Circular Economy Dynamics in Bangladesh: A Cross-Industry Analysis of Sustainable Practices and Trends

Submitted By

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A Thesis submitted in partial fulfillment of the requirement for the degree of Bachelor of Science in Mechanical Engineering

Department of Mechanical and Production Engineering (MPE)

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Candidate's Declaration

This is to certify that the work presented in this thesis, titled, "Circular Economy Dynamics in Bangladesh: A Cross Industry Analysis of Sustainable Practices and Trends", is the outcome of the investigation and research carried out by me under the supervision of Prof. Dr. A.R.M Harunur Rashid

It is also declared that neither this thesis nor any part of it has been submitted elsewhere for the award of any degree or diploma.

Ismat Ara Kaifa

Name of the Student

Student No: 190012114

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Recommendation of the Thesis Supervisors

The thesis titled "Circular Economy Dynamics in Bangladesh: A Cross Industry Analysis of Sustainable Practices and Trends" submitted by Ismat Ara Kaifa, Student No: 190012114 has been accepted as satisfactory in partial fulfilment of the requirements for the degree of B Sc. in Industrial and Production Engineering **on 3rd June 2024.**

1. -----------------------------------

   Dr. A.R.M Harunur Rashid   Professor   (Supervisor)

   MPE Dept., IUT, Board Bazar, Gazipur-1704, Bangladesh.

Acknowledgment

CO-PO Mapping of ME 4800 -Theis and Project

COs	Course Outcomes (CO) Statement	(PO)	Addressed by	
CO1	Discover and Locate research problems and illustrate them via figures/tables or projections/ideas through field visit and literature review and determine/Setting aim and objectives of the project/work/research in specific, measurable, achievable, realistic and timeframe manner.	**PO2**	Thesis Book	
			Performance by research	
			Presentation and soft skill	
CO2	Design research solutions of the problems towards achieving the objectives and its application. Design systems, components or processes that meets related needs in the field of mechanical engineering	**PO3**	Thesis Book	
			Performance by research	
			Presentation and soft skill	
CO3	Review, debate, compare and contrast the relevant literature contents. Relevance of this research/study. Methods, tools, and techniques used by past researchers and justification of use of them in this work.	**PO4**	Thesis Book	
			Performance by research	
			Presentation and soft skill	
CO4	Analyse data and exhibit results using tables, diagrams, graphs with their interpretation. Investigate the designed solutions to solve the problems through case study/survey study/experimentation/simulation using modern tools and techniques.	**PO5**	Thesis Book	
			Performance by research	
			Presentation and soft skill	
CO5	Apply outcome of the study to assess societal, health, safety, legal and cultural issue and consequent possibilities relevant to mechanical engineering practice.	**PO6**	Thesis Book	
			Performance by research	
			Presentation and soft skill	
CO6	Relate the solution/s to objectives of the research/work for improving desired performances including economic, social and environmental benefits.	**PO7**	Thesis Book	
			Performance by research	
			Presentation and soft skill	
CO7	Apply moral values and research/professional ethics throughout the work, and justify to genuine referencing on sources, and demonstration of own contribution.	**PO8**	Thesis Book	
			Performance by research	
			Presentation and soft skill	
CO8	Perform own self and manage group activities from the	**PO9**	Thesis Book	

Acknowledgment

COs	Course Outcomes (CO) Statement	(PO)	Addressed by	
	beginning to the end of the research/work as a quality work.		Performance by research	
			Presentation and soft skill	
CO9	Compile and arrange the work outputs, write the report/thesis, a sample journal paper, and present the work to wider audience using modern communication tools and techniques.	PO10	Thesis Book	
			Performance by research	
			Presentation and soft skill	
CO10	Organize and control cost and time of the work/project/research and coordinate them until the end of it.	PO11	Thesis Book	
			Performance by research	
			Presentation and soft skill	
CO11	Recognize the necessity of life-long learning in career development in dynamic real-world situations from the experience of completing this project.	PO12	Thesis Book	
			Performance by research	
			Presentation and soft skill	

Student Name /ID: Signature of the Supervisor:
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K-P-A Mapping of ME 4800 -Theis and Project

COs	POs	Related Ks								Related Ps							Related As				
		K1	K2	K3	K4	K5	K6	K7	K8	P1	P2	P3	P4	P5	P6	P7	A1	A2	A3	A4	A5
CO1	PO2																				
CO2	PO3																				
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CO4	PO5																				
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CO6	PO6																				
CO7	PO8																				
CO8	PO9																				
CO9	PO10																				
CO10	PO11																				
CO11	PO12																				

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Signature of the Supervisor:

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ACKNOWLEDGMENT

First, I am grateful to Allah for giving me the strength to complete this thesis. I am profoundly grateful to my advisor, Dr. A. R. M. Harunur Rashid, for his guidance and support throughout the journey. Without his support, completing this thesis would be impossible. And then I am grateful to my parents, elder sister Jannat, friend Sabab, and pet bird Chiku for their constant support and love. Without them, I would not have come this far. Finally, I acknowledge the Mechanical and Production Engineering Department for giving me the independence to do this thesis in a new manner. And for supporting me whenever I needed any help.

ABSTRACT

The concept of a circular economy (CE) signifies transformation. The transformation is from a traditional take-make-dispose to a reduce-reuse-recycle model. This model emphasizes resource efficiency and waste reduction. We can see countries like Europe and North America making substantial advancements in adopting circular principles. However, Bangladesh remains predominantly linear, with minimal recycling and high waste levels. This study explores integrating CE practices across major Bangladeshi companies in various sectors. The primary aim is to identify current trends, industry-specific challenges, and opportunities.

This research combines a mixed-methods approach, quantitative data analysis, and qualitative interviews with industry leaders in the electronics, construction, textiles, and textile industries. Companies such as Walton, SMEC, DBL, and Beximco are examined to assess the extent and effectiveness of CE adoption within their operations.

The study aims to :

1. Establish a baseline understanding of CE adoption among leading Bangladeshi companies.

2. Identify which industries are leading in CE integration and why.

The electronics and textile industries show potential for CE practices in Bangladesh. However, technological limitations, insufficient policy support, and low public awareness hinder broader adoption.

Despite existing challenges, enhanced CE practices in Bangladesh have the potential to yield substantial economic and environmental benefits. Strategic investments in technology and

Abstract

policy advocacy are critical for accelerating CE adoption. The research will expand to include more industries and conduct comparative analyses with similar economies to refine strategies for effective CE integration.

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CHAPTER 1: INTRODUCTION

1.1   Background

The circular economy has emerged as a transformative concept for achieving sustainable development by emphasizing resource efficiency and waste reduction. Globally, the shift from a linear 'take-make-dispose' model to a circular one has attracted substantial attention due to its potential to mitigate environmental impacts and build economic resilience.(Mehmood,2020) Countries across Europe and North America are integrating circular principles into their industrial practices, demonstrating significant progress in the manufacturing and consumer goods sectors. Despite the global momentum, the adoption of circular economy practices in Bangladesh still needs to be revised.(Ahmed,2020)

In Bangladesh, the dominant economic model is still heavily linear, characterized by limited recycling and high levels of waste. This approach not only strains the country's limited resources but also poses significant environmental challenges. The minimized interest in the circular economy in foreign contexts provides a crucial backdrop for examining its potential applicability and benefits within the Bangladeshi context.(Opferkuch,2022)

This study aims to go deeper into the trends and practices of prominent Bangladeshi companies, such as Walton, SMEC, DBL, and Beximco, trying to integrate circular economy principles into their operations. These companies represent a cross-section of industries including electronics, construction, textiles, and pharmaceuticals, each of which contributes significantly to the national economy. By analyzing these companies, this research seeks to uncover the current state of circular economy practices in Bangladesh and identify industry-specific challenges and opportunities.

Chapter 1: Introduction

The research questions guiding this study are multifaceted:

1. What is the current trend of circular economy practices in Bangladesh?

    This question aims to establish a baseline understanding of how far Bangladeshi companies have adopted circular principles.

2.   Which industry is performing better in terms of integrating circular economy practices?

This question seeks to recognize leading sectors and derive lessons that could be applied across other industries.

To answer these questions, the study employs a mixed-methods approach, combining quantitative data analysis with qualitative insights from industry experts and stakeholders. This comprehensive methodology allows for a detailed examination of the operational, economic, and environmental aspects of circular economy practices within these industries.

Understanding the dynamics of the circular economy in Bangladesh is crucial for the economic and environmental benefits it may bring and for aligning the country with global sustainability goals. As nations worldwide strive to reduce their ecological footprints and promote sustainable growth, it is imperative for Bangladesh to consider alternative models that support both economic development and environmental stewardship.

1.2   Objectives of the Study-

This thesis looks at how Bangladesh, a developing country, is adopting a new way of doing business that's better for the environment. Traditionally, businesses take things, make products, and then throw them away. This new way, called a circular economy, keeps things in use for longer and creates less waste. As more and more countries focus on sustainability, this research is interested in how Bangladesh is making this switch. To this end, the study will focus on several leading companies across various industries, examining how they integrate circular economy principles into their operations.

Chapter 1: Introduction

The objectives of the thesis are structured to provide a comprehensive analysis of these practices:

- Exploring how circular economy is being put into practice by leading industries in

- Bangladesh by examining companies like Walton, SMEC, DBL, and Beximco Recover Fibre.

- Comparing what different industries are doing regarding circular economy to see how approaches vary from one industry to another..

- Looking at previous studies and existing knowledge to put what I've found in a broader context and see how it fits with global trends.

- Using a specific decision-making tool, the AHP model, to make sense of all the data I've gathered and come up with solid conclusions

Through this thesis, I aim to deliver insights that not only contribute to academic knowledge but also provide practical implications for policymakers and industry leaders looking to embrace sustainability within their operational frameworks.

CHAPTER 2: LITERATURE REVIEW

Recent articles show that circular economy (CE)has become a mandatory material issue in corporate sustainability reporting. However, the perspectives and capacities of the companies still need to be addressed. Hence, according to research, companies agree on the relevance of CE content in sustainability reports. Still, some challenges include the lack of assessment benchmark data complexity (Opferkuch et al., 2023). In Europe, we can see research in the ship demolition industry. The process of recovering materials and components from ships that have reached the end of their life requires the complete demolition of the boats and the adoption of reuse methods. This aims to achieve the circularity of raw materials. At a certain point which can have significant advantages for both economic and environmental sustainability. Effective collaboration among stakeholders is essential for the successful transformation of ship recycling to a circular paradigm. Integrating circular economy ideas into ship recycling can improve efficiency and sustainability. The ship recycling sector requires empirical study to develop circular economy models further (Tola et al., 2023). Some research has been done in the construction sector. A circular economy (CE) ensures long-term sustainability by facilitating the circulation of resources throughout the essential supply chains. A recent study has shown a change in perspective towards sustainability based on CE. Nevertheless, the construction industry (CI) faces challenges due to uncertainties arising from volatile raw material costs and limited availability of resources. This also includes not only rising demand but also consumer expectations. Inadequate waste infrastructure and the utilization of inappropriate recycling technology are also another part of it. The research says that policy support and organizational incentive schemes are essential facilitators for establishing a Circular Economy (CE) in developing nations' Critical Infrastructure (CI).

The systems dynamics model demonstrated that reinforcing feedback loops, which are self-

perpetuating cycles of positive change, significantly enhance critical infrastructure's social, economic, and environmental performance, promoting sustainable development. The study discovered a scarcity of factors that facilitate the implementation of a circular economy in poor nations. Future research should thoroughly investigate the key factors that promote sustainable growth in the circular economy of emerging nations (Ghufran et al., 2022).

The circular economy model is less used in emerging countries like Bangladesh than in developed countries.

There are chances of moving toward a circular economy, but it can only be used a little in Bangladesh. It is primarily seen in some businesses' recycling processes. Policy, technical, and public involvement barriers make it hard to use the circular economy in Bangladesh. Bangladesh does not follow its environmental rules, primarily because of corruption. For long-term growth, Bangladesh might benefit from switching to a circular economy. The research found that Bangladesh has a modest adoption of circular economy methods, with recycling of being the predominant method. Adopting a circular economy in Bangladesh faces challenges such as the need for technological knowledge, limited public awareness, insufficient financial resources, and ineffective policy. Corruption in Bangladesh needs to enforce environmental legislation. The potential advantages of using Bangladesh's circular economy model for sustainable economic development (Ahmed et al., 2022). The challenges to adopting a Circular Supply Chain in Bangladesh's Electric Battery businesses are primarily due to the absence of sustainable development planning, limited understanding of environmental issues, lack of coordination across businesses, insufficient investment in innovation, and subpar product quality. To overcome these impediments, the government and supply chain partners must adopt a comprehensive approach to sustainable development. The main obstacles were the absence of extensive planning for sustainable development, limited awareness, inadequate coordination, and insufficient investment.(Milki & Islam, 2021)

If we go back to ship demolition, The shipbreaking industry in Bangladesh makes a substantial contribution to the economy by recycling ship trash and providing raw materials for numerous businesses. The absence of stringent laws and environmental challenges limits the shipbreaking industry's sustainable practices. Implementing circular economy methods in firms such as shipbreaking can enhance profitability and sustainability. Industrial engineers must embrace contemporary technologies and employ strategic, long-term approaches to execute a circular economy effectively. Industrial symbiosis enables the adoption of circular economy practices across different industries. Effective education and training are essential for improving circular economy performance (Ahasan et al., 2021)

CHAPTER 3: KEYWORD ANALYSIS

Performing a keyword analysis was a crucial preliminary measure in my thesis on the circular economy in Bangladesh. This methodology enabled me to identify the subject's most pertinent and extensively debated phrases, guaranteeing that my study aligned with current patterns and deficiencies in the existing body of literature. By identifying these crucial terms, I successfully enhanced the precision of my research inquiries and goals, establishing a solid foundation for my work within the distinct framework of Bangladesh's industry and economy. The significance of keyword analysis in my research cannot be overstated. The roadmap outlined the key topics and areas requiring attention, enabling me to concentrate on parts of the circular economy relevant to Bangladesh. This strategic approach not only improved my work's significance but also allowed me to investigate new perspectives and develop patterns that may have otherwise been overlooked.

The keyword analysis played a crucial role in ensuring that my thesis was relevant and valuable to the ongoing conversations in the area. It can provide new insights and enhance our understanding of sustainable economic practices.

3.1   Comparative Analysis

Keywords –

 (("circular economy" AND (Bangladesh OR India)) AND ("industry adoption" OR "barriers to implementation" OR "government incentives" OR "environmental policy")) AND ("textile recycling" OR "pharmaceutical waste" OR "e-waste") AND ("case study" OR "empirical analysis")

Source – Web of Science

Analysis Tool – VOSViewer

Figure 1 : Comparative Analysis

Keywords –

 (("circular economy" AND (Bangladesh OR India)) AND ("industry adoption" OR "barriers to implementation" OR "government incentives" OR "environmental policy")) AND ("textile recycling" OR "pharmaceutical waste" OR "e-waste") AND ("case study" OR "empirical analysis")

Source – Web of Science

Analysis Tool – VOSViewer

Figure 2 Target Specific Analysis

We can see in the keyword analysis that country based research is very common. It helped me understand how circular economy is adopted globally and how cutting edge technology is adopted in this circular economy trend. The willingness to participate of consumers in the CE is also measured in other countries. The focus is on resource utilization and waste reduction. The presence of terms like "conceptual model," "exploratory study," and "literature review" suggests that the field is also focused on refining its theoretical frameworks and methodologies. This trend is about deepening the understanding of circular economy concepts and improving the ways these concepts are studied and implemented.

Now based on the findings of these two diagrams, I researched and found out the papers about internet and found out that there are only four paper related to the Bangladeshi circular

economy. Again, these keywords helped to select my thesis topic and set my questionnaire for interview.

CHAPTER 4: METHODOLOGY

The methodology for this thesis involves a combination of semi-structured interviews, secondary source data extraction, and data analysis using a Multi-Criteria Decision Tool. Here's how each component is designed to gather and analyze the necessary information:

1. Semi-Structured Interviews

I have conducted semi-structured interviews with key executives from leading Bangladeshi companies, namely Walton, SMEC, DBL, and Beximco Recover Fibre, to gain an in-depth understanding of circular economy practices. These interviews are designed to be flexible, allowing for open-ended questions and allowing the respondents to share their experiences, challenges, and insights freely. Here, I asked them some questions about their company culture and trends. Then, later, I tried to get insights into what matrix are essential for their company for multi-criteria analysis. Semi-structured interviews are a potent qualitative research instrument that combines the rigidity of predefined questions with the adaptability of open-ended conversations. This technique facilitates a profound comprehension essential when investigating intricate topics such as circular economy processes within firms. The adaptability of semi-structured interviews is highly advantageous as it allows the conversation to progress organically in response to the interviewee's answers, providing an opportunity to delve further into themes that emerge spontaneously throughout the discussion.

Within the scope of my research, this approach was essential in revealing intricate insights into the implementation and perception of circular economy principles by Bangladeshi enterprises such as Walton, SMEC, DBL, and Beximco Recover Fibre. The meeting provided an opportunity for the leaders to deliberate on the precise obstacles and prospects their organizations face while shifting towards more environmentally friendly operations.

Moreover, these interviews yielded abundant qualitative data that effectively demonstrated the real-world implementations of theoretical concepts and models mentioned in the literature.

The knowledge acquired from these interviews is crucial for accurately depicting Bangladesh's circular economy environment. They facilitate a more individualized comprehension of each company's approach to sustainability, emphasizing distinctive methods and activities that may be less extensively recorded. Furthermore, by directly interacting with the essential parties involved, I could collect primary testimonies regarding the effects of these practices on operational and strategic choices, providing a more distinct understanding of the practical consequences of implementing circular economy models. This technique not only enhances the scholarly quality of my thesis but also offers valuable case studies that can inform policy-making and strategic decisions in the sector.

2. Secondary Source Data Extraction

To complement the insights gained from the interviews, I have reviewed existing literature, industry reports, and previous research papers. This has included academic journals, company reports, industry analyses, and other relevant publications that discuss circular economy trends both globally and within Bangladesh. In order to establish a solid groundwork for my research on circular economy practices in Bangladesh, it was crucial to use secondary data. By doing a comprehensive analysis of various sources such as academic journals, industry reports, and previous research publications, I was able to place the primary data obtained from interviews into the larger academic and practical contexts. The secondary data was used to verify the

information given by the CEOs and also to identify wider patterns and differences in the adoption of circular economy principles on a global scale and within the local environment.

The incorporation of corporate reports was exceptionally beneficial. The records offered precise insights into corporate plans and outcomes, showcasing the adaptation of theoretical applications to real-world business operations. Furthermore, through analyzing these reports, I could evaluate the documented effects of circular economy practices on the effectiveness and sustainability of businesses, providing specific instances of successful outcomes and obstacles encountered by these companies. Industry analysis provided me with further insights, emphasizing the specific patterns within sectors and the economic and regulatory factors that influence business decisions. This was essential in differentiating between techniques that are common across the whole industry and those that are special to individual companies.In addition, the academic literature provided theoretical frameworks and critical discourses regarding the circular economy. The opportunity enabled me to situate my discoveries within ongoing scholarly discussions and pinpoint areas where my investigation could offer novel perspectives or validate established hypotheses.

3. Data Analysis:

The data collected from interviews and secondary sources has been analyzed using a Multi-Criteria Decision Tool (MCDT). This tool will help evaluate and synthesize the information based on multiple criteria that are relevant to circular economy practices, such as environmental impact, cost efficiency, and sustainability outcomes. By utilizing the Multivariate Causal Discovery Toolbox (MCDT), I was able to discern intricate patterns and trends that may not have been evident with a more basic examination. This tool enhanced comprehension of the complex interactions between various elements that impact circular economy practices. For example, the tool enabled me to assess the economic advantages in relation to the

environmental consequences, offering an equitable perspective on the sustainability measures implemented by organizations. This examination was crucial in identifying techniques that were not only theoretically sound but also practically feasible and advantageous in the long run. In addition, the MCDT facilitated the identification of areas that needed immediate attention and those that had the potential to make the greatest impact on sustainability indicators. Through the simultaneous evaluation of many variables, I successfully proposed precise plans for each organization, customized to their unique circumstances and industry norms. The tailored approach is essential for successful implementation because it takes into account the distinct obstacles and possibilities that each company encounters within the context of the Bangladeshi economy.

CHAPTER 5: QUESTIONNAIRE AND FINDINGS

This research delves into the understanding and implementation of circular economy (CE) principles within the Bangladeshi context. Semi-structured interviews will be conducted with key representatives from Walton (a leading Bangladeshi manufacturing company) and SMEC (a prominent civil engineering firm). These interviews will explore insights from diverse perspectives across industries, aiming to:

- Uncover the level of awareness and integration of CE principles within each organization.

- Identify specific practices, policies, and strategies adopted to promote circularity.

- Understand the challenges and opportunities encountered in implementing CE solutions within their respective sectors.

- Discover successful examples of projects showcasing effective CE implementation.

- Explore collaborative efforts and partnerships towards advancing CE in the Bangladeshi landscape.

- Gather expert predictions and recommendations for the future of CE in Bangladeshi industries.

5.1 Questionnaire for SMEC

The semi-structured questions set for SMEC are -

- To what extent is SMEC aware of circular economy (CE) principles and its potential in the Bangladeshi civil engineering sector?

- Does SMEC have a dedicated strategy or policy for incorporating CE into its projects?

- What are the biggest challenges and opportunities in implementing CE principles in Bangladeshi civil engineering projects?

- Can you share any specific examples of projects where SMEC has successfully implemented CE principles?

- What tools and methodologies does SMEC use to assess and measure the circularity of projects?

- How does SMEC address material selection and sourcing in the context of CE, particularly promoting local and recycled materials?

- How does SMEC design and manage construction and demolition waste to minimize landfill disposal and encourage reuse and recycling?

- How does SMEC collaborate with other stakeholders, such as government agencies, material suppliers, and contractors, to advance CE in the Bangladesh construction industry?

- Are there any existing initiatives or platforms focused on promoting CE in Bangladesh that SMEC is involved in?

- How does SMEC share knowledge and best practices related to CE within the industry?

- What are your predictions for the future of CE in Bangladeshi civil engineering in the next 5-10 years?

- What specific actions are needed to overcome the current barriers and accelerate the adoption of CE practices?

- What role can SMEC play in leading the transition towards a more circular construction industry in Bangladesh?

5.2 Questionnaire for Walton

The semi-structured questions set for Walton are -

- What is Walton's vision for a circular economy in Bangladesh? How is circular economy embedded in their overall business strategy and values?

- Does Walton have a formal circular economy policy? If so, what are its key pillars and objectives? How is the policy implemented across different departments and operations?

- How does Walton measure its progress towards a circular economy? What key performance indicators (KPIs) are used to track and evaluate their efforts?

- What steps does Walton take to design products for disassembly, reuse, and recycling? Are there any specific examples of how circularity principles are being applied in product design?

- How does Walton ensure responsible sourcing of materials with potential for circularity (e.g., recycled content, renewable materials)?

- What measures does Walton take to minimize waste and resource consumption during the manufacturing process? Are there any closed-loop manufacturing

processes in place?

- Does Walton have a program for take-back, repair, and refurbishment of products at the end of their life cycle? How are they extending product life and preventing unnecessary waste?How does Walton work with its suppliers to promote circularity practices? Are there any joint initiatives or partnerships focused on circular economy?

- What is Walton's approach to managing product returns and waste generated during the product life cycle? Are there any partnerships with waste management companies or recycling facilities?

5.3 Questionnaire for Beximco –

1. **Recycled Content Integration:**

- Can you detail the selection process for choosing recycled materials that meet your quality and production standards?

- What are the biggest challenges you face in sourcing high-quality recycled materials in Bangladesh?

- How does the cost of recycled materials compare to virgin materials, and how does this impact your pricing strategy?

2. **Yarn and Textile Recycling Capabilities:**

- Does Beximco Textile and Apparel Division have the capability to recycle textile waste internally?

- If yes, can you elaborate on the technology and processes involved?

- If not, how do you source recycled materials, and what partnerships do you have in place with other entities in the recycling chain?

3. **Design for Circularity:**

- Can you describe how Beximco Textile and Apparel Division incorporates circular economy principles into the design phase of your products (e.g., fibre selection, blend optimization, design for disassembly)?

- Are there any specific design considerations you take into account to improve the recyclability or longevity of your textiles?

4.   Consumer Awareness and Education:

- How does Beximco Textile and Apparel Division educate consumers about the circular economy and the benefits of using sustainable textiles?

- Are there any initiatives in place to promote responsible consumption and post-consumer textile waste management?

5.   Take-Back or Buy-Back Programs:

- Does Eco Beximco Textile and Apparel Division have a take-back or buy-back program for post-consumer textile waste generated from your products?

- If yes, how does the program function, and what are the challenges of implementing such initiatives in Bangladesh?

- If not, are there any plans to develop such programs in the future?

6.   Cross-Industry Collaboration and Ecosystem Building

- Collaboration with Garment Manufacturers:

- How does Beximco Textile and Apparel Division collaborate with garment manufacturers in Bangladesh to promote circularity within the textile supply chain?

- Are there any challenges in aligning your circular economy goals with those of garment manufacturers?

- How can these collaborations be strengthened to create a more closed-loop system?

7.   Policy Advocacy:

- Does Eco Beximco Textile and Apparel Division advocate for government policies that support the development of a circular economy in Bangladesh?

- If yes, what specific policies do you believe would be most beneficial for the textile industry?

5.4 Questionnaire for Beximco –

1. **Recycled Content Integration:**

- Can you detail the selection process for choosing recycled materials that meet your quality and production standards?

- What are the biggest challenges you face in sourcing high-quality recycled materials in Bangladesh?

- How does the cost of recycled materials compare to virgin materials, and how does this impact your pricing strategy?

2. **Yarn and Textile Recycling Capabilities:**

- Does Eco Threads and Yarns have the capability to recycle textile waste internally?

- If yes, can you elaborate on the technology and processes involved?

- If not, how do you source recycled materials, and what partnerships do you have in place with other entities in the recycling chain?

3. **Design for Circularity:**

- Can you describe how Eco Threads and Yarns incorporates circular economy principles into the design phase of your products (e.g., fiber selection, blend optimization, design for disassembly)?

- Are there any specific design considerations you take into account to improve the recyclability or longevity of your textiles?

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7. **Policy Advocacy:**

- Does Eco Threads and Yarns advocate for government policies that support the development of a circular economy in Bangladesh?

- If yes, what specific policies would be most beneficial for the textile industry?

- How can companies like Eco Threads and Yarns work with policymakers to create a more enabling environment for circular practices?

5.5 Key Findings from SMEC

The following table contains the key findings from the Interview with SMEC.

Table 1 : Key Findings From SMEC

Practice	Current Approach	Gradually Adapting New Approach	Circular Economy Opportunity
Design Strategy	Traditional methods		Eco-friendly design, consider lifecycle impacts.
Building Materials	Primarily virgin materials	Utilize demolition debris in new construction	
Life Cycle Assessment	Limited use	Integrate the LCA tool for all projects to optimize resource efficiency and environmental impact.	
Cost Focus	Prioritize immediate economic gains.		Balance cost with long-term environmental and resource savings

5.6 Key Findings from Walton –

The following table contains the key findings from the questionnaire survey with Walton.

Table 2 : Key Findings From Walton

Material	Waste Stream	Circular Economy Practice	Outcome
Aluminum m	100%	Melts and reuses aluminum for LED bulb parts	Reduced reliance on virgin aluminum, energy savings
Packaging and shield material	Sheet metal safety guards	Recycles materials reduces landfill waste	Resource recovery promotes a closed-loop system

Material	Waste Stream	Circular Economy Practice	Outcome
Plastic	100%	Recycles for various applications	Eliminates plastic waste, creates new products from recycled material
Dining	Waste	Biogas plant for electricity	Generates renewable energy from organic waste and reduces reliance on fossil

system		production	fuels.
Burnable materials		Incineration boiler	Energy recovery from waste avoids landfill disposal.
Copper	100%	Makes Walton cable	Reduced copper mining need, minimizes environmental impact
Metal plate wastage		Makes lift counterweight	Utilizes waste material for new applications, avoids additional production
Machine making section		Makes their machines	Increases self-reliance and reduces external resource dependence.

5.7 Key Findings from DBL –

The following table contains the key findings after conducting the questionnaire survey with DBL –

Table 3 : Key Findings from DBL

Key Finding Category	Description
Material Innovation	DBL innovates by creating unique yarns from "cut clips" and raw cotton combined with recycled materials such as PET bottles.
Recycled Materials	They use recycled polyester from PET bottles and other recycled materials in their production processes. This includes producing poly-cotton yarns and cotton-poly-terry products, showcasing a commitment to reusing materials.

Collaborations	DBL collaborates with global brands like Puma, H&M, and Zara and has specific projects with Coca-Cola to recycle PET bottles into apparel. These collaborations ensure compliance with international circular economy standards despite the lack of local legislation.
Compliance and Motivation	Though there are no local laws on the circular economy in Bangladesh, DBL follows international standards due to requirements from their partnerships with top global brands. This is crucial for maintaining their business relationships and market presence.
Specific Projects	Their "Switch 2 Circular Economy" project is notable for its innovative approach to converting PET bottles into wearable dresses. This involves multiple stages of material transformation from waste to fashion.
Resource Efficiency	DBL has achieved significant resource savings, including using 1,256,000 kg of recycled cotton in 2023, saving over 12 billion liters of water and 45 million MJ of energy, and reducing CO_2 emissions by 2,223 tons.
Waste Reduction	They focus on reducing waste throughout their production processes, contributing to substantial resource savings and minimizing environmental impact. This includes using materials like cotton nappy mélange and creating special yarns that incorporate up to 30% recycled materials mixed with virgin fibers.

5.7 Key Findings from Beximco Recover Fibre –

The following table contains the key findings from the questionnaire survey with Beximco Recover Fibre.

Table 4 : Key Findings from Beximco Recover Fibre

Key Finding Category	Description
Material Recycling	Beximco recycles pre-consumer waste such as knit polos and denim, buying from suppliers who sort these materials.
Organic Materials	They use 100% organic cotton in their products, which supports sustainable agriculture and reduces environmental impact.
Water Management	Beximco reuses 30% of its ETP water and has reduced its water usage by 70% through the ZDHC process.
Innovative Processes	Adopt the ZDHC (Zero Discharge of Hazardous Chemicals) process to minimize water use and reduce pollution.
Sustainable Manufacturing	Beximco emphasizes using recycled raw materials and aims to integrate sustainable practices across its operations, including digitalizing design to reduce sample waste and using eco-friendly processes to cut water usage.

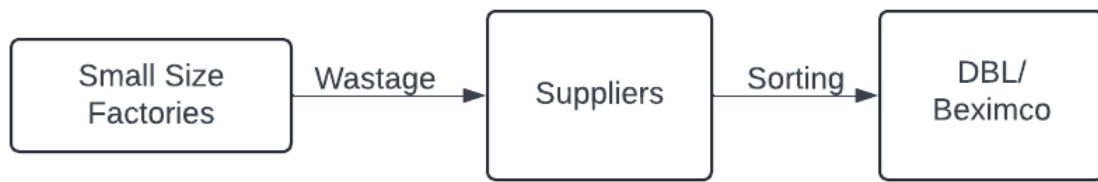## CHAPTER 6 - SUGGESTIONS FOR DBL & BEXIMCO

Figure 3 Current Supply Chain

DBL & Beximco works on pre-consumer-based wastages. Currently, their supply chain incorporates a supplier who sorts cut clips or wastages from Small or medium-sized factories.
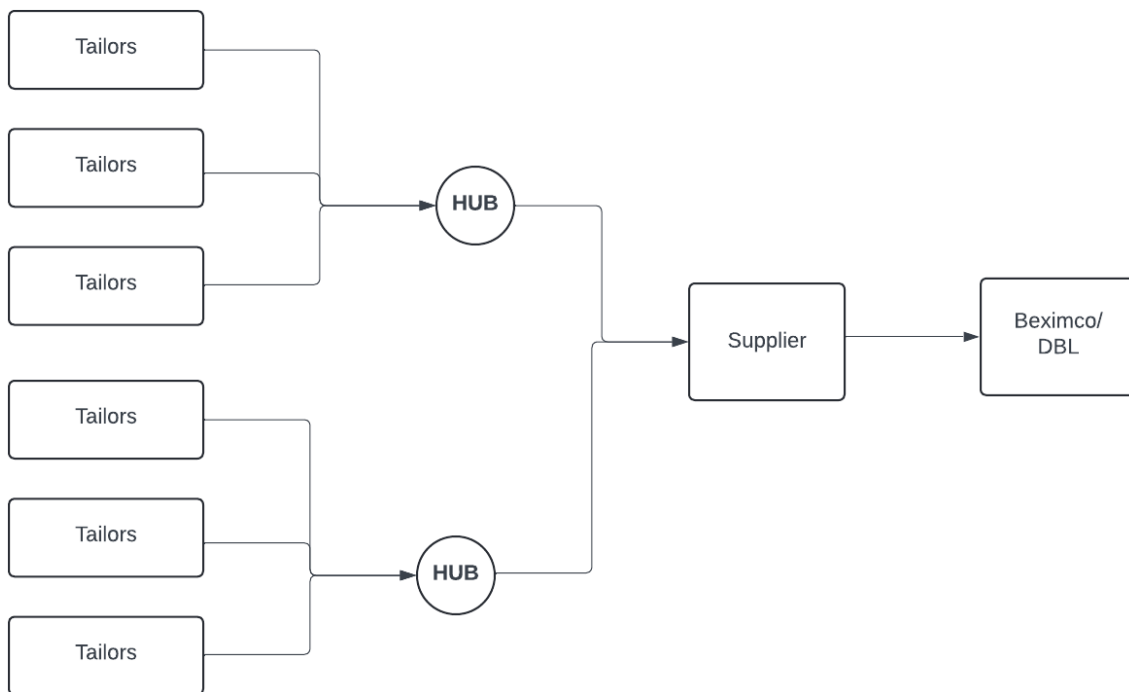

Figure 4 : Recommended Supply Chain

They sort the wastages and send them to DBL/ Beximco.

The recommendation is to extend the supply chain from small to medium-sized factories to tailors in our country. About 15% of clothes get wasted during tailoring. Recycling would be another step forward in the circular economy. After storing a certain amount of cut clip, the tailor will deliver it to the hub. In the hub, there will be sorting; after sorting, the supplier can

now offer it to Beximco or DBL. That's how Beximco and DBL can integrate Tailors into their supply chain. Integrating tailors into the circular economy process, as proposed for DBL and Beximco, is a proactive approach that can significantly improve waste management and resource efficiency. This program has the potential to establish a standard for other businesses in Bangladesh, demonstrating how the inclusion of more minor participants in a more extensive system can result in significant environmental and economic advantages. To facilitate the integration of tailors into the supply chain, DBL, and Beximco could construct specific collection locations where tailors can conveniently dump their cut clips and other textile waste. These centers would function as the primary locations for sorting, guaranteeing that only recyclable materials are transported to the factories. Implementing this system necessitates the establishment of explicit protocols outlining the permissible materials and the appropriate methods for their preparation to facilitate recycling.

Many tailors and small-scale producers sometimes lack the expertise or finances to engage in recycling projects actively. DBL and Beximco can potentially allocate resources toward training programs to enlighten stakeholders on the significance of waste segregation and appropriate disposal methods. This training can encompass guidance on effective cutting methods to minimize waste production from engaging in partnerships with local government entities, which has the potential to amplify the scope and efficacy of the recycling initiative. Government intervention could offer regulatory assistance, guaranteeing compliance with recycling processes and alignment with national environmental objectives. In addition, government-supported public awareness initiatives can educate the broader community about the advantages of recycling and sustainable fashion.

 Very beginning.

CHAPTER 7 SUGGESTIONS FOR WALTON AND SMEC

7.1 Walton's Global Expansion and Sustainability Efforts

A growing Bangladeshi company, Walton, is aiming to expand its reach internationally. This expansion necessitates compliance with international buyer regulations and alignment with Sustainable Development Goals (SDGs) as outlined by reputable organizations. While Walton possesses robust vertical integration within its operations, according to interview results, there seems to be a lack of awareness regarding the principles of Circular Economy within Bangladesh. However, Walton's vertical integration presents a significant opportunity for them to implement Circular Economy practices effectively.

7.2 SMEC's Role in Civil Engineering Projects

SMEC, a consulting firm specializing in civil engineering projects, offers oversight from initiation to completion. Their approach seems to vary based on project size. Based on the data found in the interview, adherence to circular economy principles and the use of lifecycle assessment tools appear minimal in more minor to medium-sized projects. However, SMEC demonstrates a growing awareness of these aspects for larger projects, suggesting a cautious shift towards sustainable practices.

7.3 Areas for Improvement

Overall, there appears to be significant room for improvement in the Circular Economy implementation within Bangladesh's manufacturing and construction sectors. Both Walton and SMEC can potentially lead in this transition, particularly as Walton expands globally and SMEC caters to larger projects. Here, SMEC should invest more in life cycle assessment tools and recyclable materials in civil engineering projects. Walton must also build a circular economic framework for its industry.

CHAPTER 8 RESULT ANALYSIS
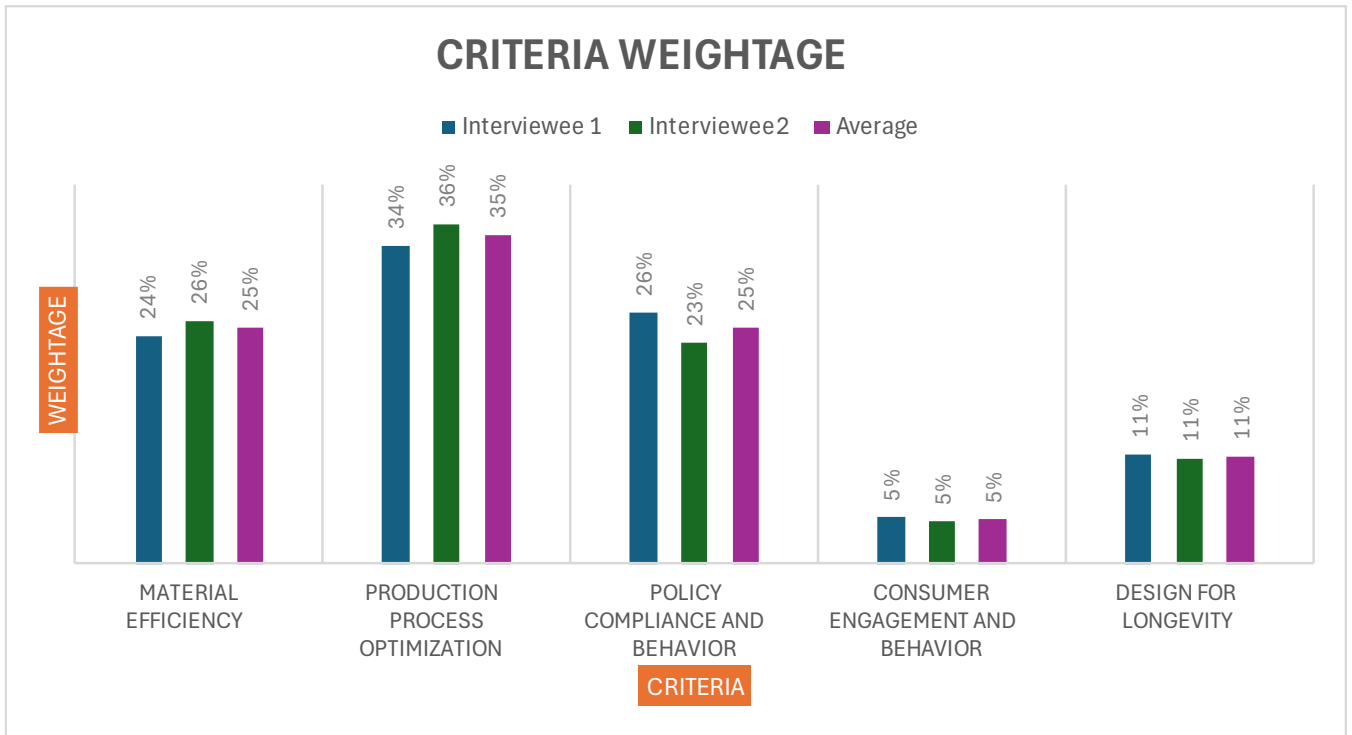
Multi-Criteria Analysis Result

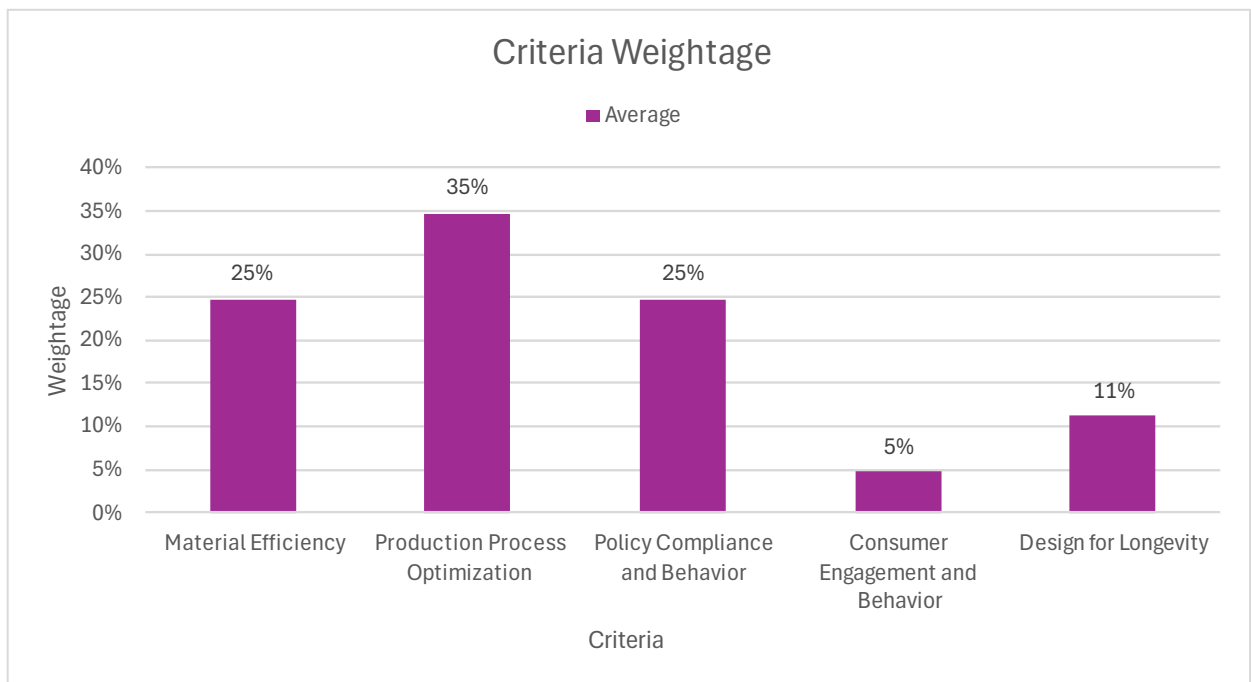**Figure 5 : Multi Criteria Analysis (a)**

Figure 6: Multi-Criteria Analysis (b)

Here, from the interview, we have seen that, on average, Material efficiency, which is the use

of recyclable material and sustainable cotton, is 25% important. Production process optimization, mainly greenhouse gas production control, is the most essential criterion for all companies. Policy compliance is 25% important. Consumer engagement and behavior are the least concerning, at only 5%. And design for longevity is moderately essential, at only 11%. However, policy compliance and behavior should be more critical for companies to implement a circular economy design for longevity as policy comes from the government. If the government makes rules and regulations about circular economy and the company adheres to those rules and regulations, then there won't be much need to take other measurements. On the other hand, considering design for longevity, the dresses will last longer. Hence, the consumer won't have to buy frequent dresses. So, there will be a minimum amount of wastage.

CHAPTER 7 FUTURE WORK AND RECOMMENDATION

In the future, I aim to segmentise the industries into three more sectors—Battery, Technology, and Ceramic. Then, I will conduct more interviews with companies for each sector. Then, a multicriteria analysis of those results will be performed, and a framework for the sector will be suggested. With the proposed framework and the result from the industry, I aim to do a side-by-side comparison with a target country, India, as our industrial culture is similar to their industrial culture. The keyword analysis found that country-wise comparison is prevalent in the research sector of the circular economy. In keyword analysis, as we have seen, the country-wise analysis is in recent trends. Hence, this thesis will prove to be groundbreaking by making country-based industrial side-by-side comparisons and suggesting a framework. Continuing with the anticipated future work, the inclusion of battery, technology, and ceramic sectors will offer a thorough comprehension of how circular economy ideas may be included into different businesses with distinct environmental consequences and economic scales. This division will provide a more thorough examination of difficulties and possibilities related to industries, particularly in areas such as batteries and technology, which are undergoing significant advancements and are crucial for national economic growth and sustainability. The battery sector will focus on managing the lifespan of batteries used in consumer devices and electric cars. This will involve examining ways to reuse, remanufacture, and recycle batteries in order to minimize environmental effect and conserve resources. This task will include examining the existing methods by which batteries are disposed of at the end of their life, finding any deficiencies, and suggesting environmentally friendly solutions. An analysis will be conducted on the technology industry, which includes electronics and information technology, to explore its capacity for advancing product durability and minimizing electronic waste through innovative design and recycling methods. This chapter will concentrate on the execution of extended producer responsibility

(EPR) schemes and the establishment of take-back and recycling programs that might serve as standards for regulatory frameworks. Within the ceramic industry, which is often neglected in discussions about the circular economy despite its substantial impact on the environment, this research aims to investigate the utilization of ceramic waste in new manufacturing processes, the possibility of extracting energy from this waste, and the improvement of material compositions to facilitate recycling.

In addition, an evaluation will be conducted on the unique regulatory and commercial characteristics of each industry in Bangladesh, and a comparison will be made with India's approach to these businesses. By comparing with India, we can not only identify the most effective methods and policies, but also provide a framework for potentially adapting and implementing them in Bangladesh. This comparative study will utilize a diverse range of sources, such as government publications, industry whitepapers, and university research, to provide a comprehensive understanding of the circular economy's application at both a large-scale and small-scale level. The multicriteria study for each sector will incorporate environmental, economic, and social components to guarantee that the suggested frameworks are comprehensive and adaptable. The criteria will be formulated through collaboration with industry experts and stakeholders to ensure conformity with global standards and local circumstances.

Additionally, the next research will include a series of practical suggestions customized for each industry. These recommendations will concentrate on transferring technology, developing skills, and improving policies to support a seamless shift towards circular economy practices. The following guidelines are intended for politicians, industry leaders, and academia in order to promote a collaborative atmosphere that supports sustainable industrial practices. In addition, the thesis will examine possible obstacles to the execution of these suggestions, including budgetary limitations, insufficient technical proficiency, and

reluctance to embrace change, while suggesting tactics to surmount these difficulties. The ultimate result will be a resilient framework for every sector that not only improves environmental performance but also adds to economic competitiveness and social well-being. The primary objective of this extensive research is to initiate a fundamental change in the way circular economy ideas are understood and put into practice in Bangladesh. This will serve as a model for other developing countries that share similar economic and cultural backgrounds. This thesis aspires to make a substantial contribution to the global discussion on sustainable development and circular economy by thoroughly examining the specific aspects of each sector and doing a comparison study with India. It offers a distinctive viewpoint from the South Asian area. Hopefully, this will serve as a catalyst for more research and policy measures that give priority to ecological sustainability in conjunction with economic growth and development.

CHAPTER 8 CONCLUSION

The study of the circular economy in Bangladesh showed that even though only 25% of the top companies are familiar with the ideas behind the circular economy, there is still a lot of room for them to adopt more environmentally friendly practices. The main problems, like not having enough modern technology, strong government policies, and public knowledge, are the same ones other developing countries face when balancing environmental sustainability with economic growth. To solve these problems, we need to do a few different things. First, we can close the technological gap by encouraging new ideas by spending money on research and development to improve recycling technologies and create biodegradable materials. This could completely change industries like textiles and electronics, which comprise most of Bangladesh's industrial sector. The second thing is that the policy environment needs a lot of work. Putting in place rules that not only encourage but also require recycling and reducing waste can spark change. For example, rewarding companies for using recycled materials or fines for not following sustainability rules could significantly change how companies act. Also, educating and raising public knowledge is very important. Extensive efforts to teach people about the advantages of a circular economy, like how it can help the environment and use resources more efficiently, can get more people involved and support sustainable practices. Along with these, changes should be made to the national curriculum so that ideas about the cycle economy are taught.

Finally, it's essential for people from the business world, schooling, civil society, and the government to work together on sustainability. Bangladesh could meet the world's goals for sustainable growth, and its economy would also improve because it would use less energy and depend less on raw materials. By working on these areas, Bangladesh can stabilize its economy, use resources more wisely, and meet global standards for the economy and the

environment. This study is essential in Bangladesh's national economic planning and development.

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