability and public health through improved waste management systems.

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Appendix A: Questionnaire

Questionnaire

"This research seeks to explore how residents in urban areas of Bangladesh view their current waste management services and how much they'd be willing to pay to see those services improved. We're using the Contingent Valuation Method (CVM), which involves presenting a realistic, hypothetical scenario—like an upgraded waste management system—and asking how much you'd be prepared to pay for it. CVM is often used to estimate how people value things that aren't bought or sold in markets, such as a clean environment or public services. Your input will help us understand what influences people's willingness to pay, including factors like income, education level, environmental awareness, and trust in local government. The findings will support policymakers and city planners in creating waste management systems that are fair, effective, and sustainable. Please remember, this is purely an academic study. You're not making any real payment, and all your answers will be confidential."

SECTION A: Socio-Demographic Information

1. Gender
   ☐ Male ☐ Female ☐ Other
2. Age
   ☐ 18–24 ☐ 25–29 ☐ 30–34 ☐ 35–39 ☐ 40+
3. Education Level
   ☐ No formal education ☐ Primary ☐ Secondary
   ☐ Higher Secondary ☐ Graduate ☐ Postgraduate and above
4. Monthly Household Income (in BDT)
   ☐ Below 15,000 ☐ 15,001–30,000 ☐ 30,001–50,000
   ☐ 50,001–80,000 ☐ Above 80,000
5. Household Size (number of members): ……
6. Estimated Value of Household Assets (BDT)
   ☐ Below 100,000 ☐ 100,001–250,000 ☐ 250,001–500,000
   ☐ Above 500,000
7. City of Residence
   ☐ Dhaka ☐ Chattogram ☐ Khulna ☐ Rajshahi ☐ Sylhet ☐ Barisal ☐ Rangpur

SECTION B: Environmental Attitudes

Please indicate your level of agreement with the following statements:

8. Do you agree that improper waste disposal harms the environment in your area?
   ☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree
9. Do you agree that improper waste disposal harms human health?
   ☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

SECTION C: Climate Change Awareness

10. Do you agree that improper waste management has harmful effect on climate change
    ☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree
11. Do you agree that waste management is related to climate change mitigation
    ☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

SECTION D: Trust in Institutions

12. Do you trust local authorities to use waste collection fees effectively?
    ☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree
13. Do you find the current municipal waste service reliable?
    ☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree
14. Would you be more willing to pay if you saw clear improvements in the service?
    ☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

SECTION E: Willingness to Pay (WTP) Scenario

Please consider this scenario:

"Your city introduces a new waste management service: regular collection 3x per week, proper waste bins, recycling options, and clean streets."

15. Where is household waste most disposed of in your area?

    ☐ Municipality/City Corporation collection points
    ☐ Empty plots or open spaces
    ☐ Highway sides or roadsides
    ☐ Recyclers or informal waste collectors
    ☐ Private farms or agricultural lands
    ☐ Drainage systems or canals
    ☐ Other (please specify): _____

16. Would you be willing to pay for this service?
    ☐ Yes ☐ No
17. If YES, how much would you be willing to pay per month (BDT)?
    ☐ 100 ☐ 150 ☐ 200 ☐ 250 ☐ 300 ☐ 350 ☐ 400 ☐ 450 ☐ 500 ☐ More than 500
18. If NO, what is your main reason?
    ☐ Cannot afford it
    ☐ Don't trust the providers
    ☐ The government should cover this
    ☐ Other: _____
19. Do you support a system where more affluent households pay more, and poorer households pay less?
    ☐ Yes ☐ No ☐ Not Sure