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KAMRAN HOSSAIN

**SUSTAINABLE SYSTEM TRANSITION OF BANGLADESHI
TEXTILE INDUSTRY**

Examiner: Associate Professor, D.Sc. Mirja Mikkilä
Professor, D.Sc. (Econ) Lassi Linnanen

ABSTRACT

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Kamran Hossain

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Examiner: Associate Professor, D.Sc. Mirja Mikkilä
Professor, D.Sc. (Econ) Lassi Linnanen
Supervisor: Associate Professor, D.Sc. Mirja Mikkilä

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Readymade garment industry (RMG) is working as a main backbone of the economy of Bangladesh. The industry has significant importance in the development of the country's economy since it was started to be grown up. The industry has great impact on global clothing supply and exporting clothes for renowned brands around the world. However, it has some noticeable problems such as poor infrastructure, unskilled workers, energy crises, unsustainable manufacturing systems, and so on that putting pressure to keep competitive in the international market. On the other hand, consumer concern about sustainability of the clothing are growing day by day that demanding sustainable manufacturing from suppliers. In this context, most of the Bangladeshi textile industries are far away from sustainable production. The industry needs a substantial systemic change in the production line. Considering the importance of sustainability, this master thesis will discuss dimensions of sustainable transition for Bangladeshi textile industry through transition knowledge. A qualitative analysis is used to give the potentiality of the niche technologies for increasing the resource efficiency of the industry and analyses systemic transition pathways to make a guideline towards a good industry to fulfil the objectives of the thesis.

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In Lappeenranta 31st August 2020

Kamran Hossain

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LIST OF SYMBOLS

\$	Dollar
M	Meter
MW	Mega Watt

ABBREVIATIONS

BGMEA	Bangladesh Garment Manufacturers and Exporters Association
BKMEA	Bangladesh Knitted Manufacturing and Export Association
CETP	Centralized Effluent Treatment Plant
ETPs	Effluent Treatment Plant System
EU	European Union
FY	Fiscal Year
GDP	Gross-Domestic Product
GSP	Generalized System of Production
GW	Groundwater
IDCOL	Infrastructure Development Company Ltd
IFC	International Finance Corporation
LEED	Leadership in Energy and Environmental Design
LNG	Liquefied Natural Gas
LUT	Lappeenranta University of Technology
MFA	Multi Fiber Agreement
MLP	Multi-level perspective
N.D.	No date
PaCT	Partnership for Cleaner Textile
PV	Photovoltaic
R&D	Research & Development
RMG	Readymade Garment Industry
SSCM	Sustainable Supply Chain Management
T&C	Textile & Clothing
USD	United State Dollar
USGBC	U.S. Green Building Council

1 INTRODUCTION

1.1 Background

"Made in Bangladesh" the clothing nametag proudly moving as a prestigious brand in the world. Bangladesh is a developing country located in South Asia with a population of around 161 million (2018) (Bangladesh | Data, 2020). Bangladeshi textile industry is one of the oldest and most successful industries with its rich history. More than four million people (mostly women) are working in the industry to bring glory for this country and they are mainly playing roles for the advancement of the textile industry in Bangladesh. The industry has helped to reduce poverty and empower women. Therefore, the living standard and per capita income have improved in recent times (Partners, 2019).

Despite its limited resources, the country has shown noticeable human and social development as well as maintaining a 6% annual GDP growth rate on average. (About Garment Industry of Bangladesh, 2020). Readymade garment industry (RMG) acting as a blessing for the growth of the economy of Bangladesh. The industry has become the main driving force of the country's economy contributing total export earnings of around 83% (About Garment Industry of Bangladesh, 2020). There are more than four thousands active garment factories currently operating in Bangladesh which specialized in woven and knit goods with a focus on shirts, t-shirts, jackets, trousers, and sweaters (earing export by the individual has shown in figure 9). They helped to export worth of around \$29.21 billion in 2019 (Textile, 2019). The country has set an ambitious goal of achieving \$50 billion export by 2021 (Partners, 2019) and increased to \$66.25 billion by 2030 (mid growth scenario) (Sagris and Abbott, 2015). Figure 1 shows the projection of the total RMG exports by 2030.

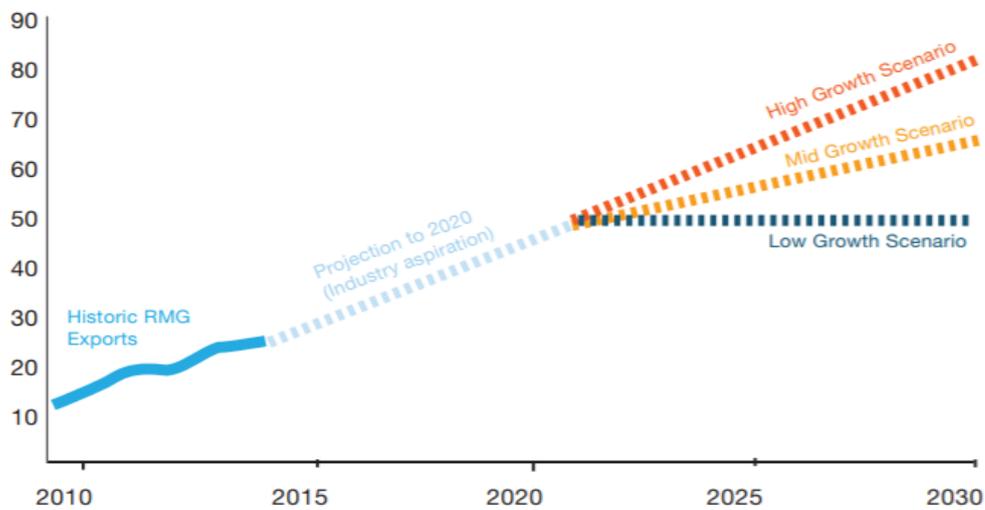


Figure 1:Total RMG export projections by 2030 (in \$ billion) (Sagris and Abbott, 2015).

Considering the total export market share by countries, China holds the first position with 41% share keeping Bangladesh in the second position with a 6.4% share. However, Bangladesh has an opportunity to keep the market share of China occupied, as they are trying to shift from the production of the garment industry to the other technology (Textile, 2019). There are some factors like labor cost, an aging workforce, hiking material cost increased that diverting small orders from China to Bangladesh. Whereas Bangladesh has cheap labor costs, more labor working hours, and low apparels make a strong competitor in the global market. Moreover, it has special access to the European Union (EU), Canada, and Japan along with quota and duty-free access to the international market (Bangladesh Textile Economy - Textile Economy Growth of Bangladesh, 2012).

However, according to the recent statistics, holding the second RMG export position has become a pressure for Bangladesh as this sector is a margin of downward in recent times. Vietnam, apparently, going to be one of the next giants on exporting RMG worldwide by chasing Bangladesh after China. The margin of apparel earning in 2019 by Bangladesh and Vietnam was \$33.07 billion and \$32.64 billion according to the General Department of Vietnam Customs (GDVC) and Export Promotion Bureau of Bangladesh (EPB) respectively. Moreover, the export growth rate of the Bangladesh apparel sector was only 0.44% comparing to 7.30% in Vietnam's apparel industry in the same calendar year which is giving threat of losing the second position to Vietnam in near future (Impact, 2020).

Recently, global RMG export sharing market in between Bangladesh and Vietnam (6.4% and 6.2% respectively) also tells the story of closest competitors (Ovi, 2019). Sustainable industry, duty-free benefit from European Union (EU), strong labor codes are some of them helping Vietnamese industries to grow up rapidly in the global market (Khan, 2020).

Therefore, Bangladeshi textile industry must need to do things that will keep competitive in the global market in upcoming years. In that process, sustainable system transition in the production process can speed up the production capacity. As a result, international buyers will attract and find an attractive sourcing place. The current system of the Bangladeshi textile industry is unsustainable, uncontrollable, and disposable which is impossible to survive in a long-term competitive market as globalization and emerging technologies putting pressure on the suppliers. The industry usages a lot of natural resources and polluting environment in the end. If the industry does not move in a systemic transformative way, then it might experience major shocks in the future. Therefore, the industry needs to address the aspect which should be phased out from the current system and introduce transition approaches.

The sustainable transition has widely used term all over the world in the current context of climate change. In terms of the textile industry, the sustainable transition has the greatest positive impacts on the environment. Growing public concern on sustainable clothing pushing strain on buyers for searching sustainable sources. The need for sustainable transition is very important for the Bangladeshi textile industry, as it has great impacts on the global textile industry. The core objective of the transition is to change from an unsustainable system to a more sustainable state. Such changes interplay in different levels and domains of transition processes which brings a qualitative system changes in the end (Muthu, 2017). However, Bangladeshi textile industries are still far behind in meeting sustainable production which is likely to be critical soon in the competitive successes.

The industry is facing several sustainable challenges throughout its supply chain management. Some of the major challenges are environmental impacts such as a significant amount of energy and water use during manufacturing and production, greenhouse gas emissions, untreated wastewater discharge, the release of toxicity, ecotoxicity, chemicals,

and so on. Moreover, other sustainable challenges are sustainable production cost, health and safety issues, sustainable raw materials, and consumer behavior. To meet such sustainable challenges this sector needs to be widely used the concept and knowledge of transition. Through the systemic transition, resource efficiency can be improved and reduced environmental pollution by introducing different sustainable practices. As the Bangladeshi textile industry taking a huge amount of natural resources like energy, water and pollute the environment without treating, a sustainable transition is a must needed for this sector to keep viable in the global export market. Some Bangladeshi textile factories have indeed improved a lot in eco-friendly production and producing sustainable clothes but most of them are not even in the line. They are either unwilling or lack of transition knowledge that keep them out of the sustainable transition track. It means, there are huge gaps in sustainable transition knowledge between the producers and suppliers. Hence, introducing and utilizing sustainable transition practices are an urgent needed for the Bangladeshi textile industries to remain competitive with the other competitors in international export market.

The purpose of this master thesis is to introduce theoretical concepts of sustainable transition for Bangladeshi textile industries through exercising transition knowledge. Therefore, a detailed understanding of transition will be implemented into the thesis.

1.2 Objective and research questions

The main goal of this master thesis is to find out the dimensions of sustainability transition of Bangladeshi textile industry through transition knowledges. Moreover, introduce basic clarification of the theoretical concept of sustainable transition and their importance for implementing transition knowledge in practically. Analyse the environmental footprints related to the textile industry of Bangladesh and suggest possible solutions for making the industry sustainable.

Concentrating part is to create a theoretical transition framework including multilevel perspectives and role of actors on transition. In that case, emphasis is given especially on niches technology development and their utilization for resource efficiency towards sustainable textile production. To fulfil the goal of this thesis, the following research questions are needed to be answered:

- What are the problems of the Bangladeshi textile industry?
- What is sustainable transition and why it is needed?
- What are the sustainable solutions for resource efficiency?
- What kind of transition is needed to fulfil the goal?

The answer to the above research questions is covered in further writing to meet the objectives of the thesis.

1.3 Structure of the thesis

This master thesis is organized in six different parts. They are consisted of introduction, overview of Bangladeshi textile industry, literature review, theoretical transition framework, research methodology, and conclusions. The structure of the thesis is diagramed in below figure 2. According to the diagram, first part of the thesis described the overall scenarios of the Bangladeshi textile industry and their growth in recent times. Moreover, how lack of sustainability makes this industry challenging in competitive global market are also shown in that part. Based on this, importance of introducing sustainable transition for the industry has placed for research questions. In the second part, overview of the Bangladeshi textile industry has introduced. Here, history of the industry such as when and how the industry has started, how the industry is structured and what are the current scenarios are discussed. Different kinds of sources are used to analysis the data of the industry. In literature review, previous works done by the various authors are analyzed to find out several problems of the industry. Moreover, sustainability of the textile industry in other countries are also considered. In fourth part, a theoretical analysis of the transition is reviewed. Here, different knowledge of transition like concepts, importance, and understanding of transitions are placed along with multiple perspectives framework of transitions. Moreover, both local and global sustainable scenarios of the garment industry have also shown in that part.

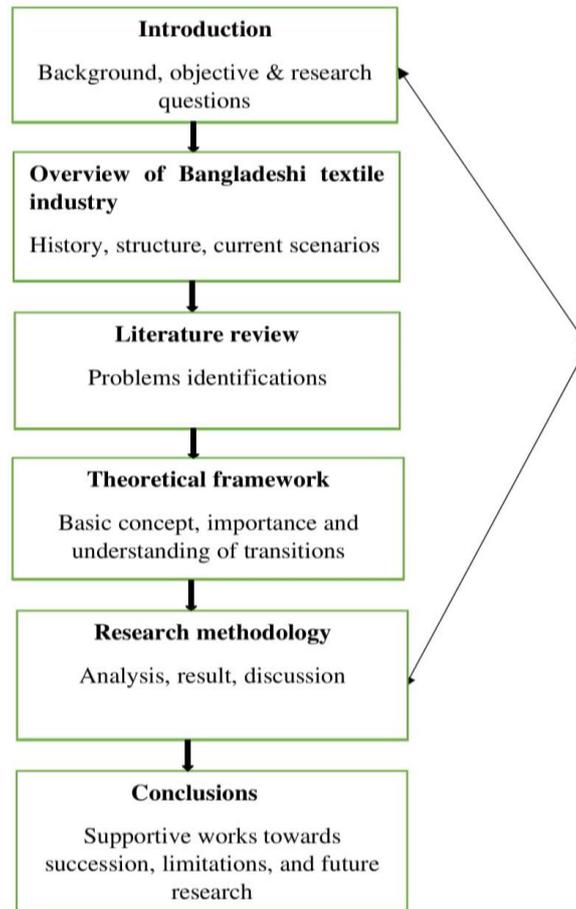


Figure 2: Structure of the thesis

In research methodology, a qualitative analysis of the environmental footprints of the industry has done to introduce niche technologies for improving the overall efficiency of the industry. Different transition scenarios are presented and analyzed to meet the objectives of the thesis. In the end, conclusions of the overall works are placed with some recommendations for the future work has given for the industry.

2 OVERVIEW OF BANGLADESHI TEXTILE INDUSTRY

In this section, an overall scenarios of Bangladeshi textile industry will be discussed from the history of the industry to the current scenarios of the industry.

2.1 History of Bangladeshi textile industry

Bangladeshi textile industry is working as a main driver for the economic growth of the country. The country was born in 1971 as the poorest countries in the world. To build the country and its economy, the RMG sector played a crucial part at that time and became the main export earners for Bangladesh within a short period. The history of RMG of Bangladesh started at the beginning of the 1980s when 130 people were sent to South Korea for training to learn how to produce clothing (About Garment Industry of Bangladesh, n.d.). When they back from training, four small garment industries started to produce garments for both domestic and export markets. The first four established industries in Bangladesh were found in Reaz garments, Jewel garments, Paris garments, and Baishakhi garments. Foreign buyers motivated Bangladeshi entrepreneurs to produce more clothes by offering special terms and export conditions as production and labor cost was lowest in Bangladesh. Moreover, when Multi-Fiber Agreement (MFA) was introduced in 1974 and imposed quotas for developed countries where exported at a higher rate than bilateral agreement, producers of those countries interested and diverted to above restrictions free countries like Bangladesh (Chowdhury et al., 2014).

The textile industry of Bangladesh then started to grow rapidly as entrepreneurs got interested because of its low investment and low labor cost. The availability of the workers was the biggest advantage for the owners. The MFA and off-shoot quota system worked as a blessing for the Bangladeshi textile industry to capture the export market of the USA and other countries. In addition to that, granted Generalized System of Preferences (GSP) privileges by EU helped to boost the industry quickly (Siddiqi, n.d.). Since then, until now Bangladesh is an attractive sourcing destination for foreign buyers, though a lot of changes made in the last couple of years.

2.2 Structure of Bangladeshi textile industry

Bangladesh's readymade garment industry can be categorized into two broad product categories such as Woven products and Knit products. Woven products mainly consist of shirts, pants, and trousers and Knit products include t-shirts, polo shirts, socks, sweaters, and undergarments. According to the export statistics, woven garments dominating on export earning of Bangladesh than knit products (Rahman et al., 2017). In 2018, woven products export to the world around \$16.7 billion which was \$14.7 billion in the previous year (BGMEA). Figure 3 presents the growth rate of woven products considering export earnings in Bangladesh textile.



Figure 3: Woven export value from Bangladesh to world from 2010 to 2018 (BGMEA).

However, recently the export growth rate of woven products going downward. This is mainly because of the gap between the supply and demand for woven fabric. Studies have shown that considering the current consumption rate, there is approximate demand for fabric is three billion meters while local mills can support only about 45 million meters (13-15%) which is far behind the demand. Moreover, longer lead time, cost of fabrics, energy crisis, such factors keep woven garments in challenging on global market. Hence, there is huge investment needed as a backward linkage in the woven sector as well as shorten lead time (Sohel, 2017).

On the other hand, Bangladeshi knitwear industry playing an important role in earning of GDP. It is effectively creating efficiencies through operating as a group of spinning, fabric knitting, dyeing, and finishing. The production process starts from importing cotton (98%) from foreign countries and rest are done in Bangladesh (Value addition from Knitwear industry, n.d.). Considering the installed capacity and volume of production, Bangladesh has one of the largest knitting capacities in the world ('Knitting' growing fast with great prospect still without business viability, 2017). Knit products especially t-shirt has great demand in the world and earning the most export (figure 4) compared to other knit products. The demand for knit products is increasing with the increase in technical efficiency every year. In 2018, the contribution of knit products in export earning was \$16.24 billion and the trend of improvement is ongoing since the last decade (BGMEA). Below figure 4 shows the total export earnings by knit products from 2010 to 2018.

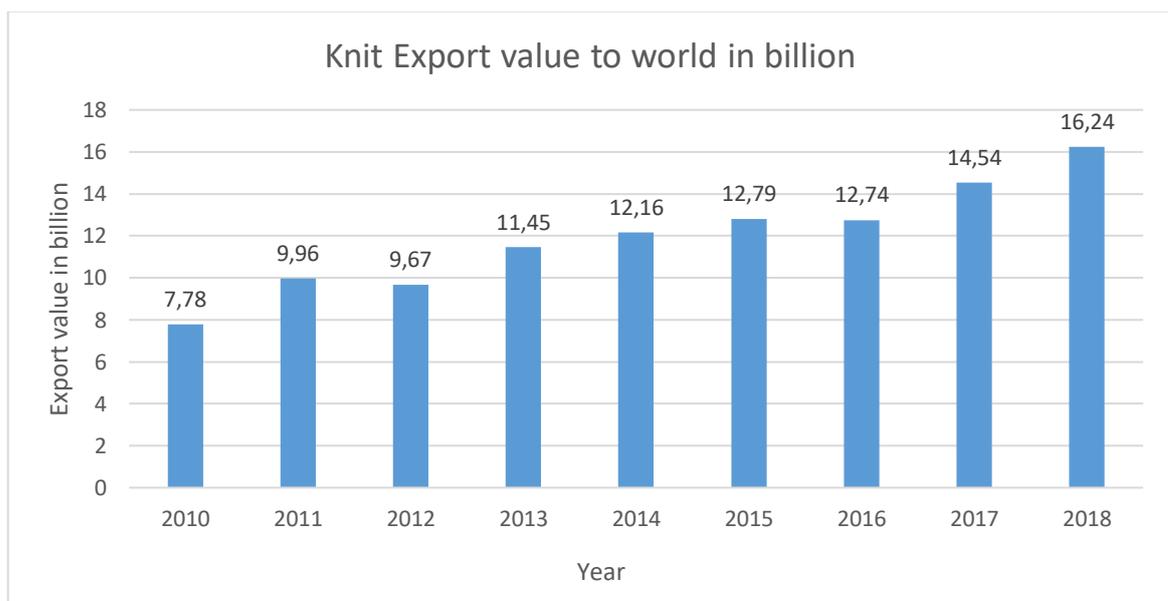


Figure 4: Knit export value from Bangladesh to world from 2010 to 2018 (BGMEA).

The overall value chain of Bangladeshi textile and clothing industry can be shown as follows:
The sector is going forward with higher value textile production processes.

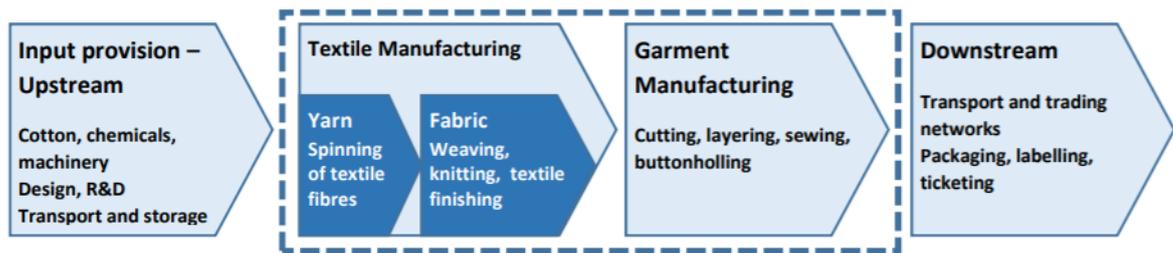


Figure 5: Textile and Clothing Value Chain in Bangladesh (Restiani, n.d.).

2.3 Current scenario of Bangladeshi textile industry

The expansion and growth of the Bangladeshi apparel industry seen mainly due to the benefit of the MFA quotas between 1974 and 2004. However, it was phased out in 2004 that caused concerned most of the entrepreneurs about the possible adverse effect on the industry. Most of the experts predicted the fall of the RMG sector in developing countries at that time. The concern was mainly about the losses of export revenue and jobs during the post MFA period. Interestingly, after the MFA era, Bangladesh RMG sector has seen tremendous improvement in export earnings, employment, and the number of factories. Despite some instability in the RMG sector in Bangladesh, the productivity and factory performance increase a lot. Moreover, improving other factors like production techniques by introducing lean manufacturing systems, labor wages, political stability, sustainable building structures and others giving an overwhelming performance of the apparel industry in Bangladesh (Ahmed, 2012).

This apparel industry has now a brand value all over the world and contributed to around \$30 billion in 2018 of the country's economy where the country's total export was nearly \$36.6 billion (almost 83%). It demonstrates the value of the garment industry in the expansion of the Bangladesh economy. Recently, authority declared a new minimum wage of labor of the RMG industry. According to the announcement, the minimum wages increased to 8,000 BDT (\$94 nearly) which was 5,300 BDT (\$68 around) in previous time. This is a noticeable step for the workers. Moreover, new labor law has passed in the parliament that will help to bring Bangladesh into an internationally accepted standard (Uddin, 2018).

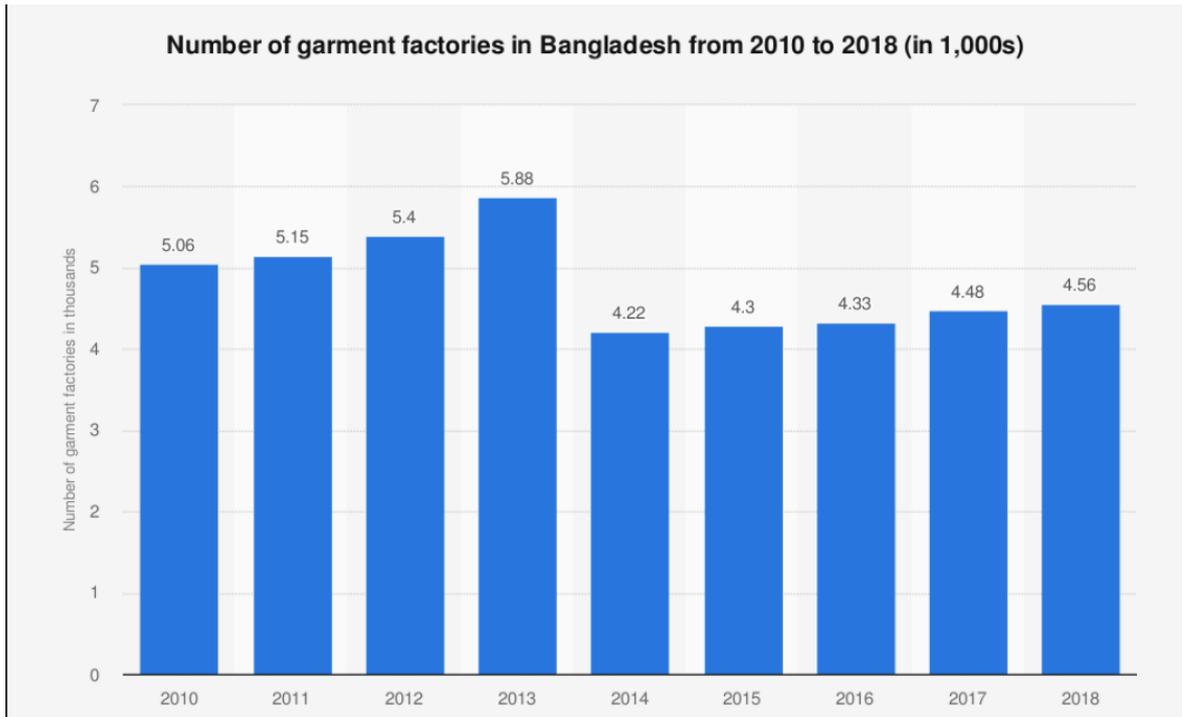


Figure 6: Number of garment factories in Bangladesh from 2010-2018 (BGMEA).

Figure 6 represents the number of factories in the RMG sector in Bangladesh from 2010 to 2018. There was an upward trend in the number of factories from 2010-2013 but different scenarios shown in the 2013-2014 fiscal year (FY). A lot of garment industries shut down due to the electricity crisis and tight inspection of risky factory. The collapse of Rana Plaza (died around thousands of workers and injured over two thousand in 2013 in Dhaka Bossavie, 2019) also causes of decreasing factories in that period. However, after the incident of Tazreen fashion which killed nearly 112 factory workers and injured at least 200 in 2012 in Dhaka (Akhteruzzaman, 2015) and Rana plaza, international buyers, consumers from all over the world increased voice to ensure the safe environment of the industry. As a result, structures of the industry shown improvement in the last few years as well as the number of industries.

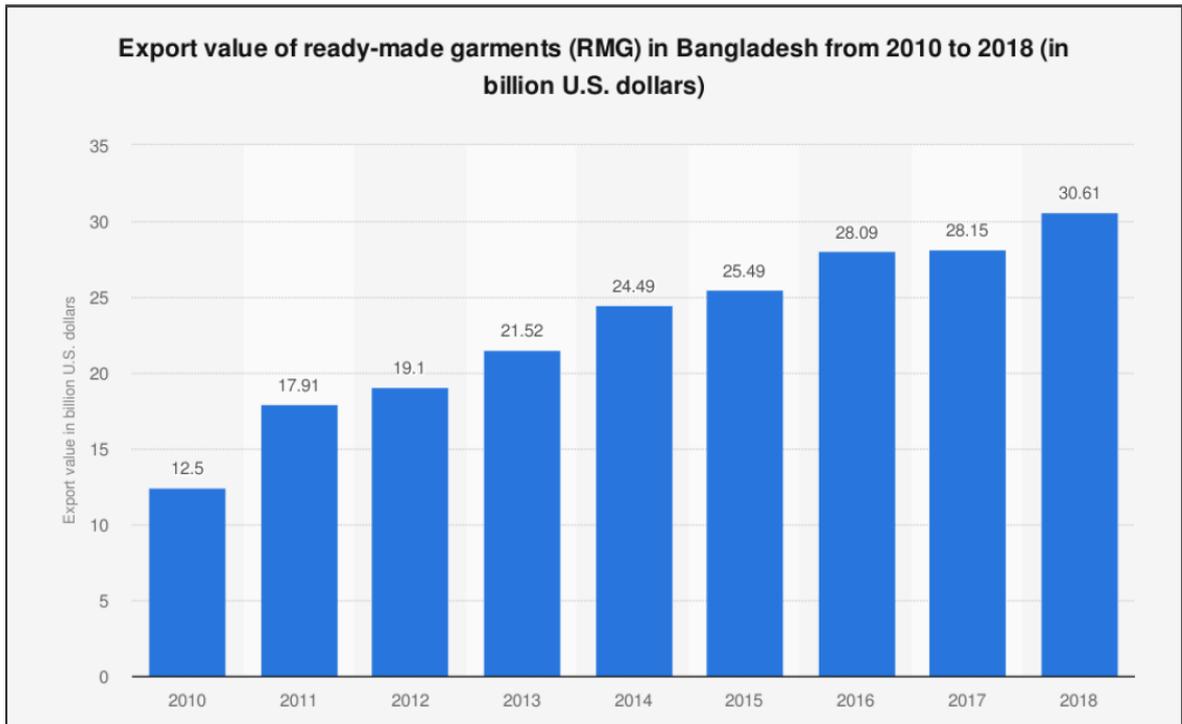


Figure 7: Export value of readymade garments in Bangladesh from 2010-2018 (BGMEA).

Figure 7 described the export worth of the RMG industry in Bangladesh economy from 2010 to the 2018 calendar year. The graph has shown a steady improvement in exporting earning in every year. The growth rate increases consistently since the last decades. The export earning keeps raising due to the interest of the buyers as they found a cheap labor availability country which helping manufacturers to get more orders from the buyers.

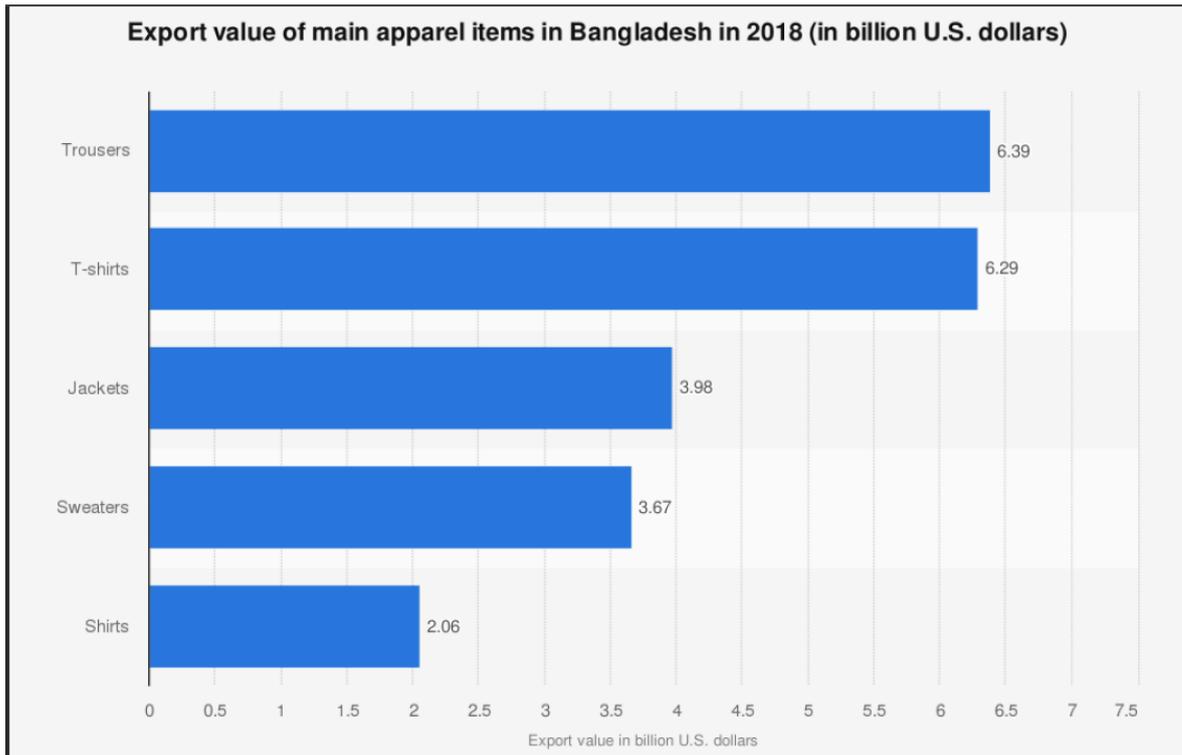


Figure 8: Export value of main apparel items in Bangladesh from 2010-2018 (BGMEA).

Figure 8 represents the main apparel items of the Bangladeshi RMG industry and their value in total export earnings individually. Trousers and t-shirts are the most exporting products from the Bangladeshi apparel industry. There are so many other items that are exported from the industry, but these are the most sales products that have a huge contribution to the total export earnings.

Many renowned clothing companies from all over the world imported clothes from Bangladesh. Table 1 presented some of the world's best brands those who imported clothes from Bangladesh.

Table 1: Renowned clothing brands import from Bangladesh (Hasan et al., 2019).

Renowned Brand	Origin
H&M	Swedish company
Walmart	American company
C&A	Dutch company
Zara	Spanish company

3 LITERATURE REVIEW

In literature review, different works of the researchers about Bangladeshi textile industry will be analyzed to identify the problems of the industry in the development path of the industry. Moreover, various sustainability of the industry from different perspectives of the researchers will be discussed.

Bangladesh was born as the poorest country in 1971. After that, the country had to fight with poverty, illiteracy, economic crisis, and many others to rebuild the country. Garment industry worked as one of the main players to stand the country at that time among the worlds. According to Rahman and Siddiqui (2015), Bangladeshi RMG industry has begun its journey in the late 1970s. It has grown significantly over the past 35 years and became the main steering force of the economy of Bangladesh. The industry brought glory for the country by employing more than 4 million workers. In other study, Chowdhury et al., (2014) said, Bangladeshi brands got familiar in the global apparel market within a short period. World-famous brands found Bangladesh as an attractive sourcing place for its cheap labor cost.

The industry has both contribution and challenges. A study conducted by Mia and Akter (2019) described the growth, contribution, and challenges of the textile sector in Bangladesh. They showed how the growth rate of factories and garments workers has increased in the last few years. The study mentioned that the RMG sector contributes to export, gross domestic product (GDP) that helps to improve the economy of Bangladesh. They addressed some challenges of the RMG sector in Bangladesh including unskilled workers, insufficient infrastructure, energy crisis, un-sustainable production. The study comments about the reform of trade policy in the border and within the border to use the potential of the RMG industry.

One of the major concerning issues of the industry is frequent labor unrest. The work done by Ahmed et al., (2013) have expressed their concern in their study regarding the unrest of the labor in the ready-made garment industry in Bangladesh. They pointed out factors like lack of facility, lack of safety, minimum wages, and benefits, working conditions, long working hours, deferred payment of wages and benefits, political instability, sexual

harassment are the main reasons of labor unrest in the industry. The condition might be changed and improved if the policymakers and owners of the industry take initiatives and consider these factors, they added.

Chowdhury (2017) said the readymade garment industry in Bangladesh has created a significant work opportunity for women. They are the dominating portion of workers in that industry. However, these workers are the most helpless in legal facilities and raise their voices, she added. The study found out that the absence of trade unions, job insecurity, sudden termination, lack of education, violent behavior, sexual harassment factors weak and discourage female workforce to raise their voice that undermines their rights and prospects in the RMG sector in Bangladesh. She suggested a combination of a trade union, civil society, NGOs, and public officials to play a significant role in reform policy and spreading knowledge about the fundamental rights and voice to improve the female workforce and strengthen their position to get the highest productivity. However, Dey and Basak (2017) found women are more concerned about survival with their family before protesting or raising the voice. They are pressurized to fulfill the targets set by the authority in every day and are not allowed to share a single word with co-workers inside the factory.

Hasan and Mahmud (2017) addressed possible risks related to RMG sectors in Bangladesh. They mentioned that around 20 noticeable risk that makes the RMG sector in Bangladesh questionable. They remind some worse accidents that have occurred already in that sector like Rana Plaza, Tazreen Fashion Ltd, and others which made the attention of the glamour world. They indicate around 94% of these incidents are happened because of fire and 3.03% by building collapse and rest are some other reasons. This paper described the roles and responsibilities of different actors like government, Brands, BGMEA, and factory owners to prevent any unexpected incident in the future.

There are some factors that the industry facing as a major determining factor. Rahman et al., (2019) mentioned the major influencing determinants and factors related to Bangladeshi textile and clothing (T&C) exports in their study. They identified three possible factors like gross domestic product (GDP), money exchange rate, and importers per capita GDP are the major contaminants in Bangladeshi T&C export. The study has used an empirical gravity

model as a methodology depending on the data collected from different countries to identify the factors.

Consumer behavior is an important fact in the fashion industry. In one study Joy et al., (2015) addressed the perception of consumers towards fast fashion versus its luxury counterpart. The main aim of the research was to get feedback on what sustainability means to the consumers while buying clothes. They conducted interviews as a methodology in both males and females to find out the subconscious values of fast fashion consumers towards their style and fashion in Hong Kong and Canada. The study found that sustainability is not a matter of concern for young consumers aged under twenty and thirty-five rather associate with fashion and trend. Findings suggested that young consumers keep separate fashion from sustainability. However, those consumers showed their environmentalism but did not apply these ethics while their consumption of fashion. They concluded by suggesting consumers to change their attitude and perceptions toward negative environmental impacts occurring from the clothes which are producing in an un-sustainable way.

Sustainable production is still a major concern of the industry. The study performed by Jang et al., (2012) mentioned that the fashion industry has not yet achieved sustainability in production despite polluting environment during production. They conducted a study to investigate the possibility of social content that can focus on products which are environment-friendly, diversity in their quality and design, and ecosystem promotion. The study suggested solutions of sustainability issues related to the fashion industry by social content model through qualitative and quantitative analysis including environmental consciousness. They believe that developing social content for the fast fashion industry helps to overcome the limitations and improve the sustainable development of brands.

In other research work done by Fani et al., (2015) described the fashion industry as one of the most polluting industries in the world that consume a huge amount of water, electricity, and chemicals. They discharged a huge amount of wastewater into the land and river that contaminant at the same time. The authors implemented a theoretical framework by mapping practices for environmental sustainability in Italian textile, clothing, and leather (TCL) industry to get an understanding of the practices. Findings indicate that Italian companies do

not show interest in sustainability activities or a few of them already taken some practices on sustainability. They sum up by expecting further research in different areas that will give details results.

One hypothesis developed by Kong et al., (2016) to determine the current sustainability knowledge and attitudes of consumers towards the fashion industry. They mainly focused on the Korean consumers who have lack of understanding of the concept of sustainability. The study found that consumers have a higher positive attitude towards the accessibility of sustainable clothing if sustainability knowledge is spread by the companies. They suggested that the importance of sustainability in the fashion industry should be developed through the curriculum of education and marketing strategy.

Scaturro (2008) described the goal of sustainability in the fashion industry as not to reject the current technological society rather to change the meanings and disclosure of technology from within. Traditional manufacturing structure will be replaced by eco-friendly technological structures by collaborating different actors like manufacturers, scientists, retailers, and consumers in the fashion industry, he added. The study concludes by expecting that when eco-tech fashion will succeed the whole fashion system move towards a promising future.

Köksal et al., (2017) conducted a literature review focusing on social issues related to sustainable supply chain management (SSCM) in the textile industry. The authors included a content analysis to review the other journals and integrated the latest findings of the textile industry to produce potential research areas in the field. According to them, social issues related aspects are still less in discussion in the textile industry that motivated them to enrich the discussion on their study which is the purpose of this study. They found a lack of investigation of the social issues in SSCM practices. Moreover, they mentioned that companies are not aware of the support needed for suppliers. So, they suggested that managers should be engaged proactively in SSCM and enhanced training, investment, and cost-sharing activities that will longer the relationship between local companies and suppliers.

Hossain and Roy (2016) described supply chain management (SCM) as a key-value concerning manufacturing and service for the Bangladesh garment industry. They said, SCM system undoubtedly a paradigm for the garment industry that allows them to respond quickly according to the customer's needs. Gomes and Daud (2020) said the management of raw material is the key factor for implementing green SCM in the RMG sector of Bangladesh to produce the final product. They suggested applying green activities in SCM to reduce pollution in the environment and make the business eco-friendly and sustainable.

Shimu and Islam (2018) illustrate the role of microeconomic variables in the export growth of RMG in Bangladesh. They mentioned that liberalized import policy helps the RMG sector to become a major export earning of Bangladesh. The study reveals that weak currency and economic growth are both related to each other. So, an increase in the inflation rate negatively affects the export growth rate. They suggested that a lower interest rate on a short-term basis and a long-term basis might reduce the number of repayable loans that stimulates the export growth of the country.

Caleca (2014) described the effect of globalization on the RMG sector of Bangladesh. She said the effect of globalization and the increase of multinational corporations have a great impact on the transformation of the world's labor and production market. Hussain (1970) defines globalization as a process of expanding and creating a borderless trade and commerce market all over the globe. He explains the challenges due to globalization faced by Bangladesh in socially, politically, and economically. He suggested that foreign policy should be strong to reduce the degree of vulnerability and improve the security environment to make pragmatic and active diplomacy to attract foreign buyers.

Akterujjaman (2013) analyses the export performance of Bangladesh's RMG industry. The study reveals that customers are satisfied with the product and quality of the RMG industry of Bangladesh but some dissatisfaction with the product delivery time due to the unskilled worker and un-modernized production structure. To keep the market, Bangladesh RMG industry needs to shorten the lead time otherwise international buyers may look for other suppliers, he added. On the other hand, Hossain et al., (2019) described lead time as a crucial factor to cope up with other competitors' countries in the global market. They identified some

main reasons for lead time such as inefficient port and mismanagement in the airport, importing lead time of raw materials, a couple of certifications and standards. They recommended couple of factors to improve RMG export performance of Bangladesh by reducing lead time, continuing supply of power and energy, increasing labor skilled, utilization of new technologies and so on.

3.1 Problems identification of Bangladeshi textile industry

Based on the review of different literature, some challenges are identified for Bangladeshi textile industry in the development paths. It is true that the RMG sector is working as a blessing for the economy of the country, but the industry has some problems in the whole production line which can hinder the export growth in the future if those challenges are not meet. Therefore, here are some problems that are named for the industry and discuss in different headlines.

Lack of Research and Development (R&D)

The country has a lack of R&D set-up in most of the garment manufacturers with an exception handful. Lack of R&D results in less efficiency and weak productivity which increasing average production cost unnecessarily. On the other hand, competitor countries have stronger R&D in factories which shortening product development from design to sample preparation. As a result, the quality of products is ensuring which attracting buyers (Ahmed, 2020).

Lack of modernization on production

Globalization and modernization change production strategies of the RMG sector in different countries. Replacing obsolete equipment to modern equipment helps to minimize the cost of production and increasing the efficiency of production. However, in Bangladesh, the operation of the RMG sector is still old and obsolete in most of the cases. The inability of replacing old to modern equipment and machinery timely, leading to higher cost of production and declining growth rate compared to countries like China, Vietnam (Khan, 2014).

Lack of labor rights exercises

Bangladesh is one of the favorite sourcing destinations for international buyers in terms of labor availability, low wages of labor, and their efficiency. But the industry has shown continuous unrest of labor due to the minimum wages, long hour works, working environment, gender discrimination, sexual violation, delay of payment, benefits, and holidays. Bangladeshi textile workers are receiving the lowest wages which are below the standard of living. According to the ILO (International Labor Organizations), workers should work in a safe environment where they will be protected from sickness, disease, injuries (safe, 2012). However, Bangladeshi textile owners vain to fulfill these requirements for the workers. As a result, there were some unwanted incidents that happened in the last couple of years where a huge number of workers died, and thousands were injured which could be avoided if there were proper regulations and inspections. Workers cannot raise their voice about the basic demands in scared of their job loss. Lack of leadership and proper workers union cannot reach the voice of the workers to the government and international levels. Most of the workers are poor and illiterate that keeps them unskilled in the production line. There are in-sufficient housing facilities for the workers rather they must rent houses whose conditions are very poor and unhealthy in most of the cases. Therefore, they are living in a sub-standard condition that down their values in the society.

Lack of inflow of investment

Investment inflow is slow in recent times considering both entrepreneurship and expansion (Reimagining the future game-plan of Bangladesh's RMG industry, 2020). Experts mentioned that political instability might be one of the main reasons to fail to attract foreign investors. However, the internal working environment and safety issues are still unpredictable that discourages foreign investors for high investment frequently (Hussain, 2011). The collapse of Rana Plaza in Dhaka, as for example, in 2013 had clearly seen poor infrastructure and lack of safety of workers where around 1,132 garment workers died and many more injured (6 Years After the Rana Plaza Collapse, Are Garment Workers Any Safer?, 2020). Moreover, obsolete textile machinery takes time to design and production that results in low production which demotivates especially new investors.

Resource extractions and environmental pollution

The industry has huge environmental footprints. It takes a large amount of water especially on wet processing causing scarcity of water in some parts of the country. Factories use more than 250 liters of water, one of the highest waters consuming factories country, for washing and dyeing fabrics to produce one kilogram of the fabric where the international best level is 70 liters. Wet processing unit alone consuming 1,500 billion liters of groundwater (GW) per year (Mirdha, 2017). As a result, the groundwater level is decreasing day by day, especially near the factory areas. Likewise, using natural gas for production purposes making a shortage of the amount of gas in the country. Furthermore, the usages of imported unsustainable raw materials consist of chemicals has enormous surface water pollution. Most of the industries do not have a wastewater treatment plant. Hence, they released wastewater and chemicals into the environment without treating them resulting deteriorate the ecology and environment.

Energy crisis

Due to the increase of industrialization in recent times in Bangladesh, the energy requirement is surging every day. The government cannot properly cope with economic growth and the supply of electricity and gas which prevailing in the energy shortage condition (Hasan et al., 2019). As a result, load shedding arising and declining textile production up to 30% in various sub-sectors. On the other hand, an instant increase in electricity tariff has also risen the cost of production. Besides, production losses also arise due to the continuous gas disconnection over months that badly affect the industry in the international market (Khan, 2014).

Inadequate infrastructure

Incident happened due to inadequate infrastructure that felt the industry in an embarrassing situation so many times all over the world. Consequently, negative images arising in the industry that hinder continuous export earning successes. Other obstacles like inefficient ports, facilities of transportation, delayed shipment, damage of products in loading and unloading times are the factors that keep the industry out of getting full advantages in export earnings (Rahman, 2015). The mentioned factors increase the lead time of the products.

Therefore, suppliers fail to deliver orders in time that sometimes lose further orders from the buyers.

Considering the above challenges, development in the system of production and utilization of modern resources is an urgent need for Bangladeshi textile industry. Despite many reasons for the declining production rate, there are a lot of hopes to change the downward trend. The trend has been placed already among successful and leading exporters focusing on ensuring quality, service, and sustainability especially when dealing with global apparel brands. However, considering current global warming, sustainability in textiles, particularly, an increasingly important point on moving forward for exporters (Uddin, 2018). In that case, the sustainable system transition of Bangladeshi textile industry is an important argument to make the production growth rate upward.

4 THEORETICAL TRANSITION FRAMEWORK

This section will cover the main theoretical disciplines such as basic concepts of sustainability, sustainability transition, importance of sustainable transition, understanding of transition, multilevel perspectives of transition, local and global sustainable scenarios, and operationalization of MLP to meet the goal of this thesis.

4.1 Basic concepts

Sustainability

There is no direct agreed definition of sustainability in globally. Nevertheless, it can be defined as below,

“Sustainability focuses on meeting the needs of the present without compromising the ability of future generations to meet their needs.” (Understanding Sustainability, 2020).

The term Sustainability is composed of three pillars namely Environment, Social, and economic.



Figure 9: Three pillars of sustainability (Sustainability, 2020).

Sustainable development is not possible without fulfilling pillars of sustainability. Environment, one of the pillars of sustainability must be viable by considering sustainable natural environment, and sustainable economic development. Economic sufficiency is another sustainable development criterion which need to be secure and sufficient in the development path. Nurturing community is a social norm in terms of sustainable

development. Basic needs, equality, increasing awareness for sustainability of the society is the criterion that fulfilled under sustainable development.

However, in terms of business, it is very important to understand how sustainability works. Sustainability inspires businesses to make a long-term decision like years or decades and to focus on more diverse factors rather than simply considered profit or loss. The company will set sustainable goals and work according to them. When a business will achieve the goals, they can recognize themselves as "green" or "sustainable". Sustainable goals for a business can be achieved by reducing emissions, decreasing energy usage, extracting fewer natural resources, and using products from fair-trade organizations (Understanding Sustainability, 2020).

Sustainability transition

The concept of sustainability transition can be defined as below,

“Sustainability transitions are long term, multi-dimensional, and fundamental change processes through which established sociotechnical systems shift to more sustainable modes of production and consumption” (Markard et al., 2012).

According to the definition, sustainability transition has long term goals that show the future direction of the transition. In that case, guidance and governance have significant roles in the process of transition. Moreover, a wide range of actors like political actors, and supports from regulatory to institutional is required to work together and play a major role in the transition pathway (Markard et al., 2012). According to the Geels (2011), sustainability transitions are the combinations and interactions between technology, policy, economics, politics, culture, and public opinions. To accomplish these, researchers need theoretical approaches that will help to address a different kind of sustainability transitions and changing aspects dynamics.

4.2 Importance of sustainable transition

Three phases of transition are needed to change, transition, emerging, and positioning of solutions in transition framework. These phases will give an outline for implementing solution for a longer period.

Phase 1: Need for a change

At the beginning of the phase, changes needed in the larger operating environment. In that case, emerging ideas are required for new solutions. Ideas will analyze and utilize for functioning in longer terms.

Phase 2: Transition

In the transition period, different solutions and mutual competition ought to be developed. Though, planning for a vision and creation of expectations are a crucial part for transition phase to fulfill the mission. Moreover, increasing investment and networking of actors is also an integral part of the transition that is essential to consider.

Phase 3: Developing and positioning solutions

In the final phase, business model development and looking for emerging of new markets is placed for spreading the outcomes of the solution (Mikkilä, 2019).

4.3 Understanding of transition

"The term transition refers to the process of change from one system state to another via a period of nonlinear disruptive change". According to the definition, systemic change occurs when a variety of changes interplay at different levels as well as in different domains that emphasize each other results in a qualitative structural change in a societal system (Loorbach et al., 2020). Systemic changes of these are known as "socio-technical transitions" who involves in the change of overall transport, energy, and other systems that entail in technology, infrastructure, policy, consumer habits, cultural meaning. However, multiple actors like firms and industries, politicians, policymakers, civil society, and consumers involve these elements to reproduce, operate, maintain, and transform. Therefore, considering multiple actor's transition is taken as a complex and long-term process.

Below figure 10 presented the dynamics of socio-technical change in three different levels. Macro-level (landscape) accounts for slow-changing external factors whereas meso level (regime) provides stability for the development of existing technology and micro level (niches) generate and development of radical innovations. The dotted arrows symbolized the strong influence of niches by existing landscapes and regimes (Geels, 2002).

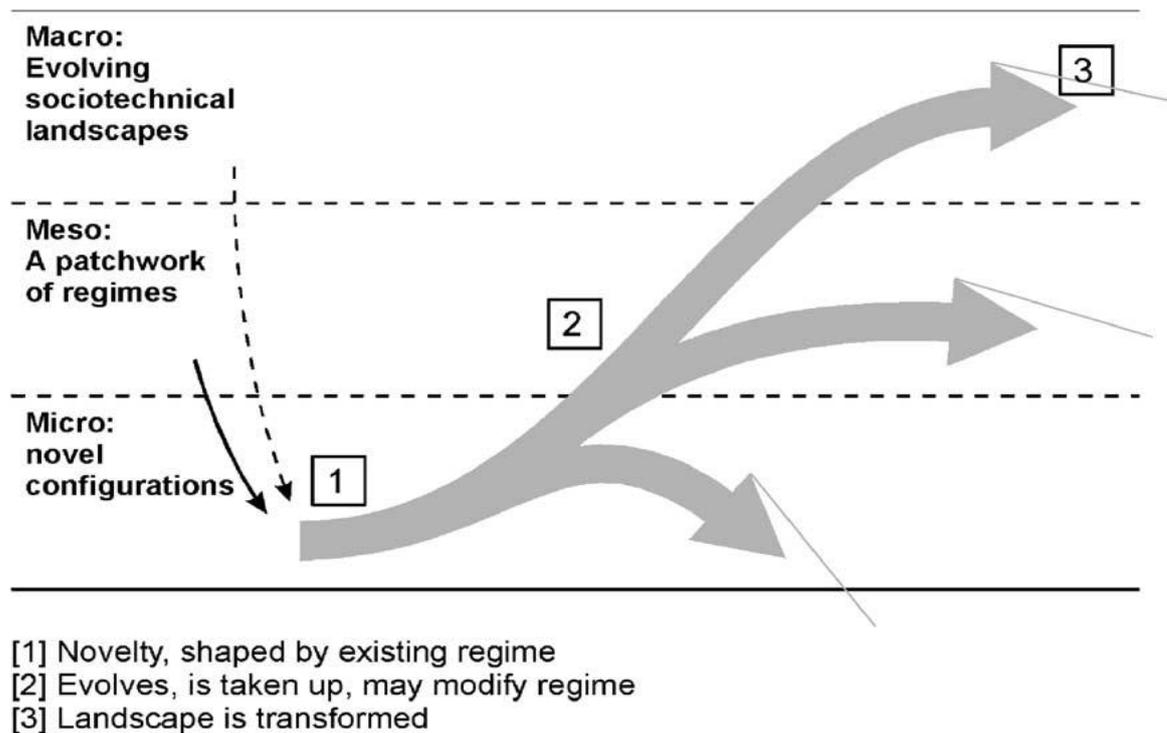


Figure 10: The dynamics of sociotechnical change (Geels 2002).

According to the Geels, there are some special characteristics of transition towards sustainability in a certain respect that makes them different. Firstly, in addressing persistent environmental problems, the sustainability transition act as a goal-oriented and purposive. In that case, private actors address limited incentives towards sustainability transition as the goal is related to collective good. Whereas, public authorities and civil society play an important role to address public goods to change economic condition.

The second characteristic is taken as unique that sustainable solutions mostly do not suggest user benefits rather make a decrease in price & performance ratio than formed technologies towards sustainability transition. Sustainability transitions are most essential in realistic

domains such as transport, energy, and so on which are taken as third characteristics. So, the above characteristics imply that sustainability transitions are relations of technology, business, market, policy, politics, and culture (Geels, 2011).

4.4 Multi-level perspective framework on transitions

Multi-level perspective (MLP) in transition can be described as a middle-range theory that defines overall dynamic models in socio-technical transitions (Geels, 2011). While, transitions are defined as a change from one socio-technical regime to another in the MLP. The MLP differentiates different transition pathways according to the nature and timing of the MLP interactions. Transitions occur through interaction processes in three analytical levels called socio-technical regime, niches, and socio-technical landscape (El Bilali, 2019). In MLP, the role of actors is very important. It is said that pathways of sustainable transition are mainly dependent on the interaction of various actors. They are taken as utilizers and opportunity creators for sustainable transitions. Actors have the potential to stimulate system change and create sustainable innovation at those levels (Koistinen, 2019).

4.4.1 Socio-technical landscape

The socio-technical landscape is considered as a wider context that influence regime and niche dynamics (Rip and Kemp, 1998). The socio-technical landscape consists of exogenous events and trends like demographic changes, climate change, cultural and societal values which takes a long time to change. When it changes create opportunities for niches and regimes (El Bilali, 2019). In that wider context, civil society, government, leadership, and others play an important role.

4.4.2 Socio-technical regime

The socio-technical regime provides stability for the development of existing technology by creating deep structure. It helps to reproduce different elements of socio-technical systems through a set of rules and co-ordinate activities of various actors and social groups (Geels, 2011). According to El Bilali (2019), the socio-technical regime incumbent socio-technical system. It includes technologies, institutions, actors, values, and beliefs to run the dominant system. Holtz et al., (2008) characterized main regimes according to their purpose, stability,

coherence, and autonomy. They said transformation or reconfiguration are rarely happened in the regime rather tend to change incrementally. Regime actors such as regulators, policymakers, and strategists articulate problems and provide stability for the development of existing technology (Brown et al., 2013).

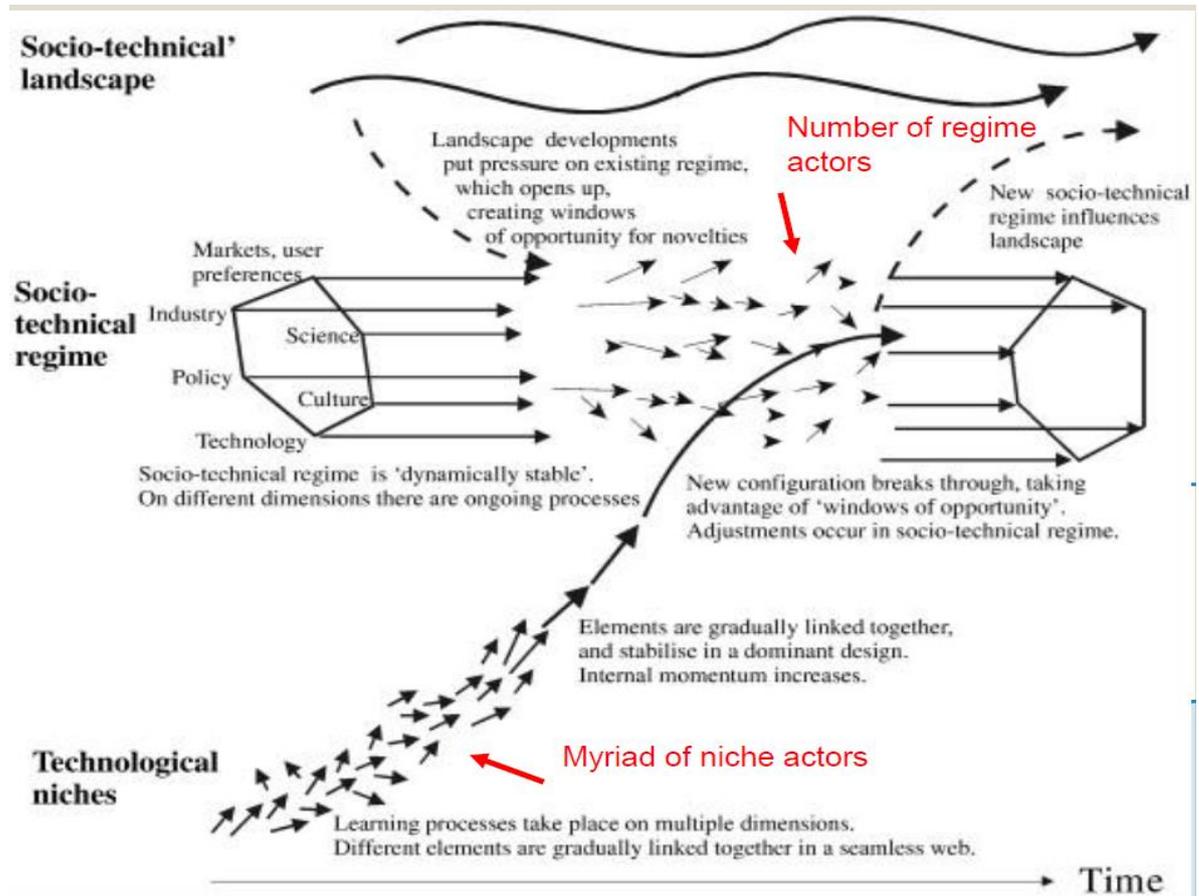


Figure 11: Multi-level perspective on transitions (Koistinen, 2019).

4.4.3 Niches

Geels (2011) defined niches as a protected space, for example R&D laboratories or small markets where people will have demand and support towards emerging innovations. Different niches actors like entrepreneurs, innovators, experimenters, and start-ups work on radical innovations and they believe that it will replace the existing regime eventually. These actors involved in various processes such as development and diffusion of knowledge, market formation, resource mobilization, and entrepreneurial activities (Fischer and Newig,

2016). Niches will get momentum when expectations are more accurate and largely accepted by the people.

Here are some examples of niche technologies and the regime are given below to get a better idea.

Table 2: Some examples of niche technologies and the regime

Niche technology	Regime	Function
Solar photovoltaic (PV)	Electricity sector	Power supply
Wastewater Effluent plant	Water sector	Clean water supply
LNG	Energy sector	Gas supply

4.5 Global sustainable scenarios in garment sector

Sustainability in the textile industry has gained a lot of attention over the last few years. Consumers no longer only consider fashion and comfort while purchasing clothes rather they are demanding more eco-friendly textiles nowadays. Consumers especially in Europe and the US are more interested to know the details of clothes origin they wear. A survey on "European consumer attitudes to sustainability and supply chain transparency in the fashion industry in 2018" shows that 80% of consumers want to know the operation of the supply chain from brands (Ending the era of dirty textiles, 2020). Though brands and retailers are concerned about the social and environmental impacts have started to address within their supply chain individually or organizationally.

However, in most cases, the current scenario for producing, distributing, and throwing of cloths is wasteful and polluting. Many natural resources are used for producing clothes putting pressure on resources, pollutes ecosystems, and creates considerable negative impacts at different levels from local to a global scale. The textile industry uses around 98 million tonnes of non-renewable resources per year consist of oil, fertilizers, chemicals to produce synthetic fibers, grow up cotton, and to produce the dye, respectively. Moreover,

textile production takes a huge amount of water (nearly 93 billion cubic meters) annually results in water scarcity problems in some regions. Furthermore, the industry has a large amount of greenhouse gas emissions and if this trend continues its current way, then 26% of the carbon budget it could use by 2050 as estimated (Circular Fashion - A New Textiles Economy: Redesigning fashion's future, 2020). Bangladeshi garments have a great influence on global textile clothing markets that exported around \$34 billion in the calendar year of 2018-19 in globally (Trade Information, 2020).

In European Union (EU) countries, the textile and clothing manufacturing industry has played an important role with a turnover of around \$200 billion and employing over 1.7 million people in nearly 176 400 companies in 2017 (Environmental impact of the textile and clothing industry, 2020). Recently, this sector has some radical changes undergone to maintain competitiveness in the global market by moving towards high value-added products. Changes cover a range of transformation activities from natural like cotton, wool, flax, or synthetic fibers such as polyester, polyamide into yarns and fabrics to the manufacturing of different products like hi-technological synthetic yarns, bed- linens and industrial filters.

Nowadays, companies are concentrating on producing different varieties of higher value-added products rather than mass production of simple products that improved competitiveness in the market. Moreover, European producers are considered as a world leader in the textile market for technical, non-woven like hygiene products and high-quality garments along with high design content (Textiles and clothing in the EU - Internal Market, Industry, Entrepreneurship and SMEs - European Commission, 2020). Bangladesh is one of the main exporters after China in the EU clothing sector which exports worth nearly \$21 billion in the 2018-19 fiscal year (Trade Information, 2020).

4.6 Green scenarios of Bangladeshi textile industry

Bangladesh, second-largest garment exporters in the world, has been working to make greener alternatives in textile production. This attempt is seen as a next step to secure its position in the international market (www.dw.com, 2020). However, it was quite pressure to change the traditional strategy from international buyers especially after the collapse of Rana

Plaza in 2013 in Dhaka. The glamour was shattered in global fashion industry after that disaster. Right away, workers, labor advocates, and users around the world began demanding and raising their voice towards serious change to the culture of impunity and abuse in world's fashion that had for decades (6 Years After the Rana Plaza Collapse, Are Garment Workers Any Safer?, 2020). On top of that, RMG sector in Bangladesh collide when the USA stopped to give the facility of Generalized System of Production (GSP) after that tragedy and filed against Bangladesh by four rights group from the EU. For both cases, the reason was cited as poor labor rights and unsafe working environment in factories.

Time has changed and the working condition of the Bangladeshi garment industry improved a lot since then. Bangladesh fulfilled 16 conditions initially given by the USA administration to recovery GSP facility, but the US has not reinstated the privilege rather they put new conditions (Report, 2020). However, recently European Ombudsman has nullified the complaints against labor rights violations filed by four rights groups from the EU and given verdict in favor of continuing GSP facilities in the EU market as they are satisfied with the present working environment in Bangladesh (Report, 2020).

Bangladesh is not only the second largest RMG exporters in the world but also a leading green manufacturer garment sector in the world. Bangladesh's garment industries are now going with more eco-friendly technologies to cope with global demand for green garments. The trend of creating green industrialization culture has started and established 67 eco-friendly green buildings so far, which is the highest number in the world. A "green building" is a combination of nine different aspects from the choice of building materials to building locations that encourage sustainability. Other aspects are transportation, the efficiency of water, energy and atmosphere, indoor air quality, materials and supplies, sustainable sites, and innovation in design. The purpose of green building is to mitigate carbon emission, reduction of groundwater usages, using renewable energy and recyclable materials (www.dw.com, 2020).

According to the U.S. Green Building Council (USGBC), Bangladesh has 67 Leadership in Energy and Environmental Design (LEED) green factories currently with 13 factories are rated as LEED Platinum and more than 280 factories are waiting for LEED certification from

USGBC. Bangladesh also leading in the top-scoring of green garment factories and has at least five out of the top ten platinum factories are originated from Bangladesh according to USGBC. As a part of environment-friendly green concepts, BGMEA trying to promote and motivate it among entrepreneurs and its members to familiar with energy-efficient technologies and production machinery (Gias, 2016). It is expected that about 10% of the total RMG sector will use green technology in the next decades.

Table 3 represents the globally top 10 LEED-certified factories (Industry categories) in Bangladesh. Remi Holdings Ltd, a group of the Bitopi, is the number one green factory in the world representing Bangladesh from the front. It has ensured zero wastage in production (Our Business, 2020).

Table 3: Globally top 10 LEED certified factories (Industry categories) (Gias, 2016).

No	Point Awarded	Project name	Country name	Certification level
01	97	Remi Holdings Ltd	Bangladesh	Platinum
02	92	Plummy Fashions Ltd	Bangladesh	Platinum
03	90	Confidential	Ireland	Platinum
04	90	Vintage Denim Studio Ltd	Bangladesh	Platinum
05	86	Bottega Veneta Atelier	Italy	Platinum
06	86	Method Products PBC	United States	Platinum
07	85	SQ Celsius 2	Bangladesh	Platinum

08	84	FGL-tan phu Expansion	Vietnam	Platinum
09	83	Princetel	United States	Platinum
10	81	Genesis Fashion Ltd.	Bangladesh	Platinum

4.6.1 Operationalization of the MLP for Bangladeshi textile industry

The concept of multi-level perspectives can be used for the development of Bangladeshi textile industry in the following ways.

Landscape structure

Bangladeshi textile industry has impacts in the international textile market, as it cannot operate in isolation. Therefore, this macro-development pushing pressure on the current regime structures. With the rising global population, clothing and consumption demands are growing so fast that further reinforcing the current regime. As a result, natural depletion and pollution continuously posing a threat to natural capital. At the same time, international buyers creating a force to take measures to make this industry circular business. In that case, Bangladeshi industry needs to address environmental footprints to minimize emissions and waste into the environment. Landscape development will result in better opportunities for building blocks and transformation to a better future pathway. On the other hand, consumerist culture is increasing around the world where consumers are demanding high quality and affordable clothes rather than durability. Consequently, the fashion industry takes a central place in consumer culture society. Short durability and trendy culture of consumers have huge obstacles in the sustainability of the industry. However, public awareness is raising considering the social and environmental values that forcing industry to change and create sustainability.

Regime structure

The current regime system in Bangladesh is an unsustainable, time-consuming, and traditional way of manufacturing. Whereas, the demand for low-cost production and sustainability is increasing in the global fashion market. The structure of the industry results in many natural resource extractions and ending up with landfills. Hence, the sector has a huge amount of environmental impacts. Therefore, the current regime structure demands to find out which part of the regime needs to be broken down or phased out to keep competitive in the global market. Considering short-term business strategies will help to shift manufacturers from one to another product with lower price and higher turnover. Moreover, increasing enforcement of labor regulations or regulation standards for environmental protection will meet the demands of foreign buyers and reimagining the industry at the international level. On the other hand, sustainability awareness among many corporations is only seen in environmental protection or green buildings while sustainability in social and economic dimensions is ignored in most of the time. Though most of the Bangladeshi textile companies have a lack of motivation towards introducing sustainability, as they believe it will create additional cost which is taken one of the main barriers towards making the industry sustainable. However, introducing sustainability on a long-term basis has cost savings mainly in materials, energy, and maintenance cost reductions which should be understood and accepted by the companies. In that case, awareness among the corporation companies needs to be increased about the long-term benefit of sustainability. Pioneering sustainability has some economic management implementation. Owners think that implementing sustainability may create management problems like schedule management, supply chain management, and so on which are taken obstacles towards sustainability. To improve sustainability performance, respected authorities should arrange workshops and seminars to raise awareness of the sustainable management system among the owners.

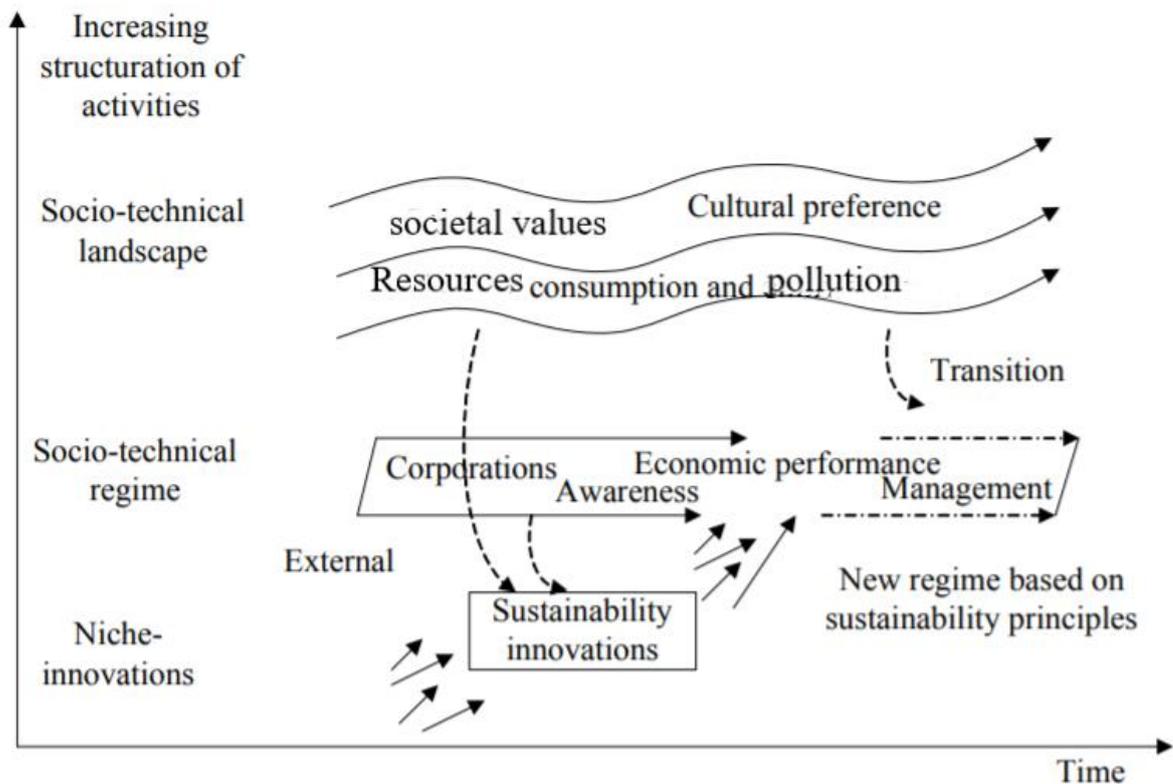


Figure 12: Multi-level perspectives on sustainable transition for Bangladeshi textile industry. Modified from Chang et al., (2015).

Niche innovation

Niche initiative offers new or alternative solutions for building power relations, roles & regulations for environmental protection through doing or experimenting on a short-term or long-term basis (Buchel et al., 2018). As the Bangladeshi textile industry has huge environmental impacts, they should focus on the development of niche technologies. Niche innovation will help to reduce the use of energy, water, chemicals, especially in the dyeing process. Recycling innovation will offer automated sorting, chemical recycling, raw materials use, as well as reduce landfilling. Therefore, sustainable transitions are needed to introduce more than one potential solution which will play different roles in the development of sustainable technologies in the garment industry. As a result, the overall efficiency of the industry will improve.

5 RESEARCH METHODOLOGY

The research methodology is defined to solve the problem in a systematic procedure. The procedure includes description, explanation, and prediction phenomena of the work chosen by the researchers. It helps to shape a methodology for the chosen problem by the researcher (Rajasekar et al., 2013). For this master thesis, qualitative analysis has been chosen as a methodology to analyze the objective of the thesis. Niche technologies are chosen in qualitative analysis to describe the sustainable potentiality of those technologies considering the textile industry in Bangladesh.

5.1 Qualitative analysis

Qualitative analysis is described as an effective model that helps the researcher to develop a detail of a problem based on actual experiences. It analyzes knowledge and understanding from people's perceptions considering experiences, meanings, social relationships, and processes (Mohajan, 2018). It enables us to make sense of reality through observed phenomenon to generate a strong outcome (Morse and Field, 1996). This master thesis considered qualitative analysis by collecting data based on different online sources and websites, and previous research work to meet the objectives of the thesis. Data is collected according to the environmental footprints and the transition needed of the industry through systemic changes. A qualitative analysis of the environmental footprints of the industry will introduce some sustainable niche technologies for the industry to minimize environmental pollution and resource extractions. In the end, an analysis of transition pathway scenarios will shade the systemic changes of the industry to meet the goal of the thesis.

The textile industry has several impacts on the environment by polluting the environment in different ways. Major pollutions are considered wastewater discharge, air pollution, and nuisances, and greenhouse gas emissions. Below figure 13 shows the distribution of environmental impacts by the apparel industry occurs during resource extraction to product supply (Correspondent, 2018). According to the figure, water consumption and land use are the two huge resource extractors in the industry. It can be said that a huge volume of freshwater is used by the industry that making the scarcity of freshwater in some parts of the

country, especially near the industrial areas. The industry is mainly dependent on freshwater which needs to be changed to alternative sources.

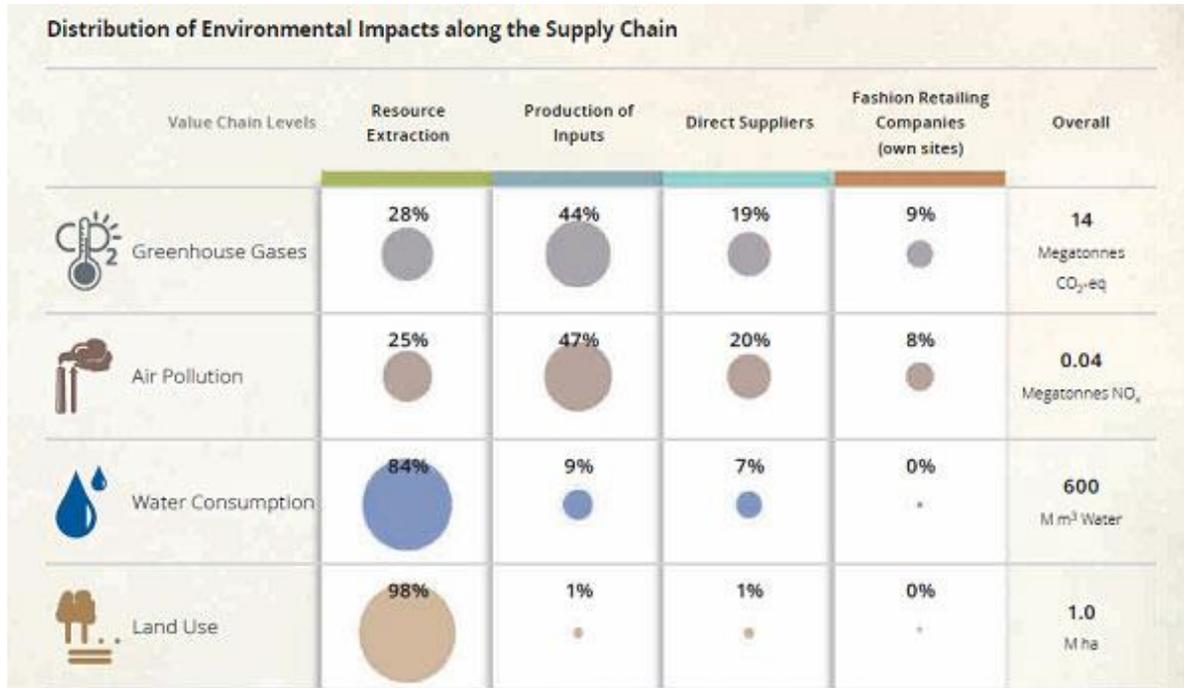


Figure 13: Environmental impacts by clothing industry (Correspondent, 2018).

Figure 14 presented the environmental footprints occur in the clothing industry. In every footprint, wet processing takes the largest portion than the others. Wet processing is the so-called hunger of energy, water, and chemicals in the industry. Considering these major impacts, overall textile production is needed resource efficiencies. In that case, development and utilization of niche technologies are required to achieve environmental sustainability in the textile industry in Bangladesh.

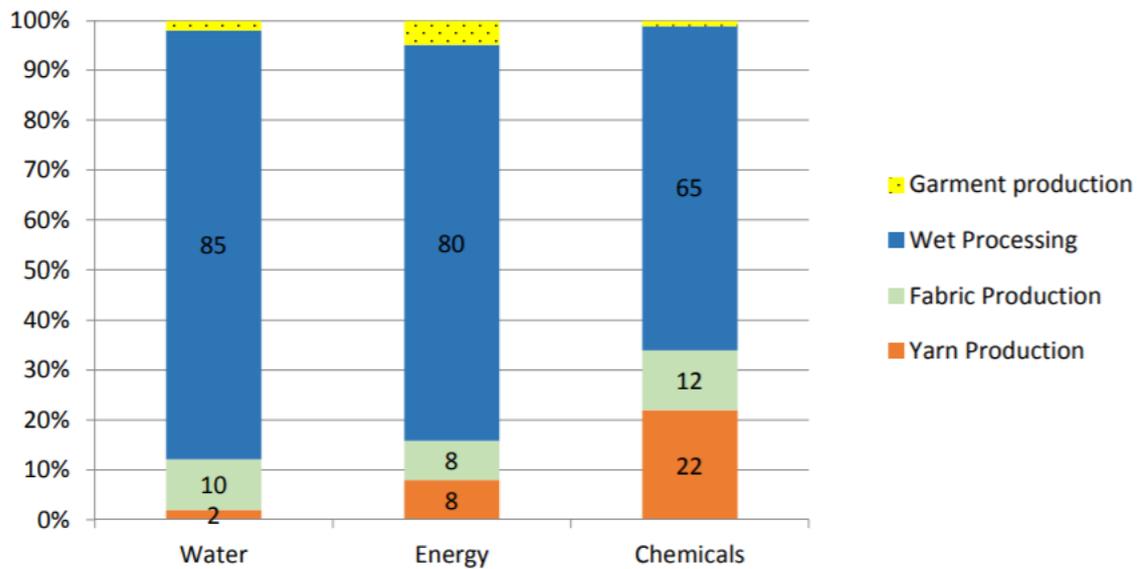


Figure 14: Environmental footprints of clothing industry (Restiani, n.d.).

There are some suitable niche practices are discussed in the below section to improve the different resource efficiencies and sustainability of the industry. Moreover, the role of actors for implementing efficiency practices is also taken into discussion.

5.1.1 Energy efficiency practices

The development of sustainability, technological innovation, and expertise is no more an option for Bangladesh rather a must move to the next level, create a decent working environment, and cement Bangladesh's position in a competitive outsourcing hub. Truly sustainable textile industry demands increased efficiency and productivity in their production lines (Henry-Gréard, 2019). With the economic growth rate, power demand in Bangladesh has increased in recent times. The average growth rate of power demand is 10% in Bangladesh, currently. The government of Bangladesh has set a target to raise the installed capacity to 24,000 MW, 40,000 MW, and 60,000 MW by 2021, 2030, and 2041, respectively (Begum, 2019).

Energy efficiency can be defined as the usage of less energy for the completion of the same task. It can be achieved through process optimization and replacing current technology with energy-efficient technologies (Hasan et al., 2019). Bangladeshi textile industries are substantially facing a shortage of gas and power supply. They are using natural gas as a gas

supply which will be run out by the next 16 years (estimated) as the demand is growing day by day according to the Petro-Bangla. In that case, liquefied natural gas (LNG) can be a sustainable alternative solution in supply of gas. The government has signed in an agreement with Qatar to import annually 2.5 Million tons of LNG for the next 15 years to meet the national demand of gas supply. However, the price hike can be a question for the utilization of LNG by the manufacturers in the industry. But considering the gas supply shortage, it can be good alternatives for the industry in supplying power sources if the price hike can be kept in tolerable level (bdapparelnews.com, 2018).

The generation of renewable energy in Bangladesh has huge potential considering countries' geographical location. The main renewable sources in Bangladesh are Solar Photovoltaic (PV), Hydropower, Wind turbine, Biogas, and Biomass. Among all renewable sources, solar energy has the brightest potential in Bangladesh. Bangladesh is called sunbelt country due to its tropical climate which has adequate sunlight for a breeding ground of solar power throughout the year. Bangladesh has more than 4.5 million units of Solar Home System (SHS) users (mainly rural areas) that make this country as the world largest SHS market (Bhuiyan, 2020).

Table 4 representing renewable energy plan of Bangladesh till 2021 which will contribute to the main grid lines of the country.

Table 4: Renewable energy plan of Bangladesh (Knaack et al., 2018).

Technology	2017	2018	2019	2020	2021	Total
Solar	120	350	250	300	250	1470
Wind	50	150	350	300	300	1153
Biomass	6	6	6	6	6	30
Biogas	0	0.5	0.5	0.5	0.5	7
Hydro	-	1	1	2	2	236

Total	176	507.5	607.5	608.5	558.5	2896
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According to the Infrastructure Development Company Ltd (IDCOL), Solar PV has 400 MW installed capacity in 1,500 members of the Bangladeshi Textile Mills Association who have 42 million square feet of rooftop space (Begum, 2019). A recent announcement by the Joules Power limited, a Dhaka based developer, will install a 3.1 MW solar rooftop on top of the multiple buildings owned by Rabintex Group, a textile company, which will be Bangladesh's largest industrial solar rooftop near the capital (Islam, 2020).

Moreover, a partnership agreement has signed recently between Omera Solar and local apparel manufacturer and exporters for installing a 2.6 MW capacity rooftop solar panel which will encourage other industry owners. These small initiatives will help to fulfill the country's ambitious vision of achieving \$50 billion exports by 2021 as well as provide a cushion against increasing energy costs and reducing greenhouse gas (GHG) emissions (Begum, 2019). Growing environmental conscious among the brands, adopting rooftop solar PV can be a representative as a sustainable company. The international competitive market is based on price and quality, savings of energy could contribute to this (Knaack et al., 2018).

The price of electricity from rooftop solar PV is up to TK 8.50 (\$0.10) per unit during daytime which is even fewer than the price of electricity, TK 8.56 (\$0.16) per unit according to the IDCOL which makes potential to generate 400 MW of power in textile mills from the rooftop (Correspondent, 2018). However, it cannot be denied that the textile industry requires a huge amount of energy but adopting solar energy in the textile industry offers control of operational cost which is one of the most critical elements. The solar plant not only helps to form better energy to run the machine but also keep ready for a power cut. Because the power cut happens very often in Bangladesh (Textile industry eyeing benefits of renewable energy like solar | The Indian Textile Journal, 2019). According to International Finance Corporation (IFC), by adopting rooftop solar, factories can minimize 5 to 20% grid power consumption. They also mentioned that the potential of the solar rooftop will be 109 MW across the textile industry in Bangladesh for an on-grid replacement which will reduce 98591 tonnes of CO₂ emission, leading to less air pollution.

The role of different actors such as government, private investors, factory owners, and other value chain actors is very important in the development of energy-efficient measures in the textile industry. To keep the competitiveness in the world-wide market, the government needs to make a balance in price hike of gas and electricity. They can think about some ways of indirect compensation like withdrawal of source tax or can be reduced corporate tax to make a balance by the manufactures for using such an alternative in their operation (bdapparelnews.com, 2018). To motivate private investors, a tripartite agreement between private owners, investors, and power companies needs to be added in Guideline Implementation policy which will encourage private investors to invest in solar energy. Moreover, financial benefits need to be declared for Solar PV developers to encourage them to generate power from renewable resources (Begum, 2019). Overall, energy management is required through implementing, monitoring, and examining the measures to ensure the least amount of energy for the same task.

5.1.2 Water efficiency practices

In modern times, energy efficiency became the rage keeping less talked about water efficiency in the industrial sector. Clothing manufacturing in Bangladesh consists of several steps such as yarn production, fabric production, wet processing (washing, dyeing, and finishing), and garment production (Hasan and Leonas, 2018). Bangladeshi garment factories use more than 250 liters of water, one of the highest water consuming factories country, for washing and dyeing fabrics to produce one kilogram of the fabric where the international best level is 70 liters. Wet processing unit alone consuming 1,500 billion liters of groundwater (GW) per year (Mirdha, 2017). As the availability of clean water is critical for the industry, groundwater is utilizing as the main source of it that decreasing the GW level at a rate of 2.5 m/year which is an alarming in overpopulated country like Bangladesh. Due to the lower water level, water pumping cost would be higher which will directly affect the production cost (Hasan and Leonas, 2018).

Not only groundwater but also surface water is under threat by the textile industry in Bangladesh. Textile factories discharge highly polluted effluent including salts, dyes, and bleaches which has the possibility to harm humans as well as pollute the environment. These

industrial effluents are discharged directly into the environment without treatment. There are a few factories have effluent treatment plant, but they are also unwilling to operate the plant properly to minimize operational cost. To keep industrial production growth rate upward and away from the threatening of the GW level, introducing and utilizing water efficiency practices and alternative water sources is a must needed move. Water efficiency practices will minimize both water supply and effluent treatment costs. Some practices are discussed below in detail.

Centralized Effluent Treatment Plant (CETP) has a significant positive impact on health and the environment. Treatment plant works to clean the polluted water discharged by the factory in a proper treatment way to meet the national standard, satisfy buyers, and most importantly minimize environmental impacts. Considering the level of effluent released by the Bangladeshi textile factories, treating wastewater by CETP is a must needed for all factories. The approach has the potential to enhance the monitoring and execution of compliance with environmental standards. It also offers cost-efficient recycling and reuse of effluent. The size of the plant will depend on the capacity of wastewater to be treated. Normally the consumption of water in different dyeing processes represents the volume of wastewater produced (Sagris and Abbott, 2015).

Most of the Bangladeshi textile factories have Effluent Treatment Plants (ETP) because they must submit the ETP plan along with details before getting site clearance from the Department of Environment (DoC) and it should be operating throughout the year. Few good textile factories follow the rules but still not up to the mark. Lack of technical expertise, unskilled personnel, and lack of willingness are the taken as main constraints for implementing CETP (Sultana et al., 2013). However, due to the sustainability concern by international buyers, this kind of practice is an urgent requirement for the industry. Different actors like government, private organizations, and factory owners need to play an important role in developing CETP.

Introducing **Enzyme**, another practice, in the production process can help to minimize environmental footprints of 2/3 of water and 50% energy during wet processing. It is a non-toxic alternative that saves energy, water, time, and money and improves overall efficiency

and productivity (Anam, 2019). Amylase enzymes (for removing starch-based sizing agent) helps to reduce the volume of harsh chemicals during production that minimize chemical discharged into the environment and improved the quality of fabrics. Cellulase enzyme helps the jean industry to reduce and eliminate uses of stones without damaging the garments and giving new looks according to consumer demands. These biological solutions facilitate to get sustainable fabrics, prolong the lifetime of clothes through improving quality, strength, and appearance (Enzymes in the textile industry, 2007). Enzymes are safer for employees and the environment. Towards sustainable textile processing, enzymes are a win-win for everyone (Textiles, 2020). The utilization of enzyme solutions can be strengthened by developing a local formulation. Though import tax for enzyme raw materials is high that makes it less attractive for manufacturers. However, considering substantial environmental benefits of enzymes textile processing, lowering import tax can create huge opportunities for the Bangladeshi RMG industry (Anam, 2019).

Sourcing alternative water practices need to be explored to keep water efficiency in line. Here, some alternative water sources are given that might be useful considering the climatic condition and industrial aspect in Bangladesh.

Wastewater reuse

Bangladeshi textile industry releases a huge amount of wastewater into the environment without treating them. Wastewater reuse, an alternative approach, offers the opportunity to treat effluents for reusing which can save energy, water, and chemicals. In that case, the quality standard of alternative water supply needs to be ensured so that they are clean, safe, and appropriate for the intended use as different factories might have the presence of impurities in the water supply. For the successful implementation of wastewater reuse technique, partnership, and collaboration of different stakeholders across the sector is needed (Sagris and Abbott, 2015).

Rainwater harvesting

Rainwater harvesting is another alternative practice to meet water demand and reduce groundwater abstraction. It works by converting rainwater that falls on roofs, collection

surfaces of a factory, or property and keeps in store for processing by a relatively simple technology for later use on site. The uses of the rainwater harvesting technique offer a link to urban sustainability which is important for local solutions and sustainable development. The unpredictability of the water supply by the rainwater harvesting technique may not offer an absolute solution but could meet part of the water demand of an industry. Investment is needed to ensure future water supply and effluent standards to make anticipated growth (Sagris and Abbott, 2015).

Groundwater recharge

Bangladeshi industry mostly dependent on groundwater supply that makes water scarce in many regions especially in factories areas. The groundwater level is dropping day by day due to the overexploitation of freshwater. So therefore, artificial groundwater recharge from stormwater runoff in industrial areas could be used to augment the GW situation. It spreads the natural movement of surface water by suitable structures into the groundwater reservoir. To improve the groundwater situation, the government should implement a large scale of aquifer storage and recharge schemes which will improve stormwater infiltration and reduce flooding (Sagris and Abbott, 2015).

5.1.3 Chemical & material efficiency practices

Considering sustainability in the textile industry, the importance of materials is inevitable. Because they are the beginning point for creating a product sustainable. Sustainable product designing should begin by considering more resource-efficient, social, and environment-friendly products from raw materials to final products. So, towards sustainable textile development choice of recyclable and resource-efficient materials should be given in priority. There are mainly two types of fiber used in textile production and these are natural and manufactured. Natural fibers consist of animal and plant resources whereas manufactured fibers are from synthetic materials. Mostly used textile fibers are cotton and polyester contribute around 80% textile market in all over the world. However, only a few attentions can be seen in the diversity of material used by the manufacturer. They should give attention to a variety of fibers that are more resource-efficient such as recyclable cotton,

organic cotton, hemp, and flax that uses fewer pesticides and water during production (Ali and Sarwar, 2010).

Recycled Cotton

Conventional cotton production requires a huge amount of energy and pesticides and it harms the environment as well. A more sustainable alternative of conventional cotton is organic cotton which has been booming since the last few years as it reduces harmful chemicals and pesticides during the production and helping on minimizing environmental impacts. In that case, recycled cotton is the best alternative for both conventional and organic cotton. Recycled cotton has the potential to minimize water and energy consumption and keep clothes out of landfills. That is why it is seen as the most sustainable fibers in the market (Rauturier, 2019).

Organic Hemp

Hemp is one of the oldest fibers are grown all over the world. It takes few waters, no pesticides, and make the soil naturally fertilize. It helps to keep warm in winter and cool in summer for that reason it considered as one of the most sustainable fabrics (Rauturier, 2019).

Organic Linen

Linen is another sustainable fiber that takes less water and pesticides and can grow in a poor quality of soil as well. It is strong, moth resistant, fully biodegradable when untreated and all parts are usable. As there are fewer environmental impacts, linen is one of the options to make clothing sustainable (Rauturier, 2019).

Bangladeshi textile mills dependent on imported raw materials, mainly cotton. The country imports more than 95% of cotton from 42 different countries to meet the export demands of the textile industry around the world (Hossain, 2018). As the export earnings are increasing, the demand for raw cotton also going high. Now to meet the sustainability demand of international buyers, looking for a sustainable cotton firm is a vital issue. Raw material importers need to ensure imported cotton is made in a sustainable way that usages less water, less energy, and fewer chemicals and pesticides. Moreover, searching renewable raw

materials rather than finite raw materials will typically give products with less carbon footprint and lower greenhouse gas emissions. Furthermore, creating green textile chemicals will offer lower impacts on the environment without compromising on performance. Chemical suppliers as an actor need to take initiatives to ensure green chemicals which usages fewer resources and will not impact on the environment to increase material efficiency towards sustainable textile production (Correspondent, 2017).

5.2 Transition pathways of Bangladeshi textile industry

In the above discussion, how Bangladeshi textile industry can be productive through meeting environmental challenges by introducing and utilizing different sustainable practices are studied. Now the question is how this sector can be more productive through system transition pathways? To answer this question, a transition storyline has developed towards a good textile industry through the collaboration process.



Figure 15: Transition pathways for a good textile industry (Buchel et al., 2018).

These above six transition pathways symbolized an inspiring guideline for motivating actors to move through a systematic transformation towards a good industry. By developing each pathway and improving coordination, optimizing strategies, and taking a variety of actions in a short-term, medium-term, and long-term basis through shared goals and interventions, a good fashion industry is possible where standardization will maintain. All these pathways are not exclusive but should develop as each other covers different parts of the industry that are needed for transition. To enable transition, four underlying conditions need to be changed

as the term transition defines a fundamental change of systemic power and value chain of the industry. The shaping principal of four underlying conditions is given below.

■ = Power

- **Connected:** In the value chain of an industry, different value chain actors connected as a partner in a long-term relationship, as value chains are transparent and traceable. They share both ownership risk and profits in their value chain.
- **Accountable:** A industry is accountable by the other actors regarding environmental and social issues. Transformative changes created by different actors like government, NGOs, customers, and the company through rules, taxation, proclamation, and financing. In that case, workers are liberated through wages, education, and equality.

■ = Value

- **Internalized:** The industry considers and takes care of its eco-system and communities on which they rely on. Internalized consists of cost, benefits, impacts in design, decision, and price making.
- **Valued:** The materials that go into the industry are valued by the society which appreciates by the industry through designing circular product cycles. Customers treat as valued products by maximizing the usage of fashion products. (Buchel et al., 2018).

5.3 Analysis of the pathways

In this section, the above mentioned six pathways will be analyzed in detail along with the changes needed for accelerating the transition pathway. The lever of changes will be analyzed against proof of concepts, promoting demand, capacity developing, transparency & accountability, and advocacy in which different actors play roles by coordinating, mobilizing, and contributing to transformative changes in the industry (Buchel et al., 2018).

Transition pathway 1: New value chain models

In this pathway, different supply chain actors shift supply chain from a disconnected, obscure model to a new model through building a partnership relationship by connecting, mutually understanding, and co-investing in the supply chain innovation for building high sustainable performance. This is called the transformation of the business to business relationships through long term collaboration. Supply chain partners allocate the resources to improve capacity for radical innovation, strategic investment so that all other actors can be able to change their business as well. They share investments, profits, losses, and work together to increase the overall performance.

Needs for change:

- Proof of concepts: The concept of the above supply chain needs to be design and experiment by involving all actors from fiber suppliers to retailers on a short transparent basis.
- Promoting demand: The demand for circular fashion can be promoted by launching campaigns by involving local actors.
- Capacity developing: To develop a profit-sharing model, capacity building, and financing to suppliers, workers are needed. Moreover, improve the leadership capacity through launching programs for retailers, suppliers that will help to collaborate with supply chain actors.
- Transparency & accountability: Increasing transparency & accountability of the environmental and social issues of the supply chain will help to measure and improve the performance.

Transition pathway 2: Workers exercising their rights

Workers negotiate about their rights including hiking wages, equality, better working environment, safety, and healthier working condition for themselves as well as their communities. The authority of the industry will bargain through freedom of speech of the workers and negotiates their rights with the governments. All of these should be publicly disclosed so that owners and buyers can be accountable regarding their rights. Developing countries like Bangladeshi textile workers have less access to exercise the rights that keep them out of basic facilities sometimes. They are paying low wages despite their contribution

to the economy. By this pathway, workers will be able to negotiate their rights with the authority through forming a labor union.

Needs for change:

- Capacity developing: Workers' skill on different tasks of the factory including manufacturing task to circular technological task can be improved by educating them through launching training programs in the factory. So that they can be skilled in quality production and adapting their wages according to that.
- Workers unions: Civil society helps workers to form and connect labor unions and other collectives to international unions and initiatives. As a result, they will have a common platform to talk and share their insights with others.
- Advocacy: Civil society, private actors facilitates workers to demand the government to implement legislation regarding the rights and benefits of the worker at a local and international level.

Transition pathway 3: Holding the industry to accounts

The industry has no longer self as the government is controlling the environment for its citizen against waste, pollution, exploitation of natural resources. Hence, stricter environmental legislation for manufacturing practices is implemented. In that case, the company's progress and prosperity are measured by transparency and traceability tools so that it can be publicly disclosed which will give them free access to the detail of impacts, origins, cost & value of the products to the consumers, governments, and supply chain. As a result, more shared power relations will be shifted from company to the government, NGOs, and citizens that will help all to induce change.

Needs of change:

- Promoting demand: To increase the awareness of the negative issues of the industry and mobilize citizens involving different new media like content creators, online apps is needed which will bring a positive attitude to the consumer demands.
- Community voice: Civil society and other actors who involved with industry will facilitate communities to raise their voice against pollution from the factories or enable to access water and energy.

- **Transparency & accountability:** Transparency of the data will enable the government, NGOs, and citizens to access and use it for demand accountability.

Transition pathway 4: Product and manufacturing innovation

Different niche technologies and practices are adopted and scaled for circular production of the industry so that the industry can use clean materials for sustainable production processes. They allocate resources for sustainable design, radical innovation by enabling capacity for transformative changes. In this transition pathway, a circular system is introduced through closed the materials loop and keeps the end-of-use stage in the design process of a product. Products are designed and made in a way that it can be wear and re-used for a longer period than the foster circular economy. The industry will use sustainable raw materials and reduce the usages of chemicals in its production process. They will introduce radical innovation for ensuring sustainability while released their discharge from production processes. By utilizing breakthrough technologies towards material recycling will help to reduce the sourcing of unsustainable materials.

Needs for change:

- **Proof of concepts:** Different actors such as CSR organizations, NGOs facilities a common design and standard selection of materials through collaboration and joint implementation on a large scale. Need to develop a shared technological innovation program between innovators and frontrunner companies like retailers, suppliers to select key innovations for creating large scale critical mass such as green chemistry, product traceability, and so on.
- **Promoting demand:** Fashion industry actors like brands, manufacturers will pool demand for market-ready innovations to overcome problems related to supply demand.
- **Capacity building:** Companies will reward their employees for their effort towards minimizing negative impacts and creating a circular design to motivate them for better output. Frontrunner innovators will work with mainstream companies through a strategy to show them the problem and opportunity of change. So that those companies are not yet frontrunners will bring niches to the regime players to contribute in good fashion.

Transition pathway 5: Natural capital approaches

In this transition pathway, companies will provide free access to the details cost of materials, environmental impacts, and cost of origin through natural assessment and radical transparency to the public. This will be done to give the value of resources, ecosystems, and the environment used in the industry. It will also facilitate financial actors to make investment strategies and help the government to imply environmental policy, and taxation. In that case, the company must decide to what extent the data will be transparent throughout its supply chain.

Needs for change:

- **Capacity building:** Different organizations like NGOs, CSR organizations, the sectoral organization in civil society have to arrange a training program to train supply chain actors to motivate them for using natural capital measuring standards and reporting to report the supply chain impact throughout their supply chain. Moreover, training also need to be introduced for brands, suppliers, manufacturers to increase their leadership ability to use natural capital approaches while dealing with buyers.
- **Transparency & accountability:** Using natural capital assessment and standard, most of the large-scale companies publish their supply chain and impacts to third parties. In that way, others need to make transparency about their supply chain and impacts.
- **Advocacy:** Creating advocacy by the manufacturers, brands, suppliers towards government by initiating joint advocacy will help to produce externalities, stimulate job creation, creates a circular cycle. However, advocacy will help to ban the landfilling of textiles.

Transition pathway 6: New business model

The current industry model is following the strategy of take-make-waste that encourages short-term use by the consumers which need to be changed to a new model where the circular economy will be given priority. This pathway will shift the dominant business-to-consumer model where people will give less priority to the owner than the use, quality, and longevity of the products. Therefore, manufacturers, suppliers will not only work on the profit margin

model but also take on new roles. The roles will enable manufacturers to use recycled raw materials, sell high-quality products to the customers. Introducing new service models will design the product in a way that can be performed for longevity. Renting and resale are also can be taken into consideration as a new business model for brands.

Needs for change:

- Proof of concepts: Introducing fashion as a service has promising niches and nature for valuing materials in a whole supply chain. Large-scale companies could shift fashion as a service which will help others to invest in new business and services. The new business model can be stimulated by introducing technologies and processes by larger companies.
- Promoting demand: A new business model can be promoted by branding, marketing, and using different social media that will encourage consumers about sustainable consumption and new fashion services.

5.4 Result

Transition 1: Benefits toward sustainable transition

The current system of fashion is unsustainable, disconnected, and disposable that demands a substantial systematic change. New value chain models will result in system change in supply chain management by introducing sustainable radical innovation, strategic planning for building a high sustainable performance for the industry. As raw materials are imported, importers should collaborate with raw material manufacturers to motivate them for sustainably producing materials. On the other hand, well co-ordination is needed between suppliers and buyers where green transportation is used to deliver the products. Green transportation such as electric vehicles or using converted natural gas will save the environment and fulfill sustainable supply chain business. In that case, mutual collaboration, and co-investing are required which will result in the overall improvement of the supply chain system strategies.

Transition 2: Benefits toward sustainable transition

Exercising workers' rights will enable them to improve the worker's condition, their wages, and a living standard that boosts the overall productivity of the industry. There is discrimination on fair payment among the workers and payment due arise unrest inside the workers. Fair and on-time payment will reduce discrimination and increase productivity. Job security is an important factor while exercising labor rights because workers are a thread of losing jobs if they raise their voice. Therefore, workers need training and education to increase their skills and leadership ability to form a strong labor union to speak out about rights. Workshop and training about sustainable production will help workers to understand sustainability in the production line resulting in sustainable transition that will happen in the industry. Moreover, safety working environment is another basic right of the workers that need to be ensured to reduce the causes of accidents. The working environment should be an ideal place where factory buildings and surroundings are in good condition like air quality, noise level, and so on.

Transition 3: Benefits toward sustainable transition

The industry has huge environmental impacts such as water pollution, air pollution, and exploitation of natural resources. Holding the industry to accounts will help the government to implement tight environmental legislation against the pollution happened in the industry. As a result, companies will be aware of their possible impacts from their production and pollute as less as possible which will motivate owners to shift from unsustainable to a sustainable industry. At the same time, transparency of the data will encourage consumers to change their consumerist culture to durability, longevity usages. Consequently, less environmental pollutions will come from the industry. Government, NGOs, and consumers can raise their voices against pollutions from the industry and the industry will be accountable for that.

Transition 4: Benefits toward sustainable transition

Product and manufacturing innovations are badly needed for the Bangladeshi textile industry as the system of manufacturing is still obsolete. Old and traditional production systems delay the overall production and delivery of the products. Thus, the production system should be changed from old to new technologies. In this transition, transformative changes will enable

to introduce niche technologies that result in the circular production system of the industry from using sustainable raw materials to the recycling of the end products. Moreover, radical innovations will help to treat wastewater from the industry before discharging into the environment resulting in less environmental pollutions. Consequently, positive images will arise among the industry which will attract foreign buyers.

Transition 5: Benefits toward sustainable transition

This scenario will help the industry to become more sustainable through valuing natural resources, and ecosystems, using sustainable materials by implementing natural capital approaches where data of the company about the different cost, and environmental impacts will be available. Transparency of the data will pressurize the industry to change their production strategies and natural assessment helps the government to tighten environmental policy against environmental pollution from the industry. The industry in the whole of their supply chain management will be accountable and transparency that prompts actors to make sustainable reporting of the industry which will facilitate buyers to know the sustainability of the industry.

Transition 6: Benefits toward sustainable transition

In this scenario, a new business model is proposed where quality, the longevity of the products is given priority rather than short-term, less quality of the products. Moreover, the recycling of end-use products is also taken into consideration that will make the industry circular. This transition offers an opportunity to shift from a traditional business strategy to a new business model where not only profit margin will consider but also environmental norms & values. This strategy is effective especially in long-term processes by the large-scale company that will inspire others to invest and follow the same path.

These transitions will not only mainstreaming alternatives but also adding and scaling existing regimes that have transformative potential. Scaling a business model like fashion as a service will incumbent regime and work as a fostering stone for valuing materials in the whole value chain. Increasing the skill of the workers by introducing different programs will help to make them more productive in a sustainable production line. When the industry will

transparency and accountable for the impacts help consumers to have access to the original cost, and the value of the products that will increase their concern to change their attitude. Using renewable energy & materials and improving wastewater treatment facility will regenerate the natural ecosystem. Hence, the industry must need to shift from a systemic power relation and value model through systemic transitions. Systematic change can be accelerated through connecting innovations and initiatives with others so that not only the circular design boundary of the products is considered but also their end-use. These transition pathways will enable actors to make a framework and take initiatives through transformative efforts to accelerate transitions to a good fashion. It will encourage them to seek and develop different strategies to shift the sector in the next level of transition through embedded regime and emerging niches technologies.

5.5 Discussion

In the present industrialization era, the sustainable manufacturing of products is getting popularity. Nowadays, product quality is not only focusing on issues by the consumers rather from cradle to grave of the manufacturing processes are taken into consideration. In that case, adopting cleaner and eco-friendly technology is an emerging issue for sustainable manufacturing. Systemic transition is inevitable to keep pace with the current competitive world. Most of the Bangladeshi textile industries are running with old machinery, unskilled workers, unfavorable working conditions, and manufacturing in an unsustainable way. They are accelerating environmental footprint through unsustainable raw materials consumption, pollution, and discharging wastewater into the environment. Labor unrest regarding the wages, payment due, suitable working conditions are common issues. These issues-driven the need for transition for a circular system. Transition pathways mentioned in the analysis will combine different aspects for innovative design, technologies, exercising labor rights, and raw materials used to minimize waste and pollution and bring good impacts towards the whole value chain of the industry. Result findings, it is needed to interact systematically both niches and regimes for optimization and experimentation to avoid difficulties. But the challenge is now how to play with this pathway to make a sustainable transition of the industry? Further research is needed to analyze the potentiality and impacts of the transition through collecting data. So therefore, all actors must participate in a long-term process to accelerate niches. The reliability of the research can be reproduced after the effective

implementation of the niche technologies and transitions mentioned above and collecting the data in the end is needed for the industry to make sustainable change. The validity of the research setting, analysis, and results correspond to each other which is reproducible if further research considers the potentiality of the niches technologies and the transitions for the industry.

6 CONCLUSIONS

The main goal of this master thesis is to find out the dimensions of sustainability transition of Bangladeshi textile industry through transition knowledges. The current industry is unsustainable, disconnected, and disposed of through landfills. Three resources energy, water, and materials are mainly exploited during the production of garments and treated in an unsustainable way that polluting the environment. Considering environmental footprints, these three resources need to increase efficiency. In that case, introduce sustainable practices for each resource efficiency might be the solution in the current context of the Bangladeshi textile industry for making sustainable fashion. Factories should focus more on water efficiency during production as a huge amount of wastewater discharged into the local river without treating which polluting and contaminating nearby areas. In addition, there are some supportive factors recommended further for improving the overall productivity of the industry. Along with sustainability, the industry also requires making change in their production strategies through introducing systemic transition knowledge to make a good industry. Systemic transition helps to innovate design, technologies, and raw materials used to minimize waste and pollution and bring good impacts towards the whole value chain of the industry. Therefore, transition pathways are discussed to make a guideline for the actors for improving the industry. These six transition pathways will connect industries and improve workers' rights resulting overall productivity of the industry. To stay viable in foreign markets, a transformative systemic transition is a must needed for Bangladeshi industries. It will encourage foreign investors to invest more in this sector rather than sourcing others. As Bangladesh garments sector have an ambitious goal of achieving export earnings of \$50 billion and \$66.25 billion by 2021 and 2030 respectively, constraints must be fixed otherwise will be difficult to meet the goal. Therefore, it is high time to make sustainable transitions of the industry and keep a favourite sourcing destination through improving images in international buyers.

6.1 Supportive works towards succession

In this section, some supportive factors are recommended based on the above discussion for the industry which is needed to consider along with others.

6.1.1 Green pricing

Despite the highest number of green factories in the world, the ethical absence of green pricing showed by international buyers who always demand sustainable production. To make LEED-certified green factories which symbolized sustainability achievement, manufacturers had to invest more that increase overall production cost but there is hardly found sustainability pricing and purchasing practices by the brands. Even sometimes buyers agreed to pay more but changed their minds in the end. Experts are suggesting for making transparent supply chains and purchasing practices by the brands and suppliers. Moreover, buyers should pay an appropriate price for garments that producing clothes in sustainable ways or factories that certified by the LEED. There should be a mechanism that will represent a win-win combination between buyers and suppliers which will help to be an increased number of green factories (Khan, 2019).

6.1.2 Raw materials production

Bangladeshi garment industries are mainly relied on imported raw materials. Most of them are imported from China, Vietnam, and Indonesia. Imports dependency creates sourcing risks and lengthier lead times. The average lead time of fabric is seven days in Bangladesh while it goes up to 15 and 30 days when sourced from Indian and China, respectively (Islam et al., 2016). Hence, unnecessary production and process time extends. To get rid of this, manufacturers should focus on local suppliers to reduce unnecessary lead time. Raw materials for knitted garments can be meet from the local market according to the BKMEA. Therefore, the government should give incentives to local producers for developing a local supply chain. Producing and utilizing local raw materials will help to reduce the delivery time of the product and when it is produced sustainably, it will minimize the impact of the environment.

6.1.3 Research and Development (R&D)

Due to the lack of R&D, Bangladeshi RMG factories are producing a basic fashion style by focusing on mass production. Products are delivered according to the international buyer's

chosen without any brightness. However, the fashion world is rapidly changing, and the diversity of trends is shown by the consumers. Therefore, the importance of R&D is inevitable to secure future competitive global market. It will work in innovation, marketing & production, quality, and cost & pricing to improve the overall RMG industry. When R&D of products and design are done will help to minimize the input and reduce the wastage without compromising of profit. It will increase production efficiency and reduce resource efficiencies (George, 2020).

6.1.4 Direct foreign investment

Direct foreign investment is playing a considerable role in economic growth and the GDP acceleration of Bangladesh. It helps to create employment, technology up-gradation, and new exportable sectors. Though several reasons including political instability, poor infrastructures, labor unrest in the RMG sector decreased investment in the last couple of years. However, various positive attributes are done by the government in recent times to attract foreign investors. Now, the country has political stability, improved working environment, and increased labor wages that drawing the attention of investors from all over the world. The highest number of green factories in the world increased images of the RMG industry to foreign investors. More foreign investment is needed for the succession of the sustainable transition of the Bangladeshi RMG industry in the current context.

6.2 Limitations and future research

The main limitations for this thesis are identified as the absence of previous theoretical research work and related data regarding sustainable system transitions in Bangladeshi textile industry. There is research on sustainability, but hardly found previous work which uses the concept of sustainable system transitions for Bangladeshi textile production. Therefore, there was limited availability and accessibility of the resources.

As sustainable system transitions are long-term processes that need time for retrieving data which was not possible to cover in this work. Hence, this thesis has only focused on the introduction and potentiality of the resources for sustainability and system transitions that

are needed for making a good textile field in Bangladesh. However, more research needed in the future to understand the utilization potentiality of those resource practices by observing the result. It is advisable to collect empirical data of the resource practices to give further recommendations about their potentiality in considering social, economic, and environmental dimensions and the positive impacts of the transitions. This will also help to motivate industry owners towards sustainable production in the future.

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