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of Applied Sciences

The analysis of drivers and strategies to develop the (eco-friendly) plastic recycling industry in the context of Bangladesh.

Bachelor's Thesis

Valkeakoski, International Business

Spring Semester 2025

Hasan All Banna Chowdhury

HAMK
Häme University
of Applied Sciences

Abstract

DP Degree Programme in International Business
Author Hasan All Banna Chowdhury Year 2025
Subject The analysis of drivers and strategies to develop the (eco-friendly) plastic recycling industry in the context of Bangladesh
Supervisors Sruti Narra

ABSTRACT

Bangladesh is a fast-developing country like many developing nations, it has sustainable plastic recycling concerns. To create a sustainable eco-friendly environment, the necessity of plastic recycling and the demand of plastic by products are on the rise in the global market. In Bangladesh despite various policy changes the industry situation had not changed significantly. To get a closer look into the plastic recycling industry the author conducted thorough research with both primary and secondary data using a pragmatic research philosophy.

The results of the research have provided a lot of interesting insights backed by data and reasoning. This research provided a deeper understanding of the reasons behind the stagnant condition of the plastic recycling industry in Bangladesh. It has also unearthed various driving factors that justify ensuring this industry's growth and potential.

This research has provided significant insights into the infrastructural gaps and the hidden potential in the context of the Bangladesh's plastic recycling industry. It also highlights how proper planning and use of resources can create many new opportunities in a market like Bangladesh.

Keywords Plastic recycling, Environmental sustainability, Plastic Waste

Pages 42 pages

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1 INTRODUCTION

1.1 Background of the Research

One of the biggest threats to the global environment and sustainability is pollution related to plastic. It corrupts land, water, and ecological life. Plastic pollution is now proving to be deadly due to inefficient management and recycling of plastic waste. Plastic waste management and recycling has now become essential for global environmental sustainability. The need for plastic pollution management and demand for recycled plastic products has created a robust recycling industry that is now growing globally.

The global industries in the plastic sector produce various types of harmful wastes that are severely impacting the environmental sustainability. This research will focus on the context of Bangladesh. Bangladesh is a developing country, there are no proper regulations regarding plastic recycling. The lack of proper regulation is a major contributor to the environmental degradation and leads to the depletion of valuable ecological resources. The harmful materials that are a result of the production and after-use of plastic products are harming our environment (Zhikun Li a, 10 May 2024). These harmful byproducts include microplastic, PAHs, methane & ethylene, POPs, carbon monoxide, etc. So, to create an eco-friendly plastic recycling industry, some strategic shift is required. This research will take a deeper look into the drivers that are making this change so important. In this research, the factors that are making plastic waste so harmful for various industries will be identified and the necessity to change these practices will be deeply analysed (Sanchez, 2020). This research aims to identify the gaps in consumer behaviour regarding the usage of sustainable plastic products and the process of transitioning into eco-friendly plastic products (Sanchez, 2020).

The case company is "RID (Relation for investment and development) Plastic & Packaging Industries". It's located in BSCIC Industrial Estate Feni, Bangladesh. The company is a Partnership Business. Their products are different types of polythene sheet rolls, PVC etc. Poly sheet rolls are made based on length, , and thickness. The rolls come in black, white, and blue colours. The length of the poly sheet roll is 27, 45, 54, 72 and 90 inches and the thickness are 1 mm to 10 mm. Material for making poly sheet rolls are recycle poly regime, colour and some calcium for shining. The colour is artificial and Rid Plastic use two colour black and blue. The type of colour used is resin.

The Company is Approved by some government organizations and certified by some government organizations such as Department of Environment Feni Department of Factory Inspection Feni, Department of Fire Service Feni, and by the Feni Municipality.

Plastic Recycling process:

First, the products for recycling are collected. Recycled products are collected always from 2 places. From some specific small business shops and from some large consumer food industrial places. Small businessmen collect various types of unnecessary plastic items lying in different places of the environment like water bodies, forests with some people. Various types of waste plastic items lying in the environment cause serious damage to the environment. All those waste plastics can be seen lying on the road, in open fields, in villages, in water or in different places of the environment. Small businessmen collect the waste plastics lying in the environment with their workers. Small businessmen sell the collected plastics by the kilogram. Which is sold for 40 to 50 taka per kilogram. (RID Plastic & Packaging Industries, March 2025)

1.2 Problem Statement of the thesis

The plastic recycling industry is neglected in Bangladesh, and there is plenty of room for improvement in the recycling industry in Bangladesh. This research will study the plastic recycling industry landscape of Bangladesh. It will take a deep dive into the various aspects of Bangladesh’s plastic recycling industry including challenges and future opportunities.

1.3 Research Questions

The main research question for this thesis is: What are the most sustainable and energy-efficient methods for recycling plastic waste in the context of Bangladesh?

In order to answer the main question, the following sub questions need to be answered

a. What are the challenges of plastic recycling industry in Bangladesh?
b. What are the drivers to create a sustainable plastic recycling industry in Bangladesh?

c. What strategies can be adopted to improve the plastic recycling industry landscape in Bangladesh?

1.4 Research Objectives

This research aims to investigate the most sustainable and energy-efficient methods for recycling plastic waste in the context of Bangladesh. It will look at the major challenges that the plastic recycling industry is currently facing, including technological, economic, and infrastructural barriers. The study also aims to determine the key factors that can influence the growth of a more sustainable recycling system. It will also look at the practical strategies and policy recommendations that can improve and enhance the overall plastic recycling landscape in Bangladesh.

1.5 Significance of the Study

The research is significant from the environmental perspective, from the economy perspective in Bangladesh's recycling industry sector, and also from the academic research perspective.

The deep analysis of the behaviour of Bangladesh's consumer market regarding plastic recycling industry is significant as it helps the industry understand the current market in order to prepare their next steps in the process of becoming more eco-friendly and more sustainable (Islam, 2021).

The emphasis on understanding the role of recycling companies in environmental sustainability is another key significance of the study (Dijkstra, 2020). The plastic waste management in a developing country will provide significant and useful insights.

The business and economic incentives are a major driver for growing any industry. The business and economic significance of the plastic recycling industries will be analysed through this research.

1.6 Research Gap

There are not enough research studies that focus on the behaviour of consumers, private recycling companies, technological solutions, effective laws, etc in Bangladesh (Islam,

2021). Addressing these gaps and ensuring an effective and sustainable plastic recycling system is essential to improve the recycling system of Bangladesh. In this research, the research gap will be addressed to understand the recycling industry of Bangladesh and how it can improve environmental sustainability.

1.7 Thesis Structure

This thesis is divided into 5 key chapters. These chapters are shortly described below:

Chapter 1: Introduction – The context and background of the research is going to be provided in this chapter. The research questions and objectives will be outlined here as well.

Chapter 2: Theoretical Framework – This chapter will provide an academic framework for this research. The current and relevant literature will be reviewed here.

Chapter 3: Methodology – The research methodology will create the research framework, including research design and data collection methods. The framework for data analysis will also be provided in this chapter.

Chapter 4: Research findings and analysis - All the primary and secondary data collected on the plastic recycling industry in Bangladesh will be analysed in this chapter.

Chapter 5: Recommendations and Conclusion – This chapter will provide recommendations based on the findings. After that the conclusion part will summarize the all the key highlights of the research.

2 Theoretical Framework

2.1 Introduction

The literature review in this area provides various perspectives to explore. There is a lack of awareness regarding the environmental sustainability caused by plastic products in

Bangladesh. This is reflected among the government regulators and the public. Many steps need to be taken by the consumers for the recycling of harmful products made of plastic. Multiple challenges are hampering the transformation of the plastic re-cycling industry toward sustainability in Bangladesh. These issues range from micro factors to macro factors (Catarina Costa, November 2024). Some Examples of micro factors are lack of consumer awareness, lack of cleanliness and isolation, insufficient technology, unaware businesses etc. Some examples of macro factors are lack of infrastructure, lack of education and research, lack of public awareness campaigns etc. But there are some efforts made towards this goal of sustainable plastic re-cycling industry and a lot can be learned from the literature. It will help to identify the backlogs and research the solutions to achieve the goal of sustainability in the re-cycling industry in Bangladesh (Lamerichs, 2024).

This research is focused on identifying the gaps in consumer behaviour regarding the usage of sustainable plastic products and the process of transitioning into eco-friendly plastic products.

2.2 The major effects of lack of plastic recycling on the environment of Bangladesh

Plastic is a product that is harmful to the environment if not properly recycled (Akter, February 2024). Plastic takes years to get mixed up with soil. It not only destroys our environment with air, water, and soil pollution, but it also creates various health risks for living creatures.

The Effect of Plastic Pollution on Soil and Agriculture

Plastic pollution can lead to soil contamination as it is non-biodegradable. It reduces the crop production by reducing the quality of the soil. Microplastics in soil are hard to separate and they slowly degrade the quality of the soil (Chen, 2020). As these microplastics make it difficult for plants to gain the necessary nutrients, the crops produced from these lands are not of the highest quality.

The Effect of Plastic on Water and Marine Life

Bangladesh has hundreds of rivers and water bodies, and the livelihood of many people is dependent on the marine life of these waters. But unfortunately, these water bodies are consistently being polluted by plastic pollutants (Abbing, 2021). The significant portion of plastic wastes ends up in these water bodies. The lack of plastic waste management is the biggest contributor to this issue.

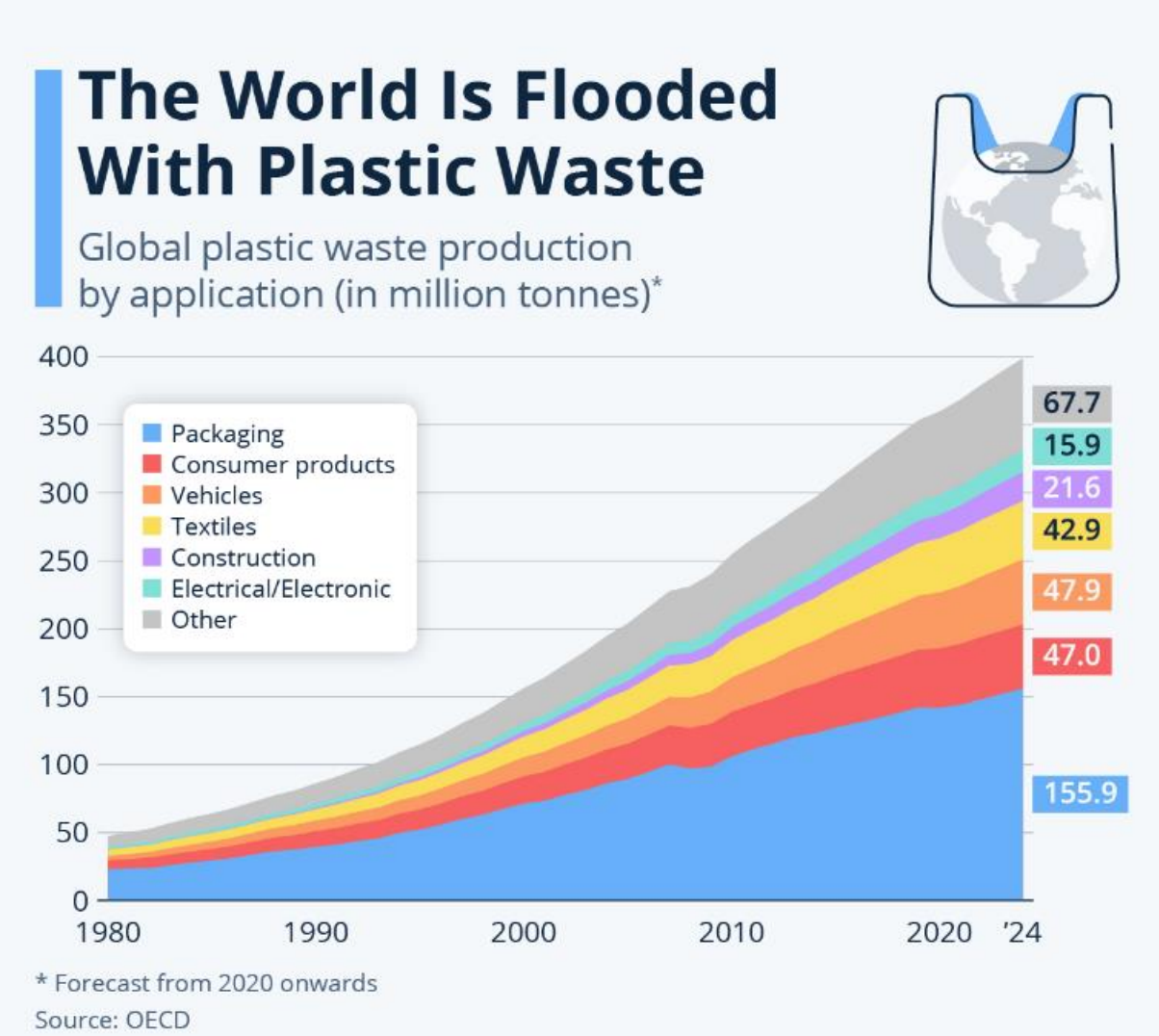

Figure 1: Increasing rate of plastic waste in our waters. (Source: OECD, 2020)

The graph shows that the global plastic waste in our oceans is on the rise and with that the demand for sustainable recycling is also on the rise. Because, accumulated plastic

waste in drains clogs the drainage system of the cities and creates waterlogs during the rainy season. The plastic pollutants contaminate the water and its marine life, thus reducing the marine biodiversity of Bangladesh. Also, water pollution due to plastic waste creates a fresh drinking water issue.

The Effect on Climate Change

The plastic pollution can affect the climate in multiple ways. It can affect natural elements of the environment through water, soil, and even air. Burnt plastics release highly toxic materials into the air. These toxic gases are directly correlated to causing greenhouse effect and causing climate change (Islam, 2021).

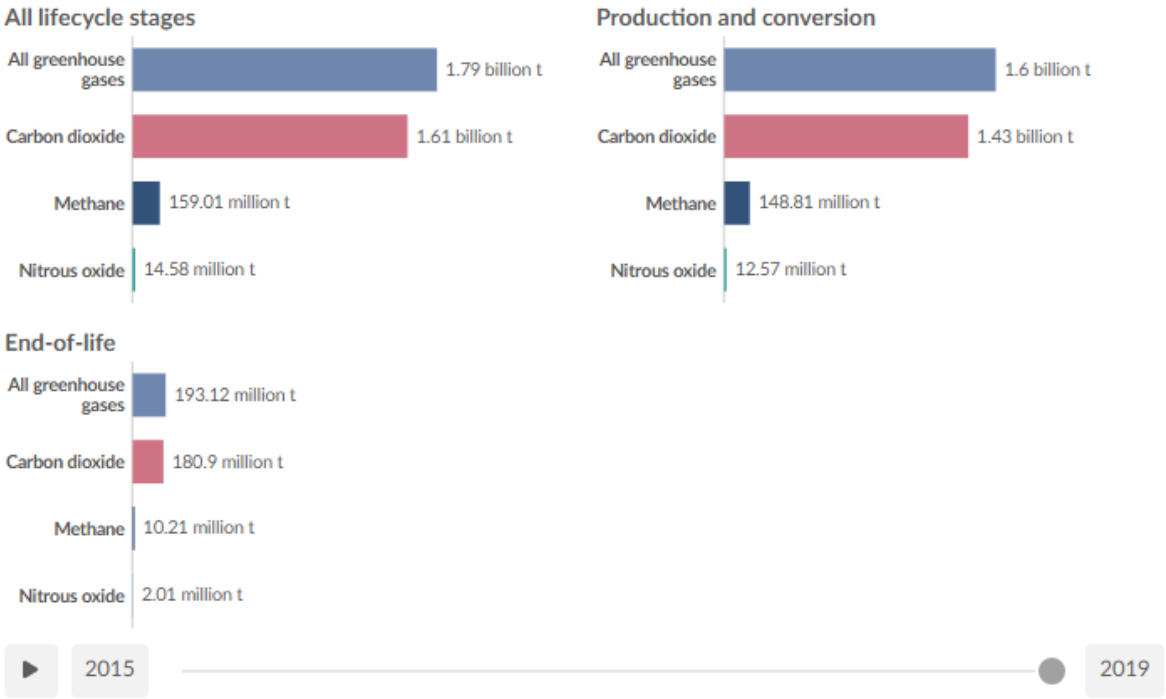

Figure 2: Plastic waste's contribution to climate change. (Source: OECD, 2022)

The figure shows the greenhouse gases produced by plastic waste at the various stages of its life cycle. Plastic wastes continuously produce carbon dioxide, methane, nitrous oxide at all stages of its life cycle. The biggest percentage of greenhouse gas produced by plastic waste is carbon dioxide.

The recycling of waste plays an important role in protecting our climate. Recycling reduces pollution and the contamination of soil and water, lowers greenhouse gas, etc.

However, recycling must be done correctly for it to be successful. Bangladesh suffers many environmental problems due to improper recycling. For example, Water pollution: Pollution of the Buriganga River, plastic deposits in Saint Martin and Cox's bazar beach. Soil pollution: Accumulation of polythene destroys fertility of agricultural land, Plastic piles in local markets and residential areas. Air pollution: Plastic burning in brick kilns, plastic burning in open spaces. Health risks: Toxic microplastics are leaching into food and water, chemicals in plastic bottles and plastic packets, health risk to workers in unhygienic recycling factories etc related to climate change (Siddique, 2022).

2.3 Plastic Recycling Practices from a Global Perspective

Globally plastic recycling industry is growing out of the necessity to reduce plastic pollution. It is important to take a closer look at the global plastic recycling industry to understand the best practices in terms of the necessary technology, regulatory policies and corporate framework. It will provide an understanding of the global plastic industry that can be implemented in Bangladesh (Chen, 2020).

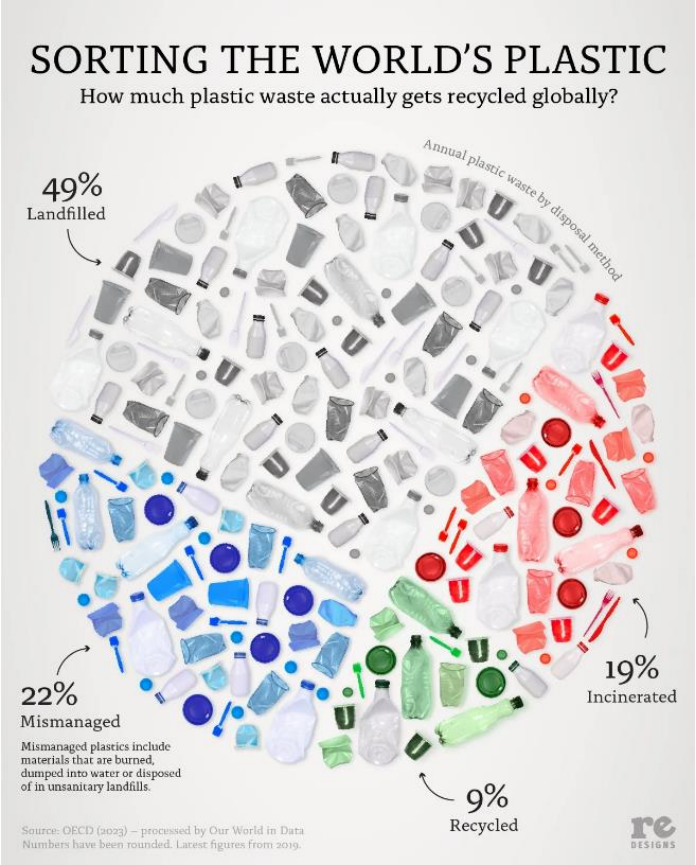

Figure 3: Global plastic recycling overview. (OECD, 2023)

The graph shows a clear picture of the room for improvement in the environmental sustainability of the plastic recycling. Most of the world's plastic ends up in landfills and only 9% of plastic is actually being recycled. So, to produce more recycled plastics, there is a need to take initiatives that ensure that plastic waste does not end up in landfills (Horvath, 2018). Then initiatives must be taken to ensure proper management of plastic waste to improve the current plastic recycling landscape.

EPR policy for plastic producers

ERP stands for Extended Producer Responsibility. Some developed countries use ERP to hold plastic manufactures accountable for their product for the duration of product's lifecycle. In Germany companies are required to register their plastic packaging and pay fees that will ensure proper recycling of plastic materials (Patil, 2018). Japan incentivizes the use of plastic within the same industry through their closed-loop recycling policy to properly track and recycle plastic waste. And some developed countries like Canada intend to shift the cost of managing plastic waste to its consumers through EPR policies.

Using Advanced Technologies to Efficiently Sort and Recycle Plastic

Nowadays in the recycling industry advanced technologies are being used to sort and process plastic waste materials. There are many experiments going on regarding biodegradable plastic alternatives and chemical recycling methods (Schmaltz, 2020). Also, AI is being implemented in various waste sorting machines to enhance efficiency of plastic waste management.

Incentivising waste collection

In developed countries like Japan, Singapore and South Korea waste segregation and collection are incentivised by government policies. In developed countries waste is categorised by the households and the public before it goes for recycling (Debnath, 2023). It reduces the cost and increases the efficiency of plastic waste management. In countries like South Korea, citizens are fined for unsorted waste.

The deposit return scheme is another mechanism of incentivising plastic waste management. Countries like Germany, Norway, Denmark use this scheme to encourage their residents to participate in the plastic waste management (Kristina, 2018). This scheme allows consumers to get monetary return by properly segregating and recycling plastic waste.

There are countries like Rwanda, UK, Canada that have already banned single use plastic and regulated the plastic products in their markets. These policies encourage the public to better manage plastic waste.

2.4 Bangladesh's plastic recycling industry

The plastic recycling industry is not yet developed in Bangladesh. It still lacks proper planning and execution. Many factors are responsible for this, such as poor infrastructure, improper execution, insufficient public awareness, etc. Even though Bangladesh generates tons of waste yearly, only a small percentage of it is recycled.

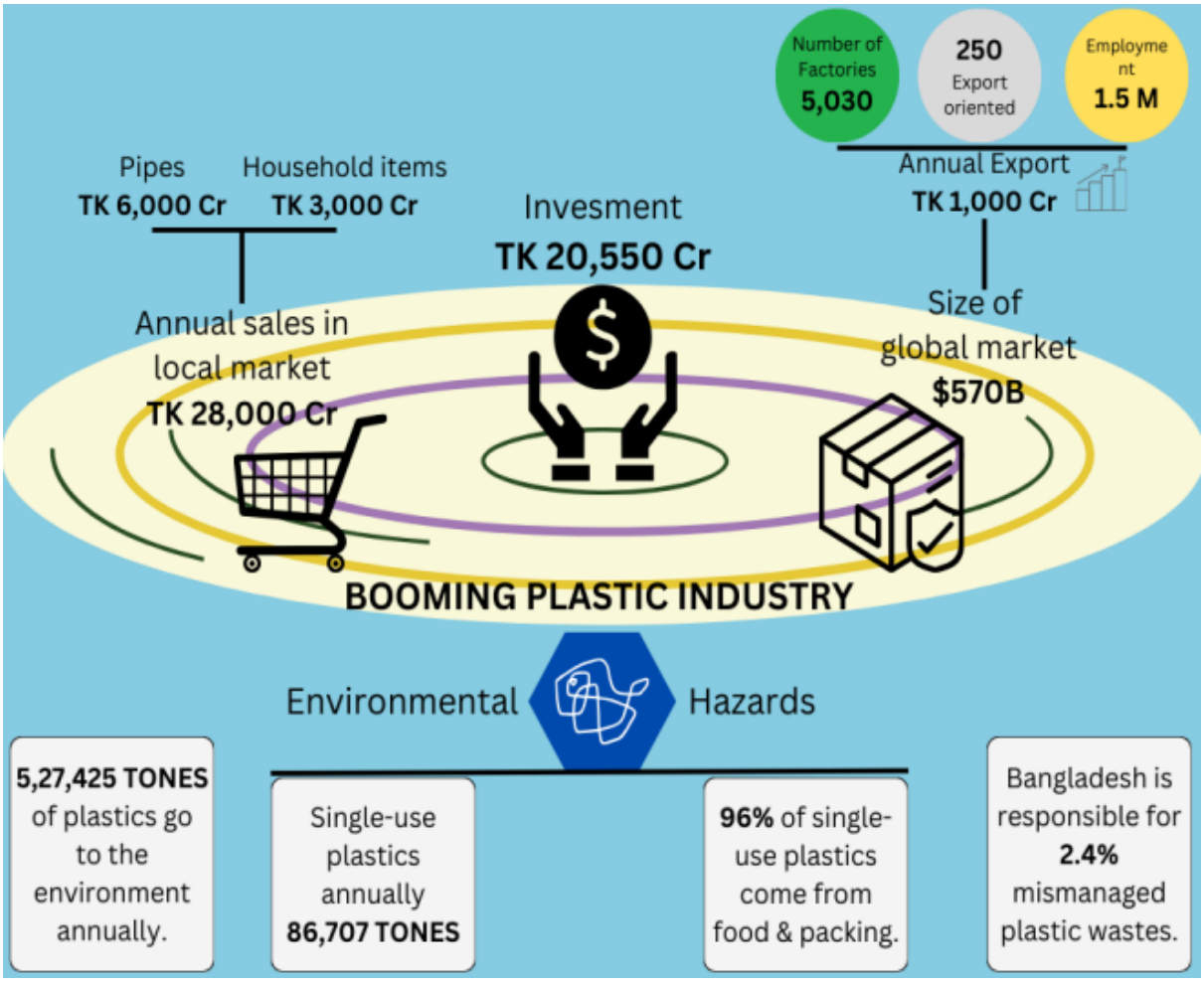

Figure 4: Plastic recycling industry overview of Bangladesh. (Noyon, 2021)

From the figure here are some major factors that are hindering the establishment of an eco-friendly plastic recycling industry in Bangladesh (Noyon, 2021):

Lack of proper infrastructure: It is estimated that 5,27,425 tons of plastic goes to environment annually. In Bangladesh major portion of plastic waste ends in landfills or in the rivers. The lack of proper infrastructure hinders the management of plastic waste (Patil, 2018). The lack of adoption of modern technologically enhanced infrastructure is the major reason for the inefficiency of the plastic recycling efforts in Bangladesh.

Public participation in plastic recycling: The residents of Bangladesh are not aware of the negative side effects of plastic waste in our society (Chowdhury, 2025). The lack of interest in the society regarding the recycling of plastic makes it difficult for relevant stakeholders to collect and recycle plastic waste. The lack of public awareness hinders the progress of the recycling industry in Bangladesh.

Cost of collecting and recycling plastic waste: Bangladesh exports around 1,000 CR BDT worth of plastic goods (Noyon, 2021). The plastic wastes are often mixed with various other type of wastes. So, it is expensive and time-consuming to separate plastic wastes from various other materials. Additionally, the lack of infrastructure makes the processing and recycling of plastic wastes more inefficient. All these factors drive up the cost of recycling plastic wastes.

Weak regulatory oversight: It is estimated that 2.4% of world's plastic waste comes from Bangladesh alone (Noyon, 2021). The regulations regarding plastic waste management are not properly enforced in Bangladesh. The illegal waste disposal in various natural habitats is possible due to this negligence. The regulatory measures to ensure plastic waste management must be enforced properly to improve the overall condition of the recycling industry in Bangladesh (Debnath, 2023).

Economic factors in Bangladesh: The micro and macro-economic factors are crucial in shaping the recycling industry of Bangladesh.

Micro-Economic Factors:

***Consumer demands*:** The demand for recycled products in the market is essential for the growth of the industry within Bangladesh. In order to establish the consumer demand the quality of recycled products has to be good to replace the existing product options.

***Industry competition*:** The entry into this industry is often expensive because business owners are required to buy machineries and equipment that are expensive which increases the cost of investment needed for setting the business up (Catarina Costa, November 2024). So small recycling companies find it extremely hard to establish operations in the plastic recycling industry in Bangladesh.

***Cost of employment*:** In this regard Bangladesh has a slight advantage. Bangladesh has access to cheap labour (Chowdhury, 2025). The utilization of this relatively inexpensive labour can provide an advantage to the companies that are trying to compete in this industry.

***Government Incentives*:** Government incentives can significantly boost the growth of the industry. If the government focuses on providing incentives to the businesses of this industry and invest in infrastructure and technology the industry will see rapid growth (Siddique, 2022).

Macro-economic factors:

Global market trends: International policies and market trends have a significant impact on the plastic recycling market of Bangladesh. How other global players are doing business in the recycling industry will have an influence on how Bangladesh does business in the recycling industry.

Global economic condition: The global economic downturn or upturn has a direct influence on the growth of the recycling industry. Global economic downturn results in a slow industrialization that as a result slows down the growth of the industry as well (Schmaltz, 2020). For instance, Covid-19 impacted the global supply chain that resulted in a significant reduction in trade and slowed the global economy.

Currency fluctuation and inflation: The volatility in currency market can have an impact on the business of recycling industry as well. So, it is imperative that companies hedge for the currency risks.

Environmental Policy: The global environmental policy shifts have an impact on the business of recycling industry (Akter, February 2024). The current global consensus regarding environmental sustainability makes a good case for the growth of recycling industry in Bangladesh.

2.5 Bangladesh government's policy initiatives

On paper, Bangladesh government has undertaken various initiatives to address the plastic pollution challenges. The government of Bangladesh has several laws for the management of plastic waste. It is important to study those initiatives to get an understanding of the current situation of the plastic recycling industry. Some of these policies are Polythene Bag Ban (2002), Bangladesh Environment Conservation Act (1995), Solid Waste Management Rules (2021), etc. (Akter, February 2024).

2.6 The Implementation of Government Policies

Companies or businesses struggle to follow these rules due to the excessive cost of compliance, poor law enforcement system, poor infrastructure for waste management, etc. Because of these reasons, the recycling costs get higher, many businesses evade laws, and inadequate collection process makes compliance with laws harder.

Poor Recycling Infrastructure: There are no proper places or systems for recycling. The cost of recycling is significantly higher in a country like Bangladesh than in developed nations. Thus, it becomes increasingly difficult for companies to follow government policies.

Low Awareness in Public: The people often do not follow recycling rules. It is a vicious cycle. The lack of awareness makes it difficult for companies to incentivize plastic recycling.

Inadequate Financial support: Bangladesh does not have proper financial support to aid in the recycling system. The private sector does not get support from the government to set up proper infrastructure to grow the recycling industry in Bangladesh.

Irresponsible law Enforcement: The laws enforced are not strictly imposed. As companies are not properly held responsible for not following the regulations these policies do not have the desired impact on the recycling industry.

2.7 Consumer behaviour in plastic recycling

For any industry to grow the behaviour of consumers is of significance. Policymakers consider the consumer mindset while developing policies for the good of the society. Their success or otherwise is directly proportional to the positive consumer behaviour.

Creating a circular economy where plastic usage, plastic segregation, and plastic recycling happen in a circular manner is important to create a sustainable environment. But current trends in Bangladesh do not look promising in this regard. The use of single use plastic bag is widespread. The households do not get incentives to segregate their waste to separate plastic waste (Debnath, 2023). There is a lack of awareness regarding the environmental harm of using and mismanaging plastic products. That is why alternative options are not properly utilized in Bangladesh.

The residents are not aware of the necessities of recycling plastic waste. The lack of infrastructure around recycling is another reason for public's disinterest toward plastic recycling. These consumer behaviours are difficult to change. To make meaningful changes in the plastic recycling landscape it is essential to ensure a shift in consumer mindset.

2.8 Consumer behaviour in plastic recycling

Despite the ongoing literature on the topic related to plastic recycling there are still some significant research gaps. Through this research the following research gaps will be addressed.

- Impact of consumer behavior on achieving plastic recycling efficiency.
- Incentives to modernize the recycling industry landscape in Bangladesh.
- CSR practices of corporations regarding plastic recycling.
- Implementation of recycling policies and their impact on the industry.

2.9 Conclusion

This chapter has given a comprehensive literary overview of the plastic recycling industry and has taken a closer look into the various aspects of the recycling industry. The global and local perspectives in the recycling industry have given us a clear picture about the current trends and challenges. The trends in consumer behavior have given important insights to consider while suggesting possible solutions.

3 Research Methodology

3.1 Introduction

The research methodology chapter is focused on creating a structure of the research. In this chapter a framework is created to scientifically collect and analyse data that best suits the requirement of this research. In order to integrate empirical data into the theoretical perspective of this research, an outline is created in this chapter.

3.2 Expected outcomes of the research

The purpose of the research is to investigate various aspects of the re-cycling industry, in order to identify the bottlenecks that are hampering the transition of eco-friendly plastic products.

This research will help us to understand the psychology of various stakeholders that are relevant to the re-cycling industry (Akter, February 2024). Thus, enabling us to identify the strategies that are required to shift toward a more sustainable method of using plastic products and their management.

3.3 Philosophy and Approach of the Research

This research is based on both qualitative and quantitative data. In order to get the best outcome, this research incorporates a pragmatic research philosophy (Cooper, 2012).

Because it allowed the author to suggest provide practical solutions that came from various real-life problems of collecting and analysing data.

In this research work, the inductive research approach was used to incorporate existing theories in the field. On the other hand, inductive research approach was adopted when there were some new findings came to light from primary data analysis (Creswell, 2017). This hybrid approach gave the author flexibility to explore the recycling industry and understand the associated market factors in the context of Bangladesh.

3.4 Types of Data

In this research, both primary and secondary data was used. To achieve the objectives of the research surveys, interviews, and various secondary sources of data were used.

Primary Data: In order to gather primary data online survey was conducted. The ideal target group was set in accordance with the users' age, profession, and region (Kabir, July 2016). Online survey tools will be used to reach out to the ideal target group of the survey.

Then, various data analysis tools like Excel will be used to analyse the received data and provide appropriate data stories relevant to the research.

Secondary Data: The secondary sources of data is gathered through various secondary sources like books, online portals, journals, etc (Ritchie, 2013).

3.5 Research Design

Qualitative and quantitative data gathered from primary and secondary sources was analysed and visually represented using various data analysis tools (J. Ellis, 2009). In order to get the best outcome from this research work a mixed-method research design is used.

Structured surveys were used to collect quantitative data. This provided insights regarding public awareness, consumer behaviour regarding the recycling industry (Kabir, July 2016). The qualitative data was collected through interviews and various case studies.

It provided an in-depth understanding of all the relevant stakeholders of the recycling industry.

3.6 Survey Sampling and Design

The author conducted a survey to get primary data to understand the consumer and relevant stakeholders' perspective about the plastic recycling industry (Collis, 2013). The survey collected data from 67 participants. The sample audience were relevant stakeholders, workers of recycling sector and general consumers. The sample audience were mostly from urban area of Bangladesh. For quantitative data analysis cluster sampling method was used. On the other hands, for qualitative data analysis theoretical sampling method was used.

Here are the survey questions:1.

1. Age

a) 18 - 25

b) 26 - 35

c) 36 – 45

d) 46+

2. Gender

a) Male

b) Female

c) Prefer not to say

3. Associated Group

a) General Consumer of Recycled Product

b) Working in Recycling Industry

c) NGO/Policymakers/CSR Experts

d) Other

4. Which recycling method is best suited for Bangladesh? (Select multiple if applicable)

a) Mechanically melt & reuse plastic

b) Chemically break plastic into monomers.

c) Burn plastic as fuel

d) Biodegradable options

e) No Idea

5. Do you support plastic recycling as a way to reduce landfill waste in Bangladesh?

a) Agree

b) Strongly Agree

c) Disagree

d) Strongly Disagree

e) Neutral

6. What are the major challenges that are hindering the growth of plastic recycling industry in Bangladesh?

a) Undeveloped Infrastructure.

b) Enforcement of policies and laws.

c) Lack of public awareness.

d) Lack of Incentives and fund.

e) Cheaper alternatives

7. Are you satisfied with the government’s efforts to develop the plastic recycling industry?

a) Yes

b) No

c) Neutral

d) No Idea

8. Do you consciously separate plastic waste at your work or home?

a) Sometimes

b) Always

c) Never

d) I don’t know the process

9. Do you have access to marked bins for recycling in your area?

a) Not available

b) I don’t know

c) Available

d) Not easily accessible

10. What steps can be the most effective to develop eco-friendly plastic recycling in Bangladesh?

a) Policy changes by government

b) Create consumer awareness about plastic recycled products

c) Proper waste management infrastructure.

d) Public & private investment.

e) Public awareness about environmental sustainability

11. What is the potential of Bangladesh to become a major player in eco-friendly plastic recycling?

a) Very high potential

b) High potential

c) Low Potential

d) Very Low Potential

e) No Idea

12. Are you encouraged to buy from companies that use eco-friendly plastic waste management?

a) Yes

b) No

c) Neutral

13. Do you think companies should be legally responsible to recycle plastic to improve eco-friendly plastic usage in Bangladesh?

a) Yes

b) No

c) Neutral

3.7 Ethical Considerations for the research

There are some ethical conundrums to consider while completing the research work. There were conscious attempts made to ensure that the participants could freely make their decision while filling up the survey form. They were given privacy while completing their survey forms. They were allowed to share their unbiased opinions. There were also verbal agreements that their valuable opinions will not be shared without their consent. The author made sure that the sample size for the survey was created to avoid any biases that might skew the results of the research.

3.8 Interview Methodology and Case Study:

The author interviewed some selected members who participated in the survey. These were high officials of the RID and some relevant stakeholders who have deep insights about the industry. The semi-structured interview method was used to get more contextual insights into the operational challenges of the recycling industry in Bangladesh.

Each interview was kept short and precise, Interviews were conducted mostly in their native language, Bengali to get the best output from the participants.

The survey questions covered the topics mentioned below:

1. What are the sustainable methods of growing the recycling industry?
2. What are the day-to-day challenges of running a plastic recycling company in Bangladesh?
3. What steps can be taken by all stakeholders to ensure the growth of this industry?
4. Do you have any recommendations that can bring positive changes in the industry?

On the other hand, the case study was conducted on the day-to-day operation of Rid Plastic. It was to understand the operational work of a plastic recycling company. It was conducted to understand the various challenges of producing recycled products and the importance of various departments within the company. The machinery required, the required human resources, and energy requirements were the priority of this case study.

3.8 Chapter Conclusion

The chapter has provided details of the methodology that was used to conduct the whole research. This worked as a structure that allowed a systematic collection of data and analysis.

4 Research and Analysis

4.1 Introduction

In the previous chapter the methodology of collecting data was discussed and outlined. This chapter analysed those data and found meaningful insights to understand the recycling industry in Bangladesh. This chapter's goal was to interpret data to find meaningful correlations with the research questions identified previously in the introduction chapter.

4.2 Recycling Method's Overview in the Context of Bangladesh

Mechanically Melt and Re-use plastic:

This is a low-cost method of recycling plastic and widely used in underdeveloped countries like Bangladesh. The technology required to achieve this is relatively low. The required amount of energy and mechanical recycling's impact on the environment is very low if done right.

Chemical Method:

It is a relatively high-cost option for recycling plastic. It is a good option for converting contaminated plastics. If the recycling company is not careful enough it could be an environmental hazard for Bangladesh's environment.

Convert to fuel:

It is a process of recycling that is difficult to do without harming the environment. The cost of doing it is also very high, and it takes a lot of energy to do this recycling.

Biodegradable:

The main reason it is one of the less popular options is because it costs a lot more than other available options. It can be done on limited type of plastics, and it requires high tech readiness which Bangladesh is currently not.

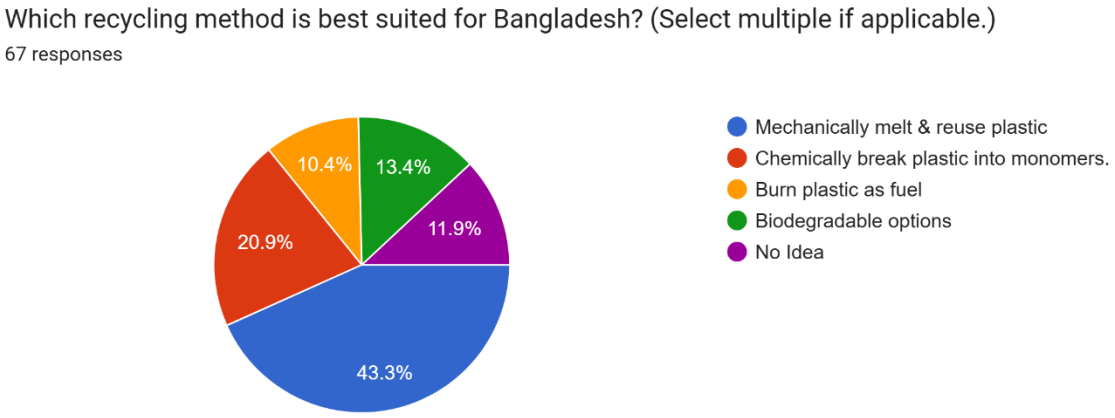

Figure 5: Recycling methods and Bangladesh.

The survey reflects the various pros and cons of using different recycling methods in Bangladesh. The 43.3% of participants choose the cheapest and most popular recycling method, mechanical recycling method.

It shows that the participants are aware of various recycling methods and what is best suited for current recycling industry scenario of Bangladesh. Only 11.9% of the consumers did not have any idea about any of these recycling methods.

The interview and survey results show that it is in the interest of Bangladesh's recycling industry to lean more on mechanical recycling methods.

In the long-term Bangladesh can investigate recycling methods that will enable Bangladesh to create a more sustainable and circular plastic recycling economy.

4.3 Major challenges of plastic recycling in Bangladesh

Infrastructure:

The biggest challenge identified by the survey participants is the lack of infrastructure. In Bangladesh, the recycling landscape is so underdeveloped that it increases the cost of recycling plastic in Bangladesh compared to other developing countries.

That is why 50.7% of the participants identified it as the biggest challenge for Bangladesh to achieve a sustainable plastic recycling industry.

Laws and regulations: Although there are lots of laws to encourage plastic recycling in Bangladesh, it has not helped much to achieve its sustainable plastic recycling goals. In the eyes of participants, it is not seen as a big challenge for Bangladesh's recycling landscape.

Public Awareness:

Another major reason identified by the participant is the lack of public awareness in Bangladesh regarding plastic recycling. 23.9% of participants believed if general publics are made aware of the necessity and importance of plastic recycling it will drastically change the current situation of the recycling industry in Bangladesh.

Funds and Incentives:

The low incentive to recycle plastic is another reason the industry is not growing in Bangladesh. To get proper funds both public and private sector needs to work together.

Cheaper alternative:

In many cases recycling plastic is expensive and in a developing country like Bangladesh cost is a big factor. That is why people are not choosing recycled plastic products. To get people to buy recycled plastic products the cost need to be brought down.

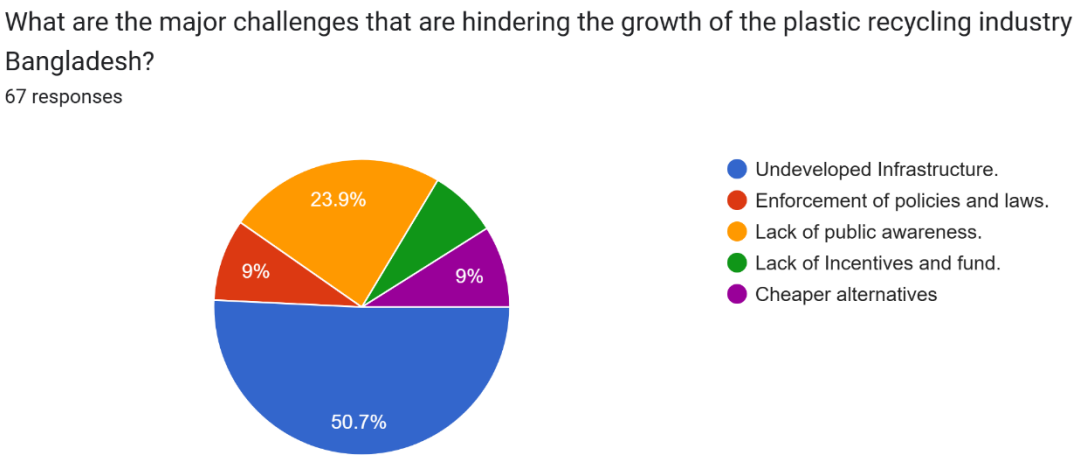

Figure 6: Major challenges in plastic recycling.

4.4 Driving factors of growing plastic recycling in Bangladesh

There are many factors that are driving the growth of the recycling industry in Bangladesh. These factors are analysed here to understand the potential of Bangladesh's recycling industry.

Environmental Factors:

It is estimated that Bangladesh produces around 633,129 tons of waste. The majority of plastic waste is produced in the urban areas. It is estimated that around 10% is produced in Dhaka alone.

These wastes end up in landfills and rivers that pollutes the environmental eco system of Bangladesh. In the survey around 80% of the participants agrees or believes strongly that plastic recycling can reduce landfill waste and reduce overall pollution in Bangladesh.

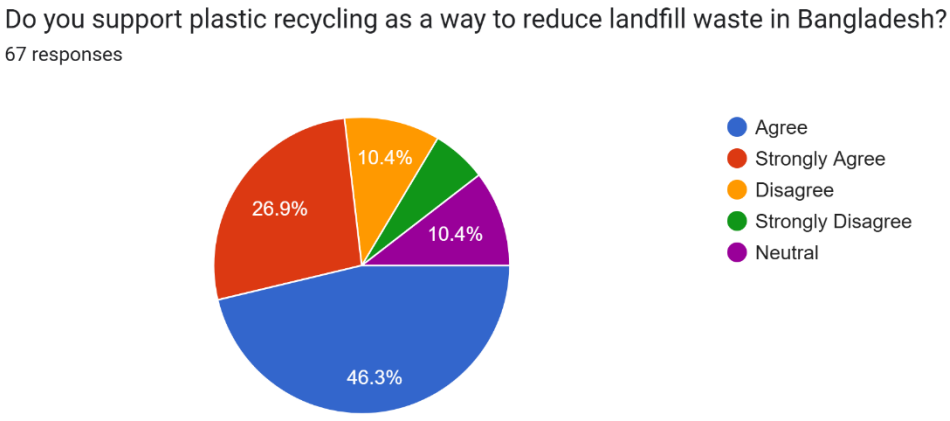

Figure 7: Plastic recycling is a way to reduce landfill waste.

Global Demand and Commitment:

Bangladesh must abide by various commitments to global agencies. It is in Bangladesh's economic and social interest to abide by these commitments. The global plastic recycling industry is also growing globally. It creates a massive incentive to grow the industry home and abroad.

Over 60% of the participant whether agrees or strongly believes that Bangladesh ca take advantage of the global demand of plastic recycled products. It will help in creating a greener environment and tackle major global warming issues. It will also open up new economic opportunities for local businesses. It will greatly benefit Bangladesh's interest to grow this plastic recycling industry and globalize.

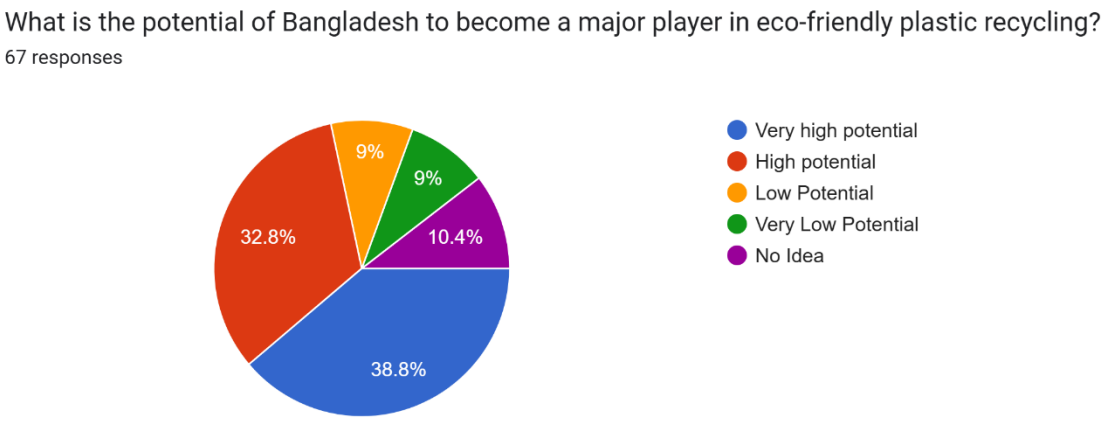

Figure 8: Plastic recycling industry's potential in the global landscape.

Consumer perspectives:

Consumers are major factors when big corporations make any decisions. It is imperative that the consumer's positive outlook on the plastic recycling industry can boost the growth of the

whole industry. It provides companies with incentives to bring more plastic recycled product to the market.

59.7% of the participants said they would prioritize buying from companies that provide products that ensures eco-friendly plastic waste management. Only very few percentage of participants are not aware of the positive impact of the plastic recycled products.

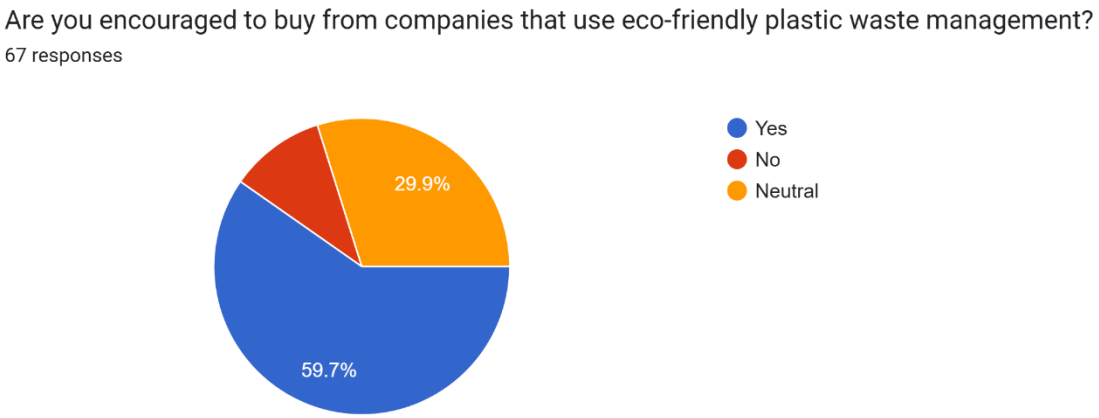

Figure 9: Consumers' perspective regarding plastic recycling.

4.5 Strategies to boost the plastic recycling industry in Bangladesh

A cohesive strategy must be implemented to create a sustainable, eco-friendly plastic recycling industry in Bangladesh.

Improve policy and implementation:

There are lots of policies regarding plastic recycling in Bangladesh. But in reality, these policies are not implemented properly.

So, in order to boost the plastic recycling industry in Bangladesh, these policies must be improved and properly implemented. 29.9% of the participants said they want the government to improve policy and ensure proper implementation.

Consumer awareness:

23.9% of the participants think consumer awareness can be helpful in boosting the recycling industry. The plastic recycling industry can prosper if a collaborative effort is made. The participation of consumers can accelerate the growth of the industry.

Waste management infrastructure:

The lack of waste management makes it costlier and more difficult to recycle plastic waste. 22.4% of the participants think proper waste management infrastructure using modern technology can make it easier for companies to manage plastic waste more efficiently.

The time and cost saving initiatives can boost the recycling industry and encourage companies to invest more in plastic recycling.

Public-private teamwork:

The public sector cannot alone tackle this issue and grow the industry. The success of this industry is going to be dependent on proper collaboration between the public and private sector. The public sector needs to provide incentives to private organizations to boost the plastic recycling economy. Then, the mutual beneficiary policies can attract investment and growth in the recycling industry.

Environmental sustainability awareness:

One of the major reasons there is a global need for sustainable plastic recycling is the environmental factors. The public needs to be made aware of the environmental benefits of creating an ecosystem that ensures there is no plastic waste in the environment.

The public awareness will push the government and private sector to enhance their efforts to make the recycling industry sustainable in Bangladesh.

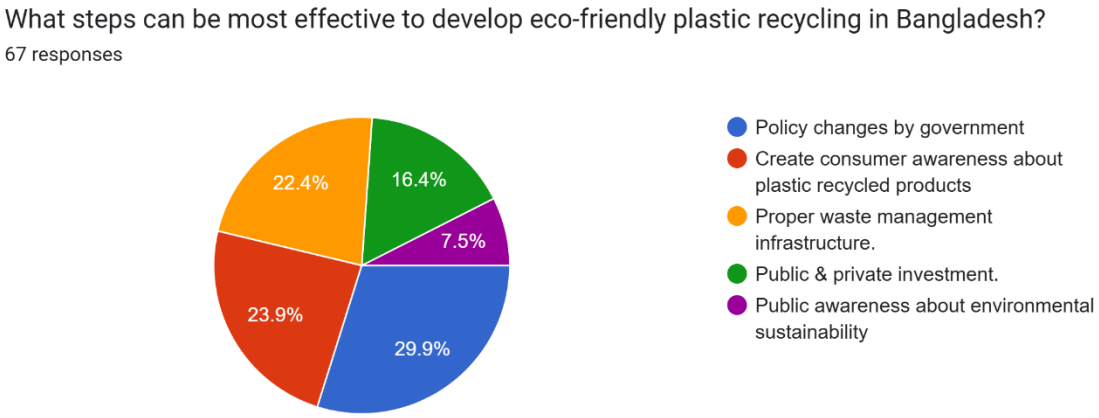

Figure 10: Strategies to improve the plastic recycling industry.

4.6 A short case study on Rid Plastic

Rid plastic company overview:

Rid Plastic is a plastic recycling and product manufacturing company. They make various types of products from recycled plastic. They mainly manufacture poly sheet rolls, PVC products and plastic pipes.

Recycling process used by Rid Plastic:

Figure 11: Plastic waste manual sorting.

Rid Plastic follows a complete recycling process step by step. In this process, they collect the plastic, grade it, clean and wash it, dry it and finally melt it in a machine to make new products. They use LD, LLD and HDP plastics as recycled materials.

Figure 12: Machineries used to process and recycle plastic.

Products Rid Plastic produce:

List of products manufactured by Rid Plastic Company:

1. Poly Sheet Roll

Different colours: white, blue, black

Different lengths: 27, 45, 54, 72, 90 inches

Used for building cantering

4 types of plastic pipes:

1.Electrical pipe (wire passing)

2.Water passing pipe

3.Plumbing pipe

4.Boring pipe (for tubewell installation):

Figure 13: Products produced from recycled plastics.

Reasons for their recycling process:

The reason for using this recycling method is.

1. It is environmentally friendly (reduces waste plastic).

2. It can produce good quality products at low cost.

3. The use of LD, LLD and HDP materials increases the quality, flexibility and durability of the product.

4. The quality of the product can be ensured by removing unnecessary items during the grading process.

4.7 Summary and analysis of Interviews:

Thematic analysis of the interview:

Code	Theme Description	Analytical Theme
Lack of trained workforce	Operational Challenges	Challenges of growing the plastic recycling industry in Bangladesh.
Lack of energy resources to run machinery.	Operational Challenges	Challenges of growing the plastic recycling industry in Bangladesh.
Minimal awareness among investors.	Market Challenge	Challenges of growing the plastic recycling industry in Bangladesh.

No enforcement of environmentally friendly policies.	Regulatory Gap	Challenges of growing the plastic recycling industry in Bangladesh.
Consumer awareness and their buying habits.	Market Challenges	Challenges of growing the plastic recycling industry in Bangladesh.
Cost of sorting required materials.	Procurement Challenges.	Challenges of growing the plastic recycling industry in Bangladesh.

Here are some key findings from the interviews conducted during this research:

Day-to-day challenges of operating a recycling company: The author interviewed some high officials of the RID Plastics. The participants mentioned their day-to-day challenges of operating their business. The lack of trained employees, power supply, hassles of procurement are the major challenges that they face in running their operation.

Pathway to growth: All the participants believed there is huge potential to be unlocked in the recycling industry of Bangladesh. Interviewed people had a general consensus that if the stakeholders properly collaborate and the government provides policy and infrastructure support, this industry can achieve great things.

The lack of awareness: There is a lack of awareness among both consumers and investors. The interviewed showed an urgency to spread awareness regarding the positive environmental impact of this industry among consumers and investors.

4.8 Summary of the chapter

The analysis showed us a detailed picture of Bangladesh's plastic recycling industry. There are many challenges and opportunities in the recycling industry of Bangladesh. The consumer's mindset and the industry's current condition have been analysed in detail in this chapter.

5 Recommendations:

5.1 Overview of the chapter

This chapter has the summary of the overall research on the topic of recycling plastic in Bangladesh. This chapter provides recommendations based on the study done throughout the research work. The evidence backed data analysis has given the author a strong ground to answer the research questions and appropriate recommendations based on the findings.

5.2 RO1 Sustainable and energy-efficient methods for recycling plastic waste in the context of Bangladesh

The most widely used method of recycling in the context of Bangladesh is Mechanical recycling. It suits the current economic and social context of Bangladesh recycling market.

Other methods of recycling are either too expensive or technologically not viable at the moment for the recycling industry of Bangladesh.

Recommendations:

- The mechanical recycling plants are mostly backdated. They need to be updated to be more energy efficient.

- There should be more investment in renewable energy generation in these plants, for example, generating energy through solar panels to power the plant.
- In order to increase efficiency, the work force needs to be trained on the modern methods of recycling.

5.3 RO2 The major challenges of the plastic recycling industry in Bangladesh

The lack of enforcement of government policies regarding plastic recycling is significantly hampering the growth of industry. Apart from that lack of awareness, cost competitiveness with other options and inadequate waste management infrastructure is slowing down the growth of this industry in Bangladesh.

There should be a combined effort to sort these problems.

Recommendations:

- Review the policies to make them more appropriate for the modern time and ensure enforcement of these regulations.
- There needs to be more incentives for recycling companies to encourage them to enter industry.

5.4 RO3 The key drivers to create a sustainable plastic recycling industry in Bangladesh

The plastic waste has become one of the major threats to eco life. It causes lots of environmental issues for Bangladesh and globally. There is a global need for creating such industries in a country like Bangladesh.

The global market is becoming more aware of the environment friendly products, and they lean towards buying products that are good for the environment.

These are the key driving force of creating a sustainable plastic recycling industry in Bangladesh.

Recommendations:

- The opportunities coming from home and abroad must be leveraged to grow the recycling industry in Bangladesh.
- The power of youth needs to be utilized to adapt to the changes of the world.

5.5 RO4 The strategies that can improve the plastic recycling landscape of Bangladesh

The world is moving at a very fast pace to create a circular economy where plastic wastes are recycled. It is done to protect the environment.

In order to improve the current landscape of plastic recycling all the stakeholders must come together to create an ecosystem that allows the industry to grow and prosper. The research and analysis have given the outline of the strategies that are currently being used in Bangladesh and can be updated to serve a much wider range of market.

Recommendations:

- Make policy and infrastructural reforms.
- Stay up to date with the modern technologies that improve the recycling process.
- The stakeholders need to ensure collaboration to reduce the cost of recycling at all levels.
- There needs to be a global and local partnership to bring in funds and provide incentives to local players.
- Consumer behaviour is favouring the growth of plastic recycling, this should be utilized to bring in significant growth in the industry.

5.6 Future opportunities for research

Implications of growing technologies like AI in the recycling industry can be a good opportunity to continue further studies.

The economic benefits of the recycling industry on developing countries like Bangladesh can be another insightful research opportunity.

The consumer behaviour patterns with the development of different technologies should be further studied.

6 Chapter: Conclusions

The plastic recycling industry's current state and future prospects were the key ingredients of this research work. In an attempt to understand the ins and outs of industry, a mixed research method was used to combine primary and secondary data. This research has provided a dynamic overview of the plastic recycling industry of Bangladesh.

The research data and analysis show that there has been visible growth in the industry, and consumer demand is also on the rise in favour of recycled plastic products. But the industry is facing challenges that have no quick fix.

In order to achieve the desired goal of achieving a thriving recycling industry in Bangladesh, all the issues regarding policy, infrastructure, and investment incentives must be dealt with one by one.

After laying the groundwork for the recycling industry, Bangladesh can utilize its immense potential to be a global player in the recycling industry.

In the context of Bangladesh, the plastic recycling industry can be a big opportunity to improve socio-economic conditions of the country. On one hand, it will improve the quality of the environment in Bangladesh.

On the other hand, it can bring in lots of monetary benefits to the country and can be an alternative industry for Bangladesh to go global. The sustainable waste management solutions need to be made popular among consumers and various stakeholders, thus the industry can slowly reach its maximum potential.

6.1 Research limitations and scope of future research

There are limitations regarding the process of reaching out to the ideal target audience for the surveys. The data can be varied due to various regional factors. The sampling for the survey is urban centric so there were limited insights regarding the rural consumer behaviour. The bias in secondary data is another limitation of the research (Robert T. Thibault, 11 October 2023).

For the future research in the region, specific research can be conducted on this topic. In future research, it can study behavioural changes and their correlation to various macro and microeconomic factors.

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Appendix:

Transcript 1:

What are the sustainable methods of growing the recycling industry?

Mr. Karim: I think the best way to achieve that is by incentivizing the owners to build more companies that recycle plastics and make recycled products.

What are the day-to-day challenges of running a plastic recycling company in Bangladesh?

Mr. Karim: A major challenge is hiring and training new employees to work with the machines for recycling plastic products.

What steps can be taken by all stakeholders to ensure the growth of this industry?

Mr. Karim: There needs to be more cooperation among various stakeholders involved with the industry. It will make it easier to identify and solve issues collectively.

Do you have any recommendations that can bring positive changes in the industry?

Mr. Karim: The policies regarding plastic products and their use need to be implemented more strictly and effectively.

Transcript 2:

What would you do to ensure the growth of the recycling industry?

Mr. Roni: The industry's growth depends on the government’s willingness to improve business conditions. The government needs to create an environment where investors can have the access to necessary resources.

What are the day-to-day challenges of running a plastic recycling company in Bangladesh?

Mr. Roni: A major challenge is ensuring that there is enough necessary fuel and electricity to run the machines. Frequent load shedding and lack of infrastructure cause inefficient production output.

What steps can be taken by all stakeholders to ensure the growth of this industry?

Mr. Roni: There needs to be a commission that will be more involved with the business owners and government stakeholders. It needs to work with other partners to improve the infrastructural capacity of the recycled plastic products production.

Do you have any recommendations that can bring positive changes in the industry?

Mr. Roni: There needs to be a more efficient way to source and procure recyclable plastics. It takes a long time to separate waste and chemical materials from the other materials.

Transcript 3:

What are the sustainable methods of growing the recycling industry?

Mr. Sohidullah: There needs to be more awareness among the consumers to adopt recycled plastic products.

How do you see plastic products, and please share your opinion about the recycling of plastic products?

Mr. Sohidullah: I feel that for environmental sustainability, we should be more careful when discarding our plastic waste. We should get more products that are recycled or promise recycling of their plastic waste.

What steps can be taken by all stakeholders to ensure the growth of this industry?

Mr. Sohidullah: There needs to be proper awareness campaigns that promote the necessity of recycling plastic waste. If the consumers are aware of the importance of recycling and using products that can be recycled, then it will also encourage the investors.