Identifying the Value Chain of Different Types of Recyclable Waste Plastics: Case Study on Selected Small and Medium-sized Enterprises (SMEs) of Dhaka city, Bangladesh

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Abstract

Economic growth and industrialisation evoked urbanisation and progress in people's living standards. It increased the consumption of plastics. As the country's capital and centre of all economic activities, Dhaka has become exposed to environmental pollution mainly due to a lack of proper waste management. The township of Dhaka is geographically divided into two administrative zones, i.e., Dhaka North City Corporation and Dhaka South City Corporation. The combined per capita waste generation of Dhaka City Corporation was appx. 0.60 kg/day in the year 2020, comprising a total population of 10 Million and generating 6400 tons of waste/day, of which 10 per cent consisted of plastic waste. Of the total waste plastic of Dhaka City, around 48 per cent goes to landfill, 12 per cent to water bodies, 3 per cent becomes responsible for clogging drainage systems, and only 37 per cent gets recycled. In Dhaka City Corporation, waste plastic collection is locally done in a very informal and unstructured manner. The present study was designed to assess the status of the Small & Medium Enterprises (SMEs) in waste plastic recycling industries in the Dhaka City Corporation. The value chain involves several actors and their activities at different phases. SMEs play pivotal in waste plastic recycling in Bangladesh. The potential role of SMEs in this area is yet to be appropriately explored due to inadequate data. The people involved in the business are generating profit and creating employment. However, due to the unstructured form and non-formal business operation, they are yet to receive any financial support from financial institutions and are also exposed to business sustainability risks.

Keywords: Plastic, Recycling, Value Chain, Small & Medium Enterprises (SMEs)

Introduction:

Bangladesh, one of the world's most populous countries, is situated in the GBM delta (Whitehead et al., 2015). The country's climate includes a typical monsoon, moderate warmth, and high humidity. The country's GDP is USD 421 billion and has a 7.00% of growth rate as of 2022 (World Bank, 2020). Massive urbanisation took place in Bangladesh following the country's economic growth, and the people's living standards have also developed accordingly. The increase in living standards has resulted in more consumption of plastics. As the country's capital and centre of all economic activities, Dhaka has become exposed to the risks of environmental pollution mainly due to a lack of proper waste management, including plastic waste (Islam et al., 2015).

The solid waste generated by the urban and cities, most commonly termed as Municipal Solid Waste (MSW), has become a matter of great concern due to rapid industrialisation and subsequent global urbanisation (Dahlén and Lagerkvist, 2008). The township of Dhaka is governed as a city corporation which has been divided into two administrative zones named Dhaka North City Corporation and Dhaka South City Corporation. The per capita waste generation of North and South of Dhaka City Corporation was appx. 0.60 kg/day in the year 2020, comprising a total population of 10 Million and generating 6400 tons of waste per day, of which 10 per cent consisted of plastic waste (World Bank, 2021; Hossain and Shams, 2020). Plastic packaging material utilisation has increased almost five times during a tenure of 15 years from 2005 to 2020. Around 40 per cent of the plastic waste of Dhaka City contains LDPE (Low-density polythene) generated from single-use carrying bags and another 7 per cent from Multi-

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Layered Plastics (MLP). During the COVID-19 pandemic, along with health consciousness, preventive measures and dependence on packed food, the consumption of LDPE has increased manifold (World Bank, 2021). In Dhaka City only 30 per cent of its waste plastic packaging materials have been possible to collect from the post-consumer end. Of the total waste plastic of Dhaka City (10 per cent of total waste of i.e., 640 tons per day), around 48 per cent destined to landfill, 12 per cent goes to water bodies (such as a pond, river, khal etc.), 3 per cent becomes responsible for clogging drainage system and only 37 percent is recycled (World Bank, 2021).

Plastic is a moulded synthetic or semi-synthetic organic material generated from petrochemicals. Different types of plastics include Thermoplastic (Polyethylene), Thermosets (Resin), Elastomers (Rubber) and Natural polymers (Cellulose, Lignin and Protein). Among the different types, Thermoplastic is most common in plastic usage and consumption and waste generation (Hopewell et al., 2009). Thermoplastic (Polyethylene) consists of different types such as PET (Polyethylene Terephthalate), HDPE (High-Density Polyethylene), PVC (Poly vinyl chloride), LDPE (Low-Density Polyethylene), PP (Polypropylene) and PS (Polystyrene) (Iroegbu et al., 2021).

Plastic has been widely utilised around the globe due to its unique qualities such as cost-effectively, protection, heat, light, temperature and chemical resistance, manufacturing compatibility and so on. Thus, it has become an alternative to wooden, paper-made, leather-produced, glass- and ceramic-made products. Due to its chemical inertness for food packaging, Polyethylene terephthalate has become the most popular material. Plastic-made goods are prevalent, from small stationary items to spaceships at the cutting edge of human civilisation. But the critical fact of plastic is that its end of life does not mean the end of its impact. Plastic exists in the environment long after the end of its required consumption and creates an effect on environmental pollution, having no end to life. Plastic as a waste may severely impact the environment, climate and biodiversity (Islam et al., 2023).

Environment, ecology and lives on the earth are highly exposed to the risks of the adverse impact of plastic, a poisonous and non-biodegradable substance. Losing fertility of agricultural land is one such impact. However, the hazardous effect of plastic can be reduced by establishing a routine recycling structure that will also reduce the volume of plastic in landfills and its presence in the ecosystem (Hossain and Shams, 2020).

The role of small and medium enterprises (SMEs) is well recognised in the global arena for their significant contribution to the economies and employment generation. SMEs are playing the role of key catalysts in developed as well as developing nations in ensuring sustainable economic growth. Globally SMEs cover approximately 90% of all business activities and accommodate more than 50% of global employment(Hossain and Shams, 2020). According to the Bangladesh Bureau of Statistics (BBS) data, SMEs' contribution to Bangladesh's GDP was 21.36% in FY17; it became 21.98% in FY18 and 22.86% in FY19. The sector was largely affected during the COVID-19 pandemic; thus, the contribution in FY20 was 22.40% (Begum et al., 2022). Small and medium enterprises (SMEs) also play a pivotal in waste plastic recycling in Bangladesh, more specifically in the Dhaka city corporation (DCC) area through getting involved in all or some of the phases of waste plastic recycling, such as collecting, sorting, and processing etc. (Bergmann et al., 2017; Majumder et al., 2020). But the potential role of SMEs in this area is yet to be adequately explored due to inadequate data and not having a proper value chain analysis which would help identify the scopes and cater support mechanisms for the SMEs towards their enhanced role in waste plastic recycling (Bergmann et al., 2017; Majumder et al., 2020).

The study aimed to identify the value chain of recyclable plastic waste for a sustainable environment. Key objectives of the study were to assess the pattern of post-consumer level plastic waste disposal system, to assess the status of plastic waste recycling practice in Dhaka city. Furthermore, it also aims to identify the value chain of plastic wastes and its recycled products to assess the prospects and challenges of SMEs in the plastic recycling industry.

Methodology

Study design

The study design is shown in figure 1. It consists of several stages involved in the conceptual development of the research and the dissemination of the outcome.

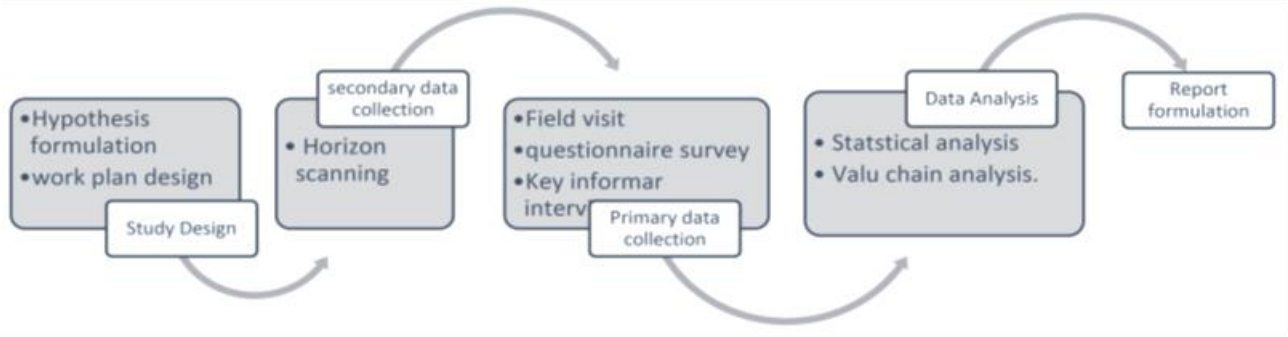


Figure 1: Study design

Horizon scanning

According to OECD, (2020), "Horizon scanning is a technique for detecting early signs of potentially important developments through a systematic examination of potential problems and prospects, with emphasis on new technology and its effects on the issue at hand"(IRM, 2018). Literature studies have been used to understand the waste management system in Bangladesh, waste recycling practices in Bangladesh, and plastic waste management practices in Bangladesh. The search items were 'types of plastics', 'recycling practice of plastic', 'recycling industries', 'value chain', and many more related to the topics. Scientific databases such as Web of Science and Scopus were used to search for relevant papers.

Survey Questions:

For the study `Identifying the value chain of different types of recyclable waste plastics: Case study on selected SMEs of Dhaka city', the following information has been collected through a structured questionnaire survey.

a) Factory details
b) Personal information
c) Technical information

- Types of plastic recycled
- Steps of recycling (Naming & Drawing)
- Production hour/person
- Source of water
- Production capacity/day
- Source of power
- Average monthly Electricity Bill (BDT)
- Pollution level (Photo evidence)
- Wastewater management?
- Selling price
- Current location
- Source of Gas
- Source of electricity

Study area

The study area was waste plastic recycling factories located in Lalbagh, Islambag, Kamrangir Char, Bagan Bari, and Bash Patti under Dhaka City Corporation (figure 2).

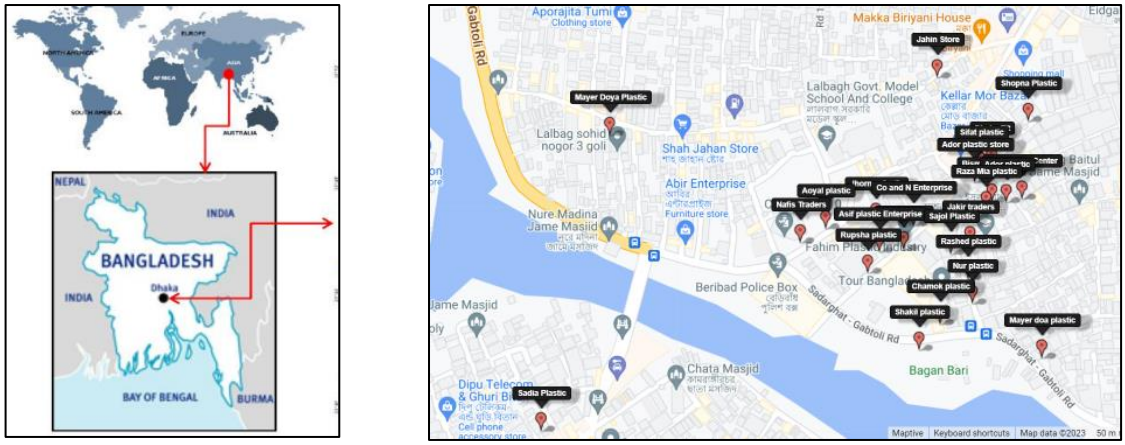


Figure 2: Study area (plastic recycling plants).

The model used in value chain analysis:

The value chain model is a handy tool for the strategic management process(Subramanian et al., 2019). It describes how the different steps of an organisational process create value and thus lead the activities toward profit generation. In this study the activities related to waste plastic recycling have been accommodated into Porter's value chain model shown in figure 2.

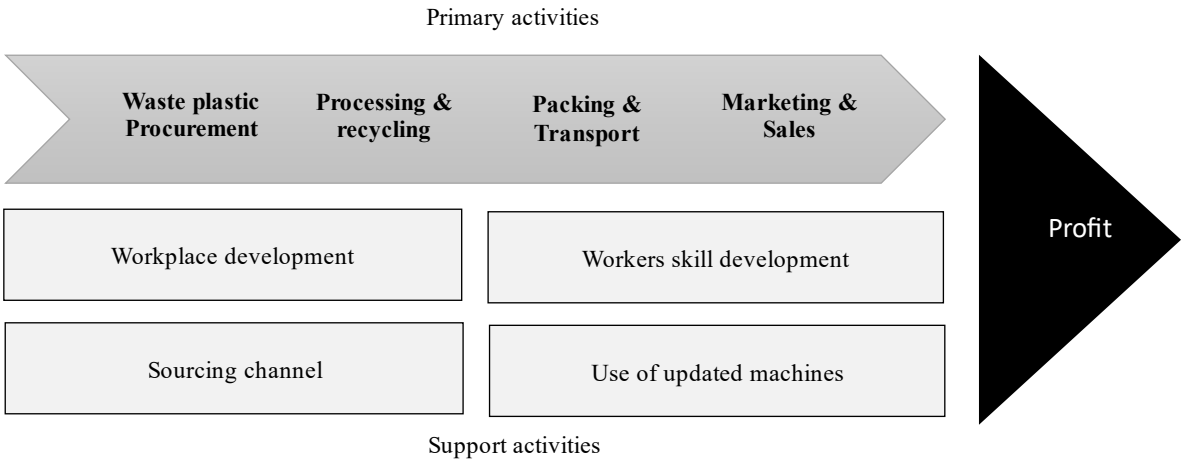


Figure 2: Porter's Value Chain Model for Plastic Waste Recycling (Subramanian et al., 2019)

Results

Waste plastic recycling process outline and value chain analysis

Value chain defines all business enterprise activities related to products and services towards its ultimate goal of profit generation. It enables business entities to maximise profit through the optimum utilisation of resources at the least possible cost. The value chain can be analysed by assessing the cross-cutting issues of business processes, such as Inbound logistics, operational activities, outbound logistics, marketing, sales and service.

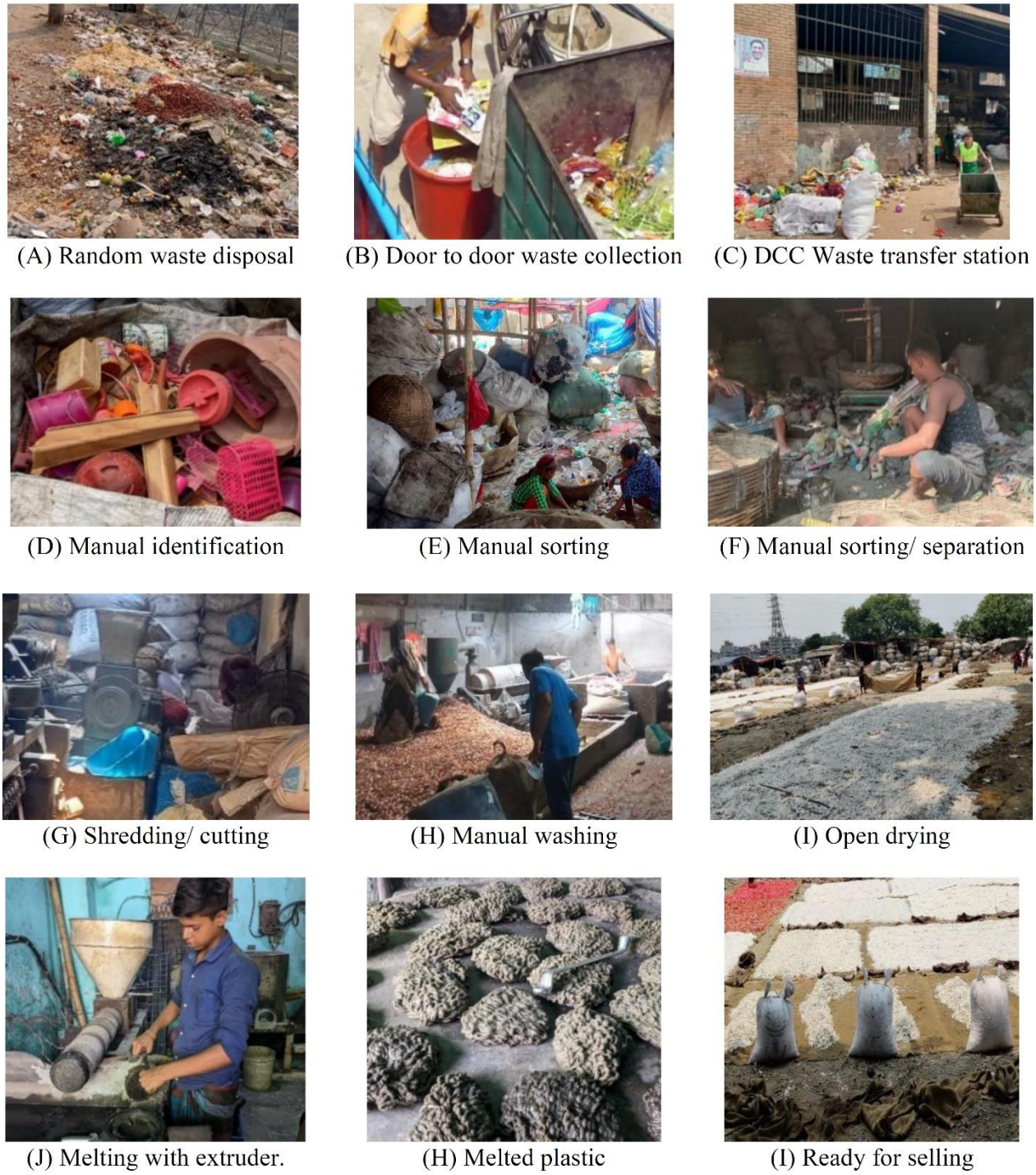


Figure 3: Waste plastic collection and recycling in images: *(Source: Author, 2023)*

The value chain of recyclable waste plastics covers a wide range of different activities, from waste collection to manufacturing plastic goods for the end users. Within the scope of the present study, it has been tried to focus on the value chain of recyclable waste plastics by studying the SMEs located under the Dhaka City Corporation area. The value chain involved several actors and their activities at different phases, a brief of which is given here:

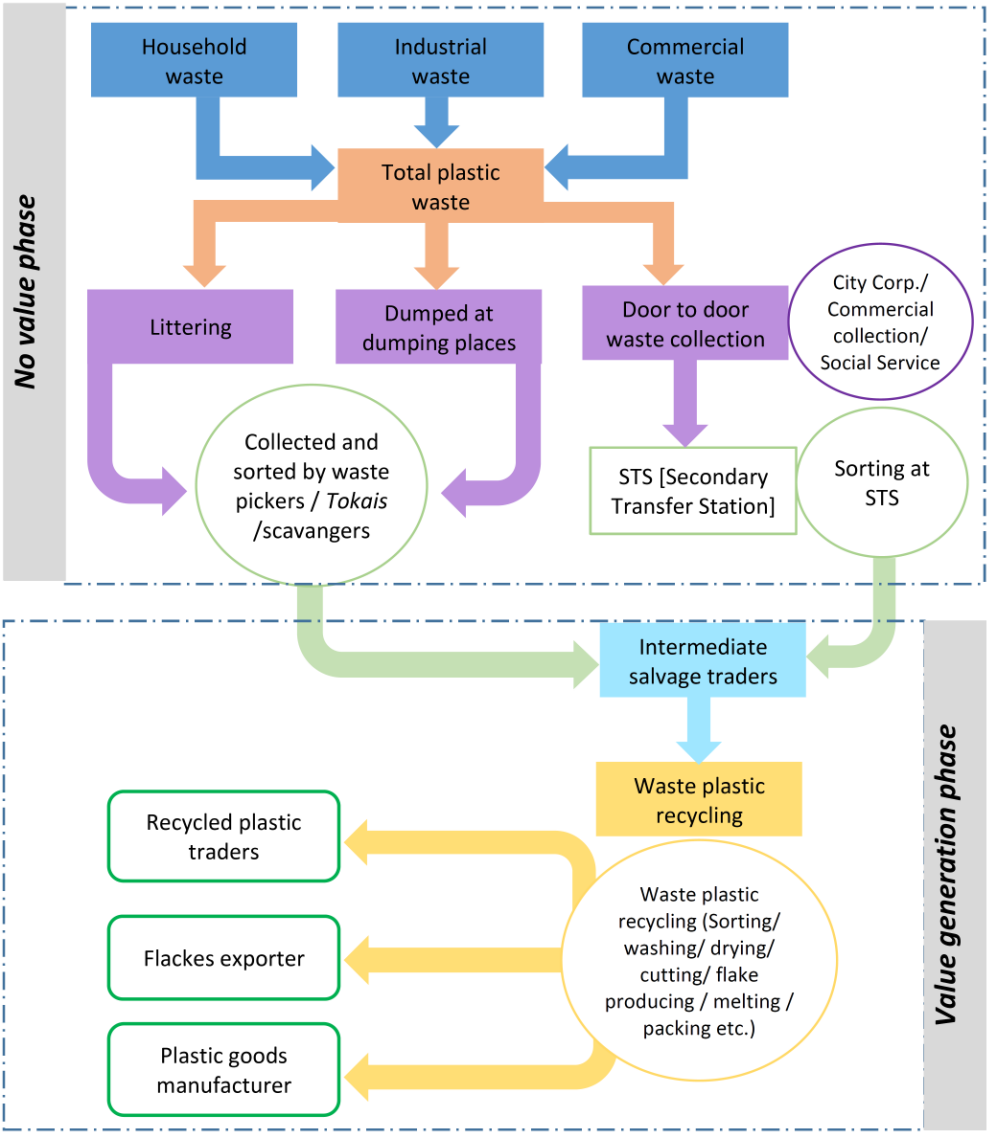


Figure 4: Value Chain process flow of waste plastic *(Author, 2023).*

Collection of waste plastics: In Dhaka City Corporation, waste plastic collection is done in a very informal and unstructured manner at a local scale. Usually, waste plastics are manually collected along with other household wastes without any sorting. A portion of this waste plastic is also collected through cash refunds or in exchange for household utensils.

Identification of plastic-type: In the following process, collected waste plastics are identified based on their colour and material type in a manual process. Usually, women and child labourers were found involved in the sorting process, having almost no knowledge about the type of plastic, executing the process only based on the color and the type of the original goods. During the field survey, the sorters were found giving local names of the plastic types as *Laal* (Red), *Shobuj* (Green), *Kaalo (* Black), *Golaapi* (Pink), *Color* (having different colorts), *Khelna* (Toys), *RFL* (Plastic products of specific producer, RFL) etc.

Separation of different types: Different types of plastics are separated and placed separately from the identified waste plastics. Separation is a manual process where waste plastics are usually separated and kept side by side on the floor.

Sorting: After separating different waste plastics, they are also sorted through the manual process. In the sorting process, the usable parts of the plastic identified, totally unusable for recycling, are excluded and mixed items are sorted out.

Categorisation: The sorted plastics are then categorised for their onward selling process. Different plastics are processed separately and prepared categorically for subsequent operations such as washing, drying and shredding.

Washing: The following process of waste plastic recycling is washing to clean. At this stage, it happens in two ways, i.e., automatically and manually. In an automatic process, the waste plastics are passed through a machine where water flows and washes out the dirt from the waste plastics. Castic Soda, soap, and detergent powders were found to be used for washing. Automatic washing was rare in the surveyed area, where most recycling units used manual processes. In the manual method, waste plastics are placed in a large chamber where water flows through, and workers get involved in washing manually using their hands and legs.

Drying: Drying is also done both automatically and manually. In the case of automatic drying, the washed waste plastics are channelled through a heat-generated chamber at a specific temperature to be dried up called Hydro Drier. However, no automatic drying machine was found in the study area. All of the studied recycling units were found using a manual drying process where washed waste plastics are kept in an open space to enable them to be dried up in available aeration.

Shredding: After drying, waste plastics are taken to the shredding machine to prepare flakes. Shredding is a semi-automatic process where workers input the waste plastics in the shredder, operate the device and then collect the output. A portion of the flakes, i.e., the shredded waste plastics, is ready for selling, and another part is taken for the onward melting process.

Melting: The shredded flakes are taken through the melting machine at a specific temperature and become ready for further use. Manufacturing units prepare usable goods from these melted recycled plastics.

Packing: Next is the packing process to prepare the products for sale. The dried and shredded flakes are then packed in large sacks according to their colour and weight.

Selling: This is the final stage of waste plastic recycling, where the recyclers become ready to sell the recycled plastics for subsequent utilisation of those, i.e., manufacturing fresh goods from the recycled plastics or exporting the flakes abroad

Value chain actors and contributors:

In the value chain of the waste plastic recycling industry, several cross-cutting issues are involved, such as the collection of waste plastic, processing for reusable shape and final utilisation of the remanufactured products. During the field survey, the following actors were found (table 1) who take part in and have contributed to the waste plastic recycling value chain:

Table 1: Value chain actors and contributors

Collection & Sorting		• Informal waste collectors • NGO-led / Private waste collectors • DCC waste collection system
Recycling & Processing		• Manual and mechanical recycling factories • Sorting, Cutting, Washing, Drying, Melting units
Manufacturing		• Producing raw materials from waste plastic • Producing new plastic products from recycled waste
Supply chain & retail trade		• Retail and wholesale traders of plastic goods • Transportation and Logistics service providers
Civil Society		• Think tanks, Social service organisations, NGO, and institutions that promote environmental conservation

Value Chain of Waste Plastic

From the surveyed data shown in Table 2, this is evident that while buying the waste plastics, the recycling factories expense most for PET (Hard Plastic for food packaging) at the rate of Tk. 38.25/kg, followed by HDPE (Green Mix) for Tk. 37.25/kg, HDPE (Cap) Tk. 37.00/kg, PET (Transparent) for Tk. 36.47/kg and PP (Colored food pack) for Tk. 33.13/kg. The PS (One-time Food Pack) has the lowest price range for Tk. 23.05/kg.

Table 2: Value Chain comparison of sub-types of Waste Plastics (In Tk./kg)

	PET			HDPE					LDPE	Elastomers		PVC	PS	PP	
Waste Plastic Type	Transparent	Color	Food Pack	Green	Cap	Cap Ring	Color Bag	Yellow Bag	LDPE	Bus/ Truck Tyre	Car tyre	PVC	SUP	Color	Transparent
Mean Buying Price	36.96 ±0.9	31.83 ±1.1	38.35 ±1.0	37.25 ±1.9	37.00 ±1.2	31.96 ±2.1	31.88 +1.2	31.41 ±0.8	32.67 ±1.3	28.43 ±1.1	26.86 ±2.2	27.50 ±1.6	23.05±0.7	33.13 ±1.7	36.47±2.4
Mean Selling Price	53.25 ±1.2	44.29 +1.9	46.47 ±0.9	50.29 ±2.2	45.42 ±1.3	47.38 ±1.7	46.18 ±.08	48.82 ±2.3	37.67 ±1.5	33.57 ±1.2	32.13 ±2.1	39.82 ±1.4	31.42+1.1	42.19 ±1.0	45.24±2.2
Mean Net Margin	11.65 ±1.3	7.82± 0.9	3.48± 2.1	8.40± 2.2	3.78± 1.7	10.78 ±2.4	9.65± 1.5	12.77 ±1.2	0.36± 2.3	0.50± 1.0	0.63+ 0.9	7.68± 1.3	3.73 +2.2	4.42+ 0.8	4.12 +2.2

However, while selling recycled waste plastics, the recyclers get the highest price for PET (Transparent) for Tk. 53.25/kg followed by HDPE (Green Mix) for Tk. 50.29/kg, HDPE (Yellow plastic bank) for Tk. 48.82/kg, HDPE (Cap ring) for Tk. 47.38/kg, PET (Hard plastic food pack) for Tk. 46.47/kg. The lowest selling price is still the PD (One time food pack) for Tk. 31.42/kg.

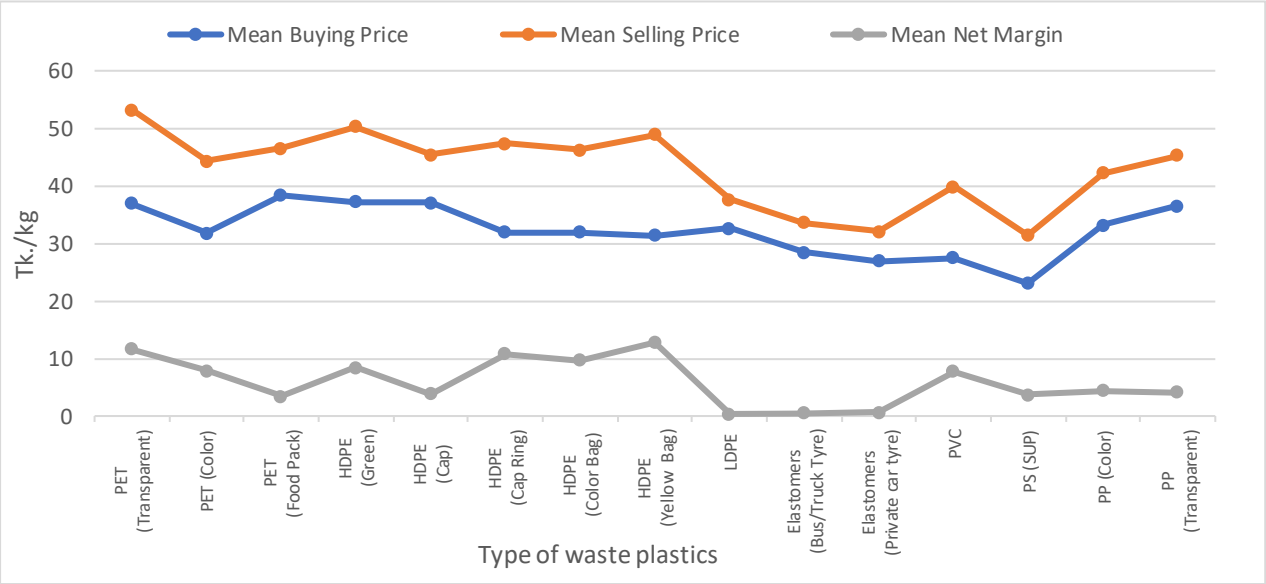


Figure 5: Value chain comparison of waste plastic recycling (In Tk./kg)

The value chain comparison of waste plastic is described in the above figure 5. It displays the distribution of mean buying, selling and net margin. The gap between the selling price and its corresponding net margin describes the higher operational expenses of the SMEs in connection to waste plastic recycling.

The figure 6 shows the distribution of the waste plastics' mean gross margin and mean net margin in the value chain. The gap between the gross and net margins is the operational expenses. It is evident from the figure that though the SMEs are generating higher gross margins, the net margin is still very low due to the higher operational expenses.

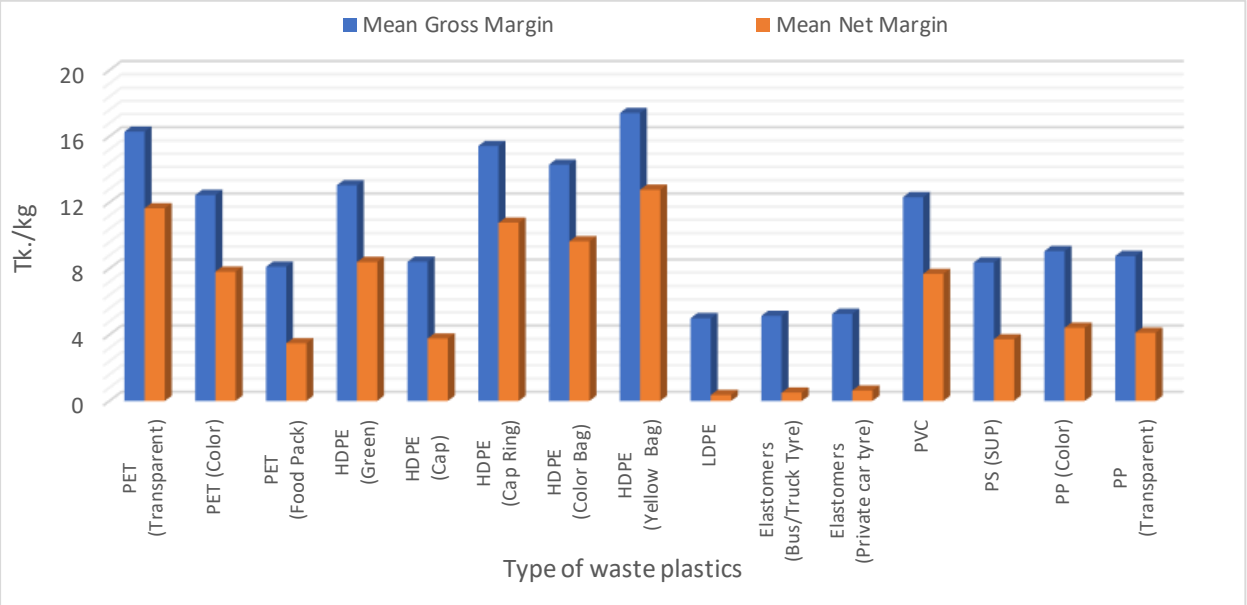


Figure 6: Gross and Net Margin in Value Chain of Waste Plastic (In Tk./kg)

The above table 3 describes the actor-wise value chain of waste plastic recycling. It shows that the waste plastics do not have any value at the waste generator level. The waste generators usually litter/dump the wastes or waste collectors collect from the generators' end. The waste then comes to Intermediate salvage traders (Bhangari shops) in two ways. First, the waste pickers, random waste collectors, and scavengers (Tokai) collect those, sort and sell them to the salvage traders. At the same time, the formal waste collectors also collect, sort and sell to the salvage traders. The selling point of salvage traders is also the buying point of the waste plastic recycling enterprises. A pictorial representation of the data is as hereunder:

Table 3: Actor-wise average saling price of waste plastic recycling (In Tk./kg)

Mean Selling Price	PET	HDPE	LDPE	Elastomers	PVC	PS	PP
Waste generators	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Waste prickers	17.00	16.00	12.00	10.00	12.00	8.00	17.00
STS collectors	22.00	23.00	20.00	15.00	17.00	13.00	22.00
Intermediate traders	36.00	34.00	33.00	28.00	28.00	23.00	35.00

Waste plastic recycling

Table 4: Distribution of factories by recycling plastic type (Multiple response)

Recycling plastic Type	No. of factories (Multiple responses)
PP (Polypropylene)	37
PET (Polyethylene Terephthalate)	30
PVC (Poly vinyl chloride)	24
HDPE (High Density Polyethylene)	22
LDPE (Low Density Polyethylene)	14
PS (Polystyrene)	13

Out of the surveyed factories, as multiple responses 23 were found involved in recycling PP (Polypropylene) followed by PET (Polyethylene Terephthalate) 19, PVC (Poly vinyl chloride) 15, HDPE (High Density Polyethylene) 14 and 9 factories were found recycling LDPE (Low Density Polyethylene) and PS (Polystyrene) respectively.

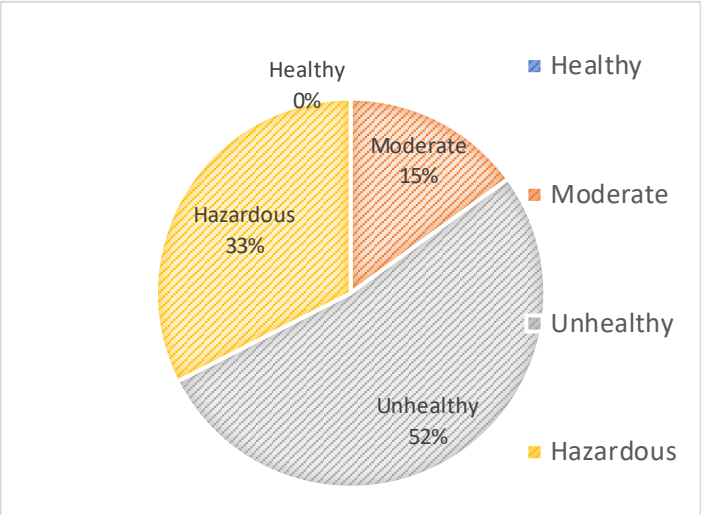


Figure 7: Distribution of factories by their occupational health condition (visual observation)

None of the surveyed had healthy Occupational Health Conditions. Only 12% had moderate occupational health conditions, followed by 60% with Unhealthy and 28% with Hazardous Occupational Health Conditions. No factories out of the surveyed 40 nos. of factories were found to have any treatment system for their wastewater. In most cases, it was found that the waste water drained to the adjacent sewage system, which ultimately led to the nearby *Buriganga* River.

Description of the factories

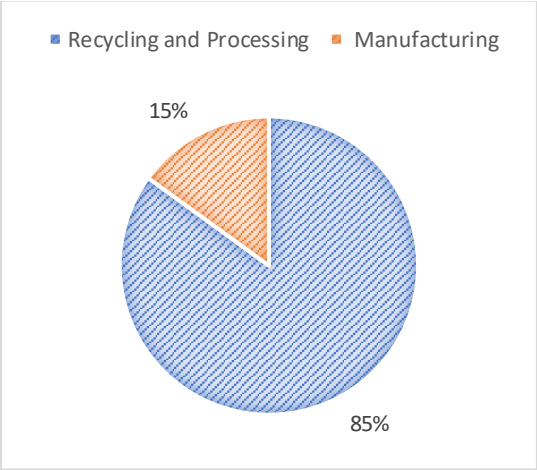


Figure 8: Distribution of factories by type

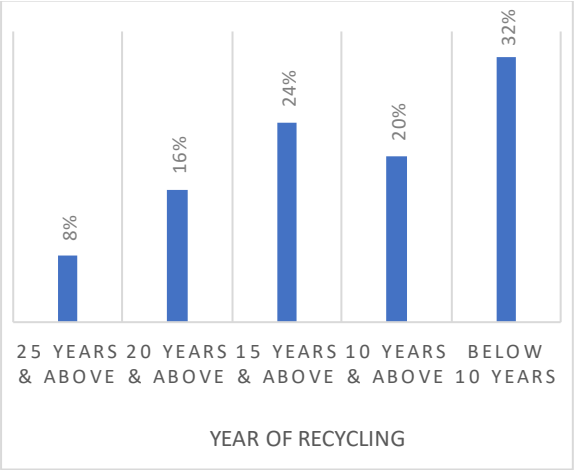


Figure 9: Distribution of factories by age of business

Out of the 40 factories, 34 (85%) were involved in the Recycling and Processing of waste plastics and the rest 6 (15%) were engaged in Manufacturing goods from waste plastic (figure 8). Again among 40 factories 3 factories (8%) were found to have a duration of business of more than 25 years, followed by 6 (16%) for 20 years and above, 10 (24%) for 15 years and above, 8 (20%) 10 years and above and rest 13 (32%) factories had business during less than 10 years (figure 9).

Table 5: Distribution of factories by area

Factory Area	No. of factory	In %
≥500 sft	8	20%
401 - 500 sft	6	16%
300 - 400 sft	16	40%
≤300 sft	10	24%
Total	40	100%

Table 6: Rental cost for factories.

Per SFT Rent (BDT)	No. of factories	In %
≥ Tk. 70.00	10	24%
≥ Tk. 50.00	16	40%
≥Tk. 30.00	14	36%
Total	40	100%

Out of the study sample of 40 nos. of factories, the highest 16 factories (40%) had factory area of 300 to 400 sft, followed by 6 (24%) having less than 300 sft factory area. Among the surveyed factories, the highest 40% paid monthly rent / square feet area for Tk. 50.00, whereas another 24% was paying more than Tk. 70.00, the rest 36% was paying Tk. 30.00 / square feet.

Table 7: Distribution of factories by workers' gender and child labor

Workers	No. of workers	Percentage
Male	234	79%
Female	40	14%
Child	22	8%
Total	296	100%

It is evident from the table 7, thant out of the total 296 workers in the surveyed factories, 79% were male and 14% female. 8% of the total workers were children. Although chield labour in bann in Bangladesh, how ever we observed many children are working in this sector specially in waste segregation.

Business position of the surveyed factories

The above table (table 8) describes the factories by their Annual Sales. Only 8% of the factories have annual sales of more than Tk. 1.00 Crore followed by 28% for Tk. 10 lac & above and below Tk. 10.00 lac. 16% of the factories were found to have annual sales Tk. 50.00 lac & above and 20% having Tk. 30.00 lac & above. It is found that the highest 32% of the surveyed factories had investment amounts less than Tk. 1.00 lac, and only 16% of them had an investment of Tk. 10.00 lac & above.

Table 8: Distribution of Factories by Annual Sales

Annual Sales	No. of factory	In %
≥ 1 Crore	3	8%
50 lac to 1 crore	6	16%
30 lac to 50 lac	8	20%
10 lac to 30 lac	11	28%
≤ 10 lac	11	28%
Total	40	100%

Table 9: Distribution of the factories by investment amount

Investment amount	No. of factories	In %
≤ Tk. 10 lac	6	16%
Tk. 5 lac to 10 lac	10	24%
Tk. 1 lac to 5 lac	11	28%
≥ Tk. 1 lac	13	32%
Total	40	100%

It was found that 28% of the surveyed factories were generating a profit of more than 20% of gross sales, whereas another 28% of the factories encountered net loss in business. 24% of them scored profit for 15% & above of sales and 12% scored profit for 10% & above. 8% of factories have profit less than 10% of sales amount. All surveyed factories were located on rented premises (figure 9). While enquiring about the source of initial investment of the factories, 32% of the respondents mentioned Own Savings, 44% about Personal Loans and 24% of Family Contributions. However, no response was found favouring Bank Loans (figure 10).

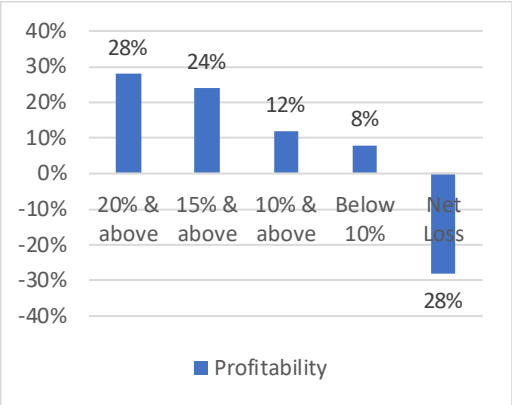


Figure 10: Distribution of factories by profitability

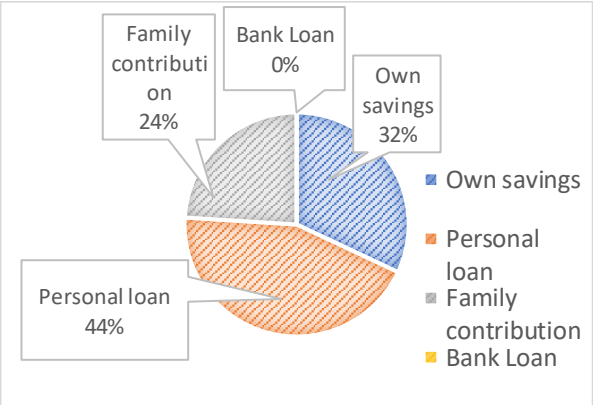


Figure 11: Distribution of factories by source of investment

Discussion

It was found during the study that the mean buying price of PET was Tk. 35.71/kg, the mean selling price was Tk. 48.00/kg, and the mean net margin (i.e., excluding operational expenses) was Tk. 7.65/kg. In the case of HDPE, it was Tk. 33.90/kg, Tk. 47.62/kg and Tk. 9.08/kg, respectively. The highest buying and selling prices were involved with PET, whereas the lowest was in the case of PS. Due to the almost similar operational expenses, the mean net margin of LDPE and Elastomers remained comparatively lower.

PET was found to have the highest value in the case of both buying and selling, whereas PS had the lowest value in both cases. The highest average margin between buying and selling was found in the case of HDPE (Tk. 17.41/kg) and the lowest for LDPE (Tk. 5.00/kg). Recycling factories were found to be involved in multi-type plastics, and no factories were focusing on a single type. It is found from the value chain margin analysis that while selling, the recyclers are adding value highest 55.43% to lowest 15.31%, which is quite good in comparison to the average value addition to many other businesses.

The waste plastic recycling industry based on Dhaka City Corporation is still very unstructured. The business areas are scattered in different locations of the city. The raw waste plastics are collected in two ways, through intermediaries traders who collect the waste plastics from waste collectors and waste collectors also directly sell those to recycling factories. The sellers do the primary sorting based on plastic types to get the actual price of their waste. Their business position, workplace condition, living standards and other facilities do not reflect this profit margin. Thus, the enterprises cannot sustain their profit margin and utilise the same constructively due to the unstructured business nature, low business managing capacity and technical know-how.

Occupational health was found to be a matter of great concern since no factories had a healthy working environment. During the physical visit, none of the workers were found to have any health consciousness, and no arrangements for personal protective measures, health safety measures, fire safety, toilet or hand washing arrangements were found in the surveyed factories. For washing purposes, the WASA (Water Supply and Sewerage Authority, Dhaka) water was found to be used, whereas no water treatment facilities were installed instead, the wastewater was found to be drained to the adjacent sewage system, which ultimately led to the nearby Buriganga River. At the study covering the area, most of the surveyed factories (88%) were found to be involved in the recycling & processing of waste plastics. It denotes that the recycling & processing units and manufacturing units are geographically distorted. Most of the surveyed factories (32%) were found to have a length of business of less than 10 years. Therefore, it can be said that waste plastic recycling has flourished in last 10 years compared to previous years and business sustainability in this business is low. The highest number of factories (40%) are established in 300-400 sft of area. It depicts that most waste plastic recycling factories have been

established utilising a minimal area. All of the surveyed factories were found situated on rented premises. The average per square foot rent of the factories is Tk. 52.00 is very high considering the location, structure and other facilities compared to other areas of Dhaka City. Due to having no bargaining power, no structured trade bodies and a low profile of the entrepreneurs, an unjustified rent is being imposed. Women's participation in the industry was high (14%), whereas the prevalence of child labour was also found to pose children at risk of different health hazards. Starting the business of waste recycling involves low capital injection (Below Tk. 1.00 lac for 32% of the respondents) in the industry as it is very informal.

All of the surveyed factories were established by arranging capital investment by the entrepreneur from different sources except bank loans. None of the surveyed factories were found any loan from any bank or financial institutions. It describes that Banks/Financial Institutions are not interested in extending credit facilities to such factories. Through further enquiry, it has been found that the factories remained ineligible to get or proceed with loan facilities for any bank or financial institution as they cannot manage the required documents and paper works in support of the business. Most of the factories reported that they almost obtained no formal documents, permission or license to start this business. 28% of the companies earned below Tk. 10 lac, whereas 8% scored annual sales more than Tk. 1.00 Crore. However, 28% of the total surveyed factories were found incurring net loss in their business. While discussing with the entrepreneurs, the causes of business loss were revealed, such as higher operational expenses such as rent, workers' wages, electricity bills, and water bills. Some of the respondents also reported seeking anonymity about the forceful subscriptions by the local musclemen as one of their business losses. Thus, almost 36% of the surveyed factories were not operating well, and their financial health was not good. Long-term exposure to poor profit generation or financial loss may lead those factories to shut.

Conclusion

Through the study, the overall waste plastic recycling process has been identified along with the corresponding role of the SMEs in the value chain. Many actors are involved in the total value chain, among which SMEs are leading. They have been involved in the process for a long time, and the business has expanded a wide range of areas. The people involved in the industry are also generating satisfactory profit and creating employment for men and women. However, the sector is still in a very unstructured form. Due to non-formal business operations, they are yet to receive financial support from financial institutions and are also exposed to business sustainability risks. Though considered a social outcast, the people involved in waste recycling are the key catalyst in transforming waste plastic from worthless to worthy. But in Bangladesh, SMEs remained the most unattended sector in the financial system for a long, and their role has not been well praised in the case of economic contribution as well as in environmental protection. However, the sector needs more policy support for structured and technologically advanced growth. Poor working conditions, being highly vulnerable to occupational health risks, and being social outcasts have been integral to people involved in the waste plastic recycling business. The business chain mainly depends on manual processes with almost no modern technology intervention. Since these business enterprises have grown up with minimal investment and due to the cost constraints, the business hubs have been established at strategic locations mostly adjacent to densely populated residential areas and on the river bank. Therefore, it may not the possible for the factories to develop ETPs and WTPs to reduce environmental pollution. Waste plastic recycling can be beneficial both for the environment and the economy of Bangladesh. Availability of enormous raw materials, i.e., solid waste, minimum production cost due to the manual process, and lower wage expenses, are the key factors that may create scopes for Bangladesh for the production of plastic flakes generated from waste plastics. It is anticipated that the research outcome shall help the interest group, scientists, and researchers develop a concept on waste plastic value chain (source to recycling of Dhaka City and thus enhance stakeholder's capacity in policy formulation for business sustainability of the SMEs and environmental sustainability. Again, the lessons learnt from the study was expected to enable Bangladesh to formulate strategies towards achieving the sustainable development goals (SDG), more specifically Goal 11 (sustainable cities), Goal 12 (Responsible consumption and production), Goal 14 (life below water) and Goal 15 (life on land) (UNSDG, 2018).

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