Barriers to green supply chain management: An emerging economy context

Abstract

Green supply chain management is attracting increasing attention as a way to decrease the adverse environmental effects of industries worldwide. However, considering the context of an emerging economy like Bangladesh, green supply chain management is still in its inception and has not been widely embraced in the textile industry, and therefore barriers hindering its adoption in emerging economy context demand a comprehensive investigation. This research reviews the viewpoints and hurdles in adopting green supply chain management practices in the context of the Bangladeshi textile industry. A questionnaire survey of Bangladeshi textile practitioners of operations and supply chain management division, having a sample size of thirty, was undertaken to identify the barriers, and a hierarchical cluster analysis technique was used in the detailed analysis of this data. Opinions were sought from experts on the significance of the resulting clusters, considering the relative importance of the barriers. Fifteen barriers to the adoption of green supply chain management were identified in the review of the literature, with these barriers then analyzed by using the data collected from Bangladeshi textile industry practitioners. The research indicates that the most important barrier is that there is low demand from customers and financial constraint resulting from short term little financial benefit to businesses, with lack of government regulations also a commonly faced barrier in adopting green supply chain initiatives. This study will provide valuables insights to practitioners and relevant policy makers about the barriers prevailing in the emerging economies towards the adoption of green supply chain management practices, which, in turn, can guide to undertake appropriate steps for alleviating those barriers.

Keywords: Green supply chain management process (GSCMP); Hierarchical cluster analysis; Textile industry; Emerging economy.

1 Introduction

The global textile industry is a complex industry consisting of agricultural, chemical industry, cotton manufacturing, synthetic fiber, clothing, retail, logistics and waste disposal units (Beton et al., 2014). Processes of the textile industry have long been criticized for being the major

contributors of harmful environmental activities including high volume wastage of non-renewable resources, global warming, and the heavy use of pesticides and harsh toxic chemical materials (Alay et al., 2016). These processes and use of several chemicals not only increase environmental concerns, but also create greenhouse gas emission, cause depletion of water and resources, acidification and several health problems (Alay et al., 2016); (Roos, 2015a). As a result, the textile industry feels the pressure to implement environmental-friendly supply chain processes due to increased public awareness and government regulations (Diabat et al., 2014). In such environment-friendly processes, manufacturers generally include those components, which impose least negative impact on human health and environment during production, consumption, conservation, and disposal of the textile products. Green supply chain management process (GSCMP), which considers the safety of the environment at every phase of the process, is considered to be an effective method of decreasing the adverse environmental impacts of the production of textile products (Roos, 2015b). Moreover, adopting GSCMP can help textile companies save huge operational energy, cut costs, improve efficiency and reduce the amount of toxic waste generation (Oliveira et al., 2018). Furthermore, to assert the better business opportunities and gain a strong market position by creating a sensation of good brand image amongst the consumers, adoption of GSCMP is a must (Ageron et al., 2012).

Although there are many advantages related to green supply chain adoption, the textile industry of emerging economies has not yet embraced it widely, rather still in a pre-mature state of adopting GSCMP (Nayak et al., 2019). For example, among the textile companies in Asia, where a large volumes of textile products are produced, very few are concerned about recyclable and renewable materials (Islam et al., 2018). Given that emerging economies play a substantial role in textile production, it has become imperative to understand which factors impede the adoption of GSCMP in such countries. However, there is a lack of studies on the barriers of GSCMP adoption in the textile industry of emerging economies (Majumdar and Sinha, 2019). On the other hand, there are many studies that discusses the barriers of GSCMP either in the context of other industries, such as agriculture or automobile, or in the context of developed economies (Blok et al., 2015); (Kaur et al., 2018); (Lorek and Spangenberg, 2014); (Oliveira et al., 2018). Due to the unique characteristics of the textile industry of the emerging economies, the findings of the other set-up may not be applicable in this context (Routroy and Shankar, 2014), and need a context-focused study to explore the barriers of GSCMP.

Therefore, this study aims at exploring and analyzing the barriers of GSCMP in the context of an emerging economy. The study uses Bangladesh, a country of South Asia, as an example of emerging economy to analyze the barriers of GSCMP to supplement the knowledge gap in this regard. The study uses Bangladesh as this country is among the leading producers and exporters of textile products and as a result is more critically subjected to the adverse environmental effects of textile production (Angel et al., 2015). Moreover, similar to other emerging countries, textile practitioners in Bangladesh have low environmental consciousness; although some have incorporated initiatives in their business strategies, the majority are still ignorant of the environmental effects of their industrial activities (Majumdar and Sinha, 2019). Moreover, in Bangladesh, there is a negligible amount of research that analyzes barriers to the adoption of GSCMP in the textile sector (Islam et al., 2018). Bangladesh has achieved noteworthy economic expansion in the last few decades and textile industry is one of the major contributors to this economic growth. Considering the harmful effects of the industrial processes of textiles on the natural environment, it has become acute for the Bangladesh textile industry to adopt immediate measures towards greening their supply chain and mitigating the barriers associated with it (Jayaram and Avittathur, 2015). However, the mitigation is not possible until the barriers are clearly identified and analyzed to understand which barrier is more critical than others. Once these are done, the practitioners and the policy makers of the industry would be able to undertake proper strategies to alleviate these hurdles.

A detail analysis is done to identify the most common and critical barriers using the hierarchical clustering analysis. This technique is used to identify the barriers in considering their association and thus it removes the weakness of evaluating the barriers using the traditional quantitative approaches. Where traditional methods evaluate the barriers only considering their relative importance, hierarchical cluster analysis technique evaluates the barriers from two perspectives: first one is that it measures the influence of each barriers on GSCMP by considering the relative importance and the second one is it considers the variations in opinions among the respondents regarding the importance of the barriers. Further analysis is done to find out the possible reasons of opinion divergence among the respondents about the same barrier, which barriers are critical for certain practitioners (opinions divergence barriers) and which are the commonly faced critical barriers for all the practitioners (the consensus barriers).

In doing so, the study contributes substantially to the scarce literature on the barriers of adopting GSCMP in the textile industry (Majumdar and Sinha, 2019). Specifically, the study adds to the literature on emerging economies by identifying and providing the barriers of GSCMP. This will help to differentiate the ways textile industry of emerging economies face barriers to implement GSCMP when compared to textile industry of developed countries and other industries of the emerging countries. Moreover, the study analyzes the barriers to identify the most common and critical barriers in this regard. Previous studies in the context of other industries or environmental set-up totally different than emerging economies already provided dissimilar set of critical barriers of adopting GSCMP. For example, while Gold et al. (2013) mention two most critical barriers towards the adoption of GSCMP are disintegrated supply chain and illiteracy of business practitioners about the advantages of GSCMP adoption, Blok et al. (2015) report that the lack of appropriate methods, tools and techniques to address environmental effects are the most crucial barriers of the implementation of GSCMP. These divergent findings suggest the need of an in-depth analysis in the context of the textile industry of the emerging economies to ensure that the findings are truly reflect the industry and context. Furthermore, by employing hierarchical cluster analysis this study differentiated between opinion divergence barriers and opinion consensus barriers, which is a unique contribution of this study.

The remainder of this article is structured into six sections: Section 2 contains the related literature review; Section 3 elucidates the methodology of our research; Section 4 presents the data survey results; Section 5 discusses the data analysis; Section 6 presents the discussion, implications and contributions of the study findings; and the conclusion, along with future research directions, of the study is given in Section 7.

2 Literature Review

2.1 Conceptualization of Green Supply Chain Management

Green supply chain is a concept that is gaining increasing popularity day by day because of its commitment to sustainability for the companies (Oliveira et al., 2018). Green supply chain is seen not only as an enabler of environmental enhancement like reduction in usage of chemicals and toxic materials, energy consumption, waste generation, air pollution etc. but also it boosts economic performance and competitive advantage (Rao and Holt, 2005). Green supply chain management demands integration and co-ordination of the business segments and strategy

alignment which includes inbound logistics, internal supply chain and production process, outbound logistics, reverse logistics, customer requirements, responsiveness, quality and efficiency.

Introducing green supply chain practice in different segments of the business process results in a coordinated green supply chain. Green supply chain yields better environmental and economic performance in the individual supply chain partners which results in overall improvement of the business organization (Green et al., 2012).

2.2 Emerging economy

Emerging economy illustrates a nation's growth of economy due to rapid growth of industrialization and increased business with other countries. Developing countries with emerging market economy have become a hub for international business. Due to low manufacturing cost many giant companies have shifted their manufacturing plants in such countries. As a result, those countries enjoy cross border trade and redefined international regulations. Such nations are experiencing an influential role in world economy. However, unlike developed countries where the market is mature, many emerging market economies are volatile and are subject to uncertainty (Chowdhury et al., 2019). Moreover, emerging economies have lack of environmental awareness, and, hence, are lagging to adopt green practices in the supply chain. Therefore, emerging markets poses a higher threat to the environment (Mani et al., 2018), however, adoption of GSCMP can rectify the threat (Moktadir et al., 2018); (Pandit et al., 2017).

Bangladesh, as an emerging economy, is not an exception, rather poses higher threat to the environment due to lack of sustainable practices. In the country, textile industry plays the key role in the economic advancement as it contributes significantly to export earnings and creates substantial employment including women employment (Cheng et al., 2018). Moreover, because of cheap labor, quality product and availability of modernized transportation system, many famous fashion retailers have concentrated their manufacturing operations in Bangladesh (Huq et al., 2016). Although currently the industry has the lack of environment concerns, it has huge scope for implementing sustainability practices, including minimization of waste generation and energy consumption, resource conservation, reuse and recycling, and therefore the potential to adopt sustainable business practices (Islam et al., 2018). In order to utilize this potentiality, Bangladeshi textile industry needs to properly identify and analyze the barriers of GSCMP.

2.3 Barriers to green supply chain management in emerging economy

Green supply chain management has not yet been popularized in emerging economy like Bangladesh (Ali et al., 2017). The textile industry is an important labor-based, export-oriented sector in Bangladesh (Ahmad et al., 2018). Many foreign investors are attracted to investments and projects in Bangladesh due to cheap labor and low cost of products. For example, Berg et al. (2011) reports that 80 per cent of European and American brands are planning to move their production plants from Chain to Bangladesh due to low cost of productions. The contribution of this industry to the Bangladesh economy is also increasing day by day (Bangladesh Economic Review, 2018). However, this growth may not sustain in the long run if the manufacturers of the industry do not adopt green practices. This is because buyers of the developed countries are increasingly becoming aware about the environment and providing stringent environment requirements before making contract with the suppliers of emerging countries (Biju et al., 2015). Some of these buyers are even ready to pay more and shift their production plants from low-cost countries to comparatively higher cost countries to ensure that they maintain sustainable practices in sourcing (Luthra et al., 2014). The current scenario is not pleasing for the Bangladeshi textile manufacturers as they lack the sustainable practices in their supply chain (Rakib et al., 2017). This suggests an study to find out which factors hinders the adoption of GSCMP in the textile industry of Bangladesh.

Through a comprehensive literature review, the following sub-sections identify the common barriers encountered in GSCMP adoption. The barriers were categorized from the perspectives of government rules and regulations, characterizations of green materials, business organization, market demand, and lack of standards and the flow of raw materials. We then listed the barriers specifically encountered in the Bangladeshi textile industry.

2.3.1 *Government policy*

The success of encouraging green initiatives in industrial sectors profoundly depends on governmental policies (Lorek and Fuchs, 2013). Often policymakers find it difficult to address the pattern of unsustainable consumption and how to encourage the development of sustainable consumption (Tseng et al., 2013). Cooper (2005) stresses the importance of Life Cycle Analysis (LCA), which is an assessment technique to determine the impact of associative stages of a product's life from the extraction of raw material to a disposal, to understand whether to emphasize

waste reduction or to lower energy consumption. Blok et al. (2015) suggest that governments should emphasize on incentive programs rather than rules and regulations to encourage the industries to adopt green supply chain initiatives. O'Brien and Li (1999), recommend that government should negotiate with industry professionals to achieve rational goals regarding GSCMP.

2.3.2 *Attributes of green and eco-friendly materials*

The increased cost incurred by producing green products is identified to be the most critical barrier towards GSCMP implementation (Luthra et al., 2011). In the textile industry, procurement of green and eco-friendly materials incurs an additional cost, which will increase overall investment. When an organization adopts GSCMP in early stages it incurs an extra cost because of lack of experience available in using new materials and undertaking new technology, design and construction processes (Ageron et al., 2012). Therefore, the idea for the adoption of green materials will fall into risks of ruining their financial performance discourages practitioners to undertake GSCMP initiatives. Besides the financial risk, green supply chain initiatives may inherit operational risks, such as incompatibility with other materials, higher requirements for materials handling, changing infrastructure, and dealing with the incompetent workforce (Grimm et al., 2014). Moreover, there may occur many technical problems in using the green products available in the current market (Govindan et al., 2014). Generally, small and medium-sized enterprises (SMEs) show comparatively more reluctance to adopt GSCMP since they lack of financial resources and strategic view in adopting GSCMP (Lee, 2008).

2.3.3 *Business organization*

Among all the green schemes, upgrading organizational environmental performance through green supply chain initiatives is of utmost importance for industry professionals (Luthra et al., 2011). However, it appears that practitioners are not yet ready to implement GSCMP organization-wide. Bunse et al. (2011) find that extensive and easy-to-use tools for measuring the environmental performance of green materials are not available to industry professionals, which is a major impediment to GSCMP initiatives. The inexperience of industry practitioners in adopting GSCMP can magnify the initial cost of green supply chain schemes. Eventually, professionals who are not involved in green supply chain tend to overestimate the additional cost of GSCMP initiatives. This overestimation leads professionals to use conventional supply chain processes, as these seem to be

reliable to them (Zhang et al., 2012). An organization-wide positive attitude towards green supply chain initiatives and organizational environmental policies taken by the managerial staff are the main enablers of GSCMP adoption (Blok et al., 2015).

In Bangladesh, entrepreneurs are notably found to be ignorant of environmental missions and policies and only a few of them are found to adopt some green initiatives in their supply chain. This situation indicates that the top management is not supportive towards GSCMP adoption (Lorek and Fuchs, 2013). Lack of environmental missions and strategies is therefore believed to be a major barrier to the adoption GSCMP. Given that green supply chain initiatives cannot be implemented effectively without coordination from all departments (Zsidisin and Siferd, 2001), the top management should carefully assign environmental responsibilities among individual departments and achieve the organization's environmental goals through coordination and support from all departments. The misleading conception of environmental responsibilities among industry professionals will adversely affect GSCMP adoption.

In addition to this, lack of consciousness about environmental factors among managerial staff hinders GSCMP initiatives (Al Zaabi et al., 2013). The professionals who are unconscious and ignorant of environmental issues hampers the adoption of sustainable practices and the promotion of green industries. Sometimes the unsatisfactory experience of using green materials discourages practitioners from adopting GSCMP. Grimm et al. (2014) find that, due to the bad performance of green materials in both cost advantage and compatibility, some industries are not interested in green supply chain. Deficiency of green and eco-friendly supplies could also significantly discourage the industries from GSCM adoption (Lorek and Spangenberg, 2014).

2.3.4 *Market condition*

The drivers a supply chain to be green are mainly operational cost savings, efficiency improvement, creating brand image etc. However, there is a common belief among textile professionals that the external incentive to undertake environmental initiatives only comes from market. Also, consumers lack awareness regarding green products (Lorek and Spangenberg, 2014) (Lorek and Spangenberg, 2014). This makes market demand of green products uncertain. This uncertainty inhibits practitioners from adopting GSCMP initiatives (Luthra et al., 2014). Although buyers from developed countries are increasingly demanding green textile products, consumers in emerging economies, such as Bangladesh, neglect the detrimental effects of the products on

environment rather they focus on price and quality of the garment products. In fact, a recent study (Kaur et al., 2018) suggests that even the customers of developed countries do not have sufficient levels of awareness regarding the green supply chain or green products. Moreover, prior studies suggest that while the cheapest price is the main criteria in low-cost country sourcing, the competence of adopting green supply chain by the suppliers is often ignored in the process of supplier selection (Kusaba et al., 2011). As a result, manufacturer in the developed countries like Bangladesh focus on achieving the cheapest price of the products as their main competitive advantage (Cheng et al., 2018). In other words, this lack of pressures from the customers hinders the motivation of the manufacturers in the emerging markets to adopt GSCMP.

2.3.5 *Standards and materials supply*

The absence of proper certification systems makes it hard for practitioners to compare alternative green materials and processes. Therefore, practitioners are bound to apply traditional materials and processes (Akadiri, 2015). In Bangladesh, there are not sufficient standards available for GSCMP, although few non-authoritative standards for specific green categories are available (Islam et al., 2018). Consequently, practitioners are not attracted to adopt these non-authoritative standards. Findings indicated that there are not enough authoritative certification standards for textile industries in Bangladesh, which can inhibit companies from adopting GSCMP.

Insufficient green materials in the local market is also a major barrier for adopting green supply chain in many industrial sectors in Bangladesh. Moreover, suppliers are reluctant to change towards GSCMP due to own interest and traditional mindset (Mudgal et al., 2010). This type of attitude inhibits the whole network from adopting GSCMP initiatives. In this case, management prefers taking a low risk path i.e. purchasing raw material from the conventional sources. Often producers fail to take the responsibility of products, especially post-sale liability of their products (Lorek and Spangenberg, 2014).

The literature review identified the barriers preventing GSCMP implementation in different industrial sectors. However, different organizations may face different hurdles while undertaking GSCMP initiatives in their supply chains. As a result, a barrier in one industry may not be such in another, or the impact of a specific barrier may differ from industry to industry (Diabat et al., 2014). Going through the current literatures and gathering views from textile practitioners through both emailed and on-site questionnaire surveys, fifteen significant barriers to the adoption of

GSCMP initiatives in the Bangladeshi textile industry were identified and are presented in Table 1.

Table 1: Barriers to GSCMP in textile industry of Bangladesh

Code	Important barriers	References
B1	Lack of attention to develop theories and increase research work in green business practices	(Govindan et al. 2014); (Ahamed, 2013); (Asgari and Hoque, 2013) (Ahmed et al., 2014); (Anisul Huq et al., 2014); (Barua and Ansary, 2017); (Wadud and Huda, 2017); (Khan and Qianli, 2017)
B2	Lack of collaboration among supply chain partners due to complex supply chain	(Bhuiyan and Haq, 2008); (Sarkis 2003); (Liu et al. 2012); (Gold et al. 2013); (Haque and Azmat, 2015); (Khan and Qianli, 2017); (Khan et al., 2016); (Fontana and Egels-Zandén, 2018)
B3	Less incentives from the government	(Blok et al. 2015); (Parent et al. 2013); (Khosla, 2009); (Wadud and Huda, 2017); (Khan and Qianli, 2017)
B4	Lack of interest and effective efforts of stakeholders	(Jones et al. 2011); (Liu et al. 2012); (Almeida et al. 2013); (Ahamed, 2013); (Asgari and Hoque, 2013); (Wadud and Huda, 2017);
B5	Financial constraints	(Ageron et al. 2012); (Grimm et al. 2014); (Govindan et al. 2014); (Luthra et al. 2011); (Araujo Galvão et al., 2018)
B6	Unskilled workforce	(Luthra et al. 2011); (Berg, 2011); (Longoni et al. 2014); (Urban and Naidoo, 2012)
B7	Organizational culture resistance to change	(Carter and Rogers 2008); (Kamalakanta Muduli et al. 2013); (Zhu and Geng, 2013); (Abubakar, 2018); (Gaur and Mani, 2018); (Govindan and Hasanagic, 2018)
B8	Lack of top management commitment	(Govindan et al. 2014); (Lorek and Spangenberg 2014); (Dubey et al. 2015); (Zhu and Geng 2013); (Khan and Qianli,

		2017); (Khan et al., 2016); (Govindan and Hasanagic, 2018)
B9	Lack of third parties to recollect used products	(Govindan et al. 2014); (Smol et al., 2015); (Tukker, 2015); (Lieder and Rashid, 2016)
B10	Lack of IT implementation for communication and coordination	(Wilson, 2007); (Luthra et al. 2011); (Khan and Qianli, 2017)
B11	Lack of producer's responsibility	(Gunasekaran and Spalanzani 2012); (Lorek and Spangenberg 2014)
B12	Technological obstructions	(Whiteman et al., 2013); (Long et al., 2016); (K Muduli and Barve, 2011), (Mathiyazhagan et al., 2013); (Tanner and Kast 2003); (Bunse et al. 2011); (Almeida et al. 2013); (Govindan et al. 2014); (Blok et al. 2015); (Lieder and Rashid, 2016); (Prieto-Sandoval et al., 2018)
B13	Lack of government regulations and legislative framework	(ILO, 2002); (Mathiyazhagan et al. 2013); (Govindan et al. 2014); (Lehtoranta et al. 2011);
B14	Low demand for green textile products from customers due to lack of awareness	(Govindan et al. 2014); (Luthra et al. 2014);
B15	Lack of promotion of sustainable products	(Lorek and Spangenberg 2014); (Jones et al. 2011); (Khan and Qianli, 2017)

3 Research method

The research data for this study was collected through the questionnaire survey method, based on the barriers to GSCMP adoption in textile industries listed in Table 1. Hierarchical cluster analysis technique was employed to examine the survey data. The result of this research was then verified and interpreted through experts' inputs.

The survey questions related to barriers encountered in GSCMP adoption and opinions on the importance of each barrier. First of all, we develop a pre-test instrument for pilot testing, and after consultations with academic and industry experts, we develop the final questionnaire on the basis of five-point Likert scale ranging 1 (Negligible) to 5 (Very Important). A Likert scale was used to measure respondents' attitudes by assigning numerical values on the significance of each barrier.

Likert scales are the most universal and easily understood method for gathering opinion on the significance level of the barriers (Zhang et al., 2012). Each expert who participated in the survey was asked to rate the barriers from 1 to 5 based on their linguistic representation. Linguistic representations exhibit the level of significance by assigning numeric values as presented in Table 2.

Table 2: Numeric values for linguistic representation of the level of significance

Linguistic representation of level significance	Numeric Values
Negligible (N)	1
Not Important (NI)	2
Common (C)	3
Important (I)	4
Very Important (VI)	5

Opinions from professionals of textile industries in Bangladesh regarding the barriers to green supply chain initiatives were gathered through both emailed and on-site questionnaire surveys. Data collection methods incorporating both mailed and on-site survey generates a better result (Zhu et al., 2008). The on-site survey helped reduce misinterpretation of questions and the mailed survey helped gather adequate responses and reduce bias from the on-site survey.

The most common method of evaluating barriers is to compare the relative significance of individual barriers by the mean value (Zhang et al., 2012), and the most significant barrier is the one having the highest mean value. In this method, barriers are generally classified into three categories: strong, common, and weak. The barriers only in the strong category are given further attention. However, the main problem with this mean value method is that it ignores the distribution of the respondents' opinion and fails to interpret the reasons for the divergence of opinions from one respondent to another, and so an important barrier may be considered to be negligible. For example, if a barrier is rated as 'strong' by half of the respondents and 'weak' by the other half of the respondents, then according to the mean value method, the barrier will fall into 'common' category. However, the barrier is critical (strong) to half of the respondents.

Therefore, it is not wise to ignore the barriers although it is classified as 'common' based on the mean value approach.

To mitigate this weakness of traditional mean value approach, this study employed hierarchical cluster analysis technique in analyzing the barriers (Harloff et al., 2013). Cluster analysis is a technique of grouping similar objects in the same cluster, while dissimilar objects are grouped into different clusters (Kaufman and Rousseeuw, 2009). Hierarchical cluster analysis technique groups the barriers from two perspectives: the relative importance of the barrier on green supply chain practice, and the difference of opinion among respondents about the same barrier. Since the differences of opinions among respondents are considered in this technique, the results derived from this method is considered valid and highly reliable. Thus, this study used this technique in analyzing the barriers of GSCMP in the textile industry of Bangladesh.

The resulting clusters of barriers were verified and interpreted through the opinions of experts' who contributed on the survey, consisting of managers and consultants in operational and supply chain divisions of leading textile and garment manufacturing companies in Bangladesh. Since combining quantitative and qualitative methods gives a better understanding of the analysis (Clark, 2007), an insightful discussion on our findings is drawn in section 6 considering both the relative importance and divergence of the experts' opinion.

4 Data survey

A rigorous survey conducted involving professionals from different textile companies in Bangladesh through email and on-site questionnaire. In a hierarchical cluster analysis the sample size requirements mostly depend on the number of items (i.e., barriers of green supply chain) to be analyzed (Harloff et al., 2013). While the responses from 15 to 25 participants are considered sufficient for generating acceptable results for researches with 15 to 20 items in hierarchical cluster analysis, a sample size up to 35 could provide further safety of claiming the validity of the results (Harloff et al., 2013). Given that total 15 green supply chain barriers are analyzed in this study, responses are collected data from 30 participants. The on-site survey was conducted involving 15 professionals, who have 10-15 years of experience in managing operations and supply chains, related to the textile industry. To achieve sufficient responses and to increase the coverage of respondents, emailed surveys were also conducted, which involved an additional 15 managers having 10-15 years of experience in managing operations and supply chains in the textile industry.

This combined method of getting respondents' opinions increased sample size and reduced the possibility of getting bias responses in one method of administering survey (Nulty, 2008). In total, we received 30 responses including 16 from SMEs from both methods of survey. Table 3 shows the respondents' opinions on the significance of each barrier.

Table 3: Total responses for each barrier on their level of significance

Barriers	Level of Significance				
	N	NI	C	I	VI
B1	0	1	6	13	10
B2	0	2	3	18	7
B3	0	1	14	10	5
B4	0	1	9	15	5
B5	1	1	5	9	14
B6	1	3	13	11	2
B7	0	2	8	15	5
B8	0	1	7	12	10
B9	0	2	15	11	1
B10	1	2	14	10	3
B11	0	3	9	11	7
B12	0	1	11	14	4
B13	0	2	7	16	5
B14	0	1	6	19	4
B15	2	3	7	14	4

5 Data analysis

For the analysis of the data, we applied a hierarchical clustering analysis technique.

5.1 *Fundamentals of Hierarchical Clustering*

In hierarchical method, the similar objects are clustered based on different criteria and clusters are represented by a dendrogram (Farrelly et al., 2017). Guo (2003) specified three criteria, namely distance-based, model-based, and density-based, to be used to cluster the objects. In this article, we use Euclidean distances between the barriers to construct the dendrogram. Each layer of the dendrogram represents a cluster.

Selected barriers are represented by X_i ; $(i = 1,2,3, \dots \dots \dots, m)$ and are set apart by their relative importance value (RIV) (X_{RIV_i}) and standard deviation value (SDV) (X_{SDV_i}) with the help of following equations,

$$X_{RIV_i} = \frac{\sum_{j=1}^{n} u_j}{n} \quad (1)$$

$$X_{SDV_i} = \sqrt{\frac{\sum_{j=1}^{n} (u_j - X_{RIV_i})^2}{n}} \quad (2)$$

Where u_j represents the score given to barrier X_i by participant j; n is the total number of responses received. These two variables are given equal importance through a standardization process (Kaufman and Rousseeuw, 2009). The formulas for the process are shown below:

$$\mu_{X_{RIV}} = \frac{1}{m} \sum_{i=1}^{m} X_{RIV_i} \quad (3)$$

$$\mu_{X_{SDV}} = \frac{1}{m} \sum_{i=1}^{m} X_{SDV_i} \quad (4)$$

$$Z(X_{RIV_i}) = \frac{X_{RIV_i} - \mu_{X_{RIV}}}{\frac{1}{m} \sum_{i=1}^{m} \left| X_{RIV_i} - \mu_{X_{RIV}} \right|} \quad (5)$$

$$Z(X_{SDV_i}) = \frac{X_{SDV_i} - \mu_{X_{SDV}}}{\frac{1}{m} \sum_{i=1}^{m} \left| X_{SDV_i} - \mu_{X_{SDV}} \right|} \quad (6)$$

Initially, Euclidean distances of one vs. all barriers are measured and the smallest distance between the pairs are grouped together, then the clusters having multiple barriers are formed. Furthermore, the distance between each primary group is measured using group linkage average proposed by Kaufman and Rousseeuw (2009). If p and q are two barriers, and P and Q are two initial cluster groups, then Euclidean distance (d) between p and q, and group average linkage (c) between cluster P and cluster Q can be calculated by the following formulas:

$$d(p,q) = \sqrt{\left(Z\left(X_{RIV_p}\right) - Z\left(X_{RIV_q}\right)\right)^2 + \left(Z\left(X_{SDV_p}\right) - Z\left(X_{SDV_q}\right)\right)^2} \quad (7)$$

$$c(P,Q) = \frac{1}{|P||Q|} \sum_{p \in P} \sum_{q \in Q} d(p,q) \quad (8)$$

Here, $|P|$ = no. of barriers in cluster P

$|Q|$ = no. of barriers in cluster Q

Equations (7) and (8) are repeated to reduce the number of clusters to a defined value. The optimum number of clusters can be determined from the Silhouette index proposed by Rousseeuw (1987). The formula to calculate Silhouette index is formulated as:

$$s(i) = \frac{b(i)-a(i)}{\max\{b(i),a(i)\}} \tag{9}$$

$$s(i) = \begin{cases} 1 - \frac{a(i)}{b(i)}; & if\ a(i) < b(i) \\ 0, \quad ; & if\ a(i) = b(i) \\ \frac{b(i)}{a(i)} - 1; & if\ a(i) > b(i) \end{cases} \tag{10}$$

Therefore, from the above definition Silhouette value is limited in between $[-1,1]$ and can be written as,

$$-1 \leq s(i) \leq 1 \tag{11}$$

where, $a(i)$ is the mean distance for an individual barrier calculated one vs. all barriers in the same cluster, $b(i)$ is the average distance between a barrier *i* and other barriers in the clusters within which *i* is not contained. The number of clusters that gives the maximum value of $s(i)$ is taken as the optimum number of clusters (Rousseeuw, 1987).

5.2 Interpretation of results

Data presented in Table 3 have been applied to Equations (1)–(6) to get the values of X_{RIV}, X_{SDV}, $Z(X_{RIV})$ and $Z(X_{SDV})$ and the values are shown in Table 4.

Table 4: Values of data characterization and standardization

Code	X_{RIV}	X_{SDV}	$Z(X_{RIV})$	$Z(X_{SDV})$
B1	1.564	1.632	1.366	1.382
B2	1.538	1.600	1.089	0.996
B3	1.397	1.472	–0.434	–0.578
B4	1.462	1.523	0.259	0.046
B5	1.590	1.701	1.643	2.220
B6	1.282	1.382	–1.680	–1.679
B7	1.449	1.521	0.120	0.030
B8	1.551	1.624	1.228	1.288
B9	1.269	1.349	–1.819	–2.074
B10	1.308	1.408	–1.403	–1.363
B11	1.436	1.537	–0.018	0.218

B12	1.423	1.484	–0.157	–0.425
B13	1.462	1.531	0.259	0.148
B14	1.487	1.533	0.536	0.172
B15	1.346	1.488	–0.988	–0.381

For example, we used the responses given to barrier B1 from Table 3 and applied it to Equation (1) to get the value of its relative importance (X_{RIV}) which is found to be 1.564. Similarly Equations (2)–(6) are used to get the values of $X_{SDV}, Z(X_{RIV})$, $Z(X_{SDV})$ which are accordingly 1.632, 1.366, and 1.382. The same process was followed to generate the other values of Table 4. In Table 4, the negative values of $Z(X_{RIV})$ and $Z(X_{SDV})$ means that they are located on the left side of the mean value and the positive values of $Z(X_{RIV})$ and $Z(X_{SDV})$ means that they are located on the right side of the mean value. As we have almost equal numbers of $Z(X_{RIV})$ and $Z(X_{SDV})$ values for both right and left side of the mean, we can say that the data is well distributed in the normal distribution curve.

A complicated computation process was involved in applying hierarchical cluster analysis to Equations (7) and (8). Therefore, this computation process was done using MATLAB, a high-performance language for computing. The results are shown in a dendrogram presented in Figure 1.

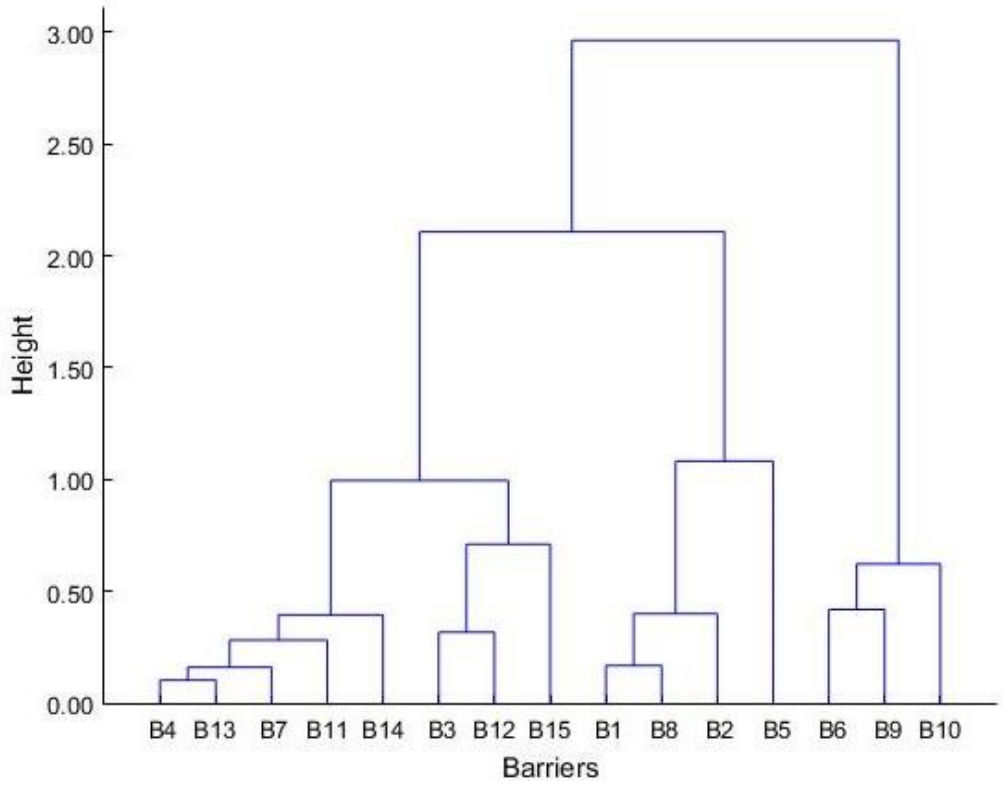


Figure 1: Results of hierarchical clustering

In Figure 1, it is seen that if the cut-off point is at height 0.65 then we get six clusters. The first one is comprised of B4, B13, B7, B11, and B14; the second one is comprised of B3 and B12; the third one is comprised of B15; the fourth one is comprised of B1, B8, and B2; the fifth one is comprised of B5; and the sixth cluster is comprised of B6, B9, and B10. It should be mentioned that all samples clustered below a particular level of distance will have inter-sample dissimilarities less than that level. In the next step we calculated the Silhouette index for finding the optimum number of clusters, which was found to be six clusters, similar to the results of the dendrogram.

In order to get best clustering performance, we need to find the optimum number of clusters in our dataset. For this, we calculated the Silhouette indexes using Equation (9). Silhouette can be used to find the consistency of the clustering data and enables us to visualize the optimum number of clusters in 2D space. The results are presented in Figure 2.

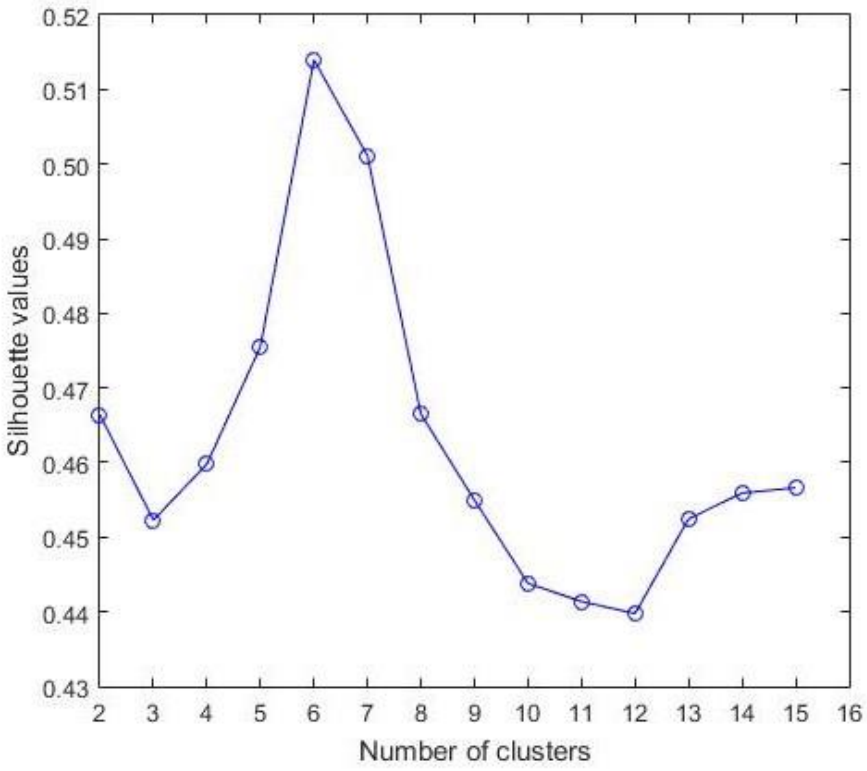
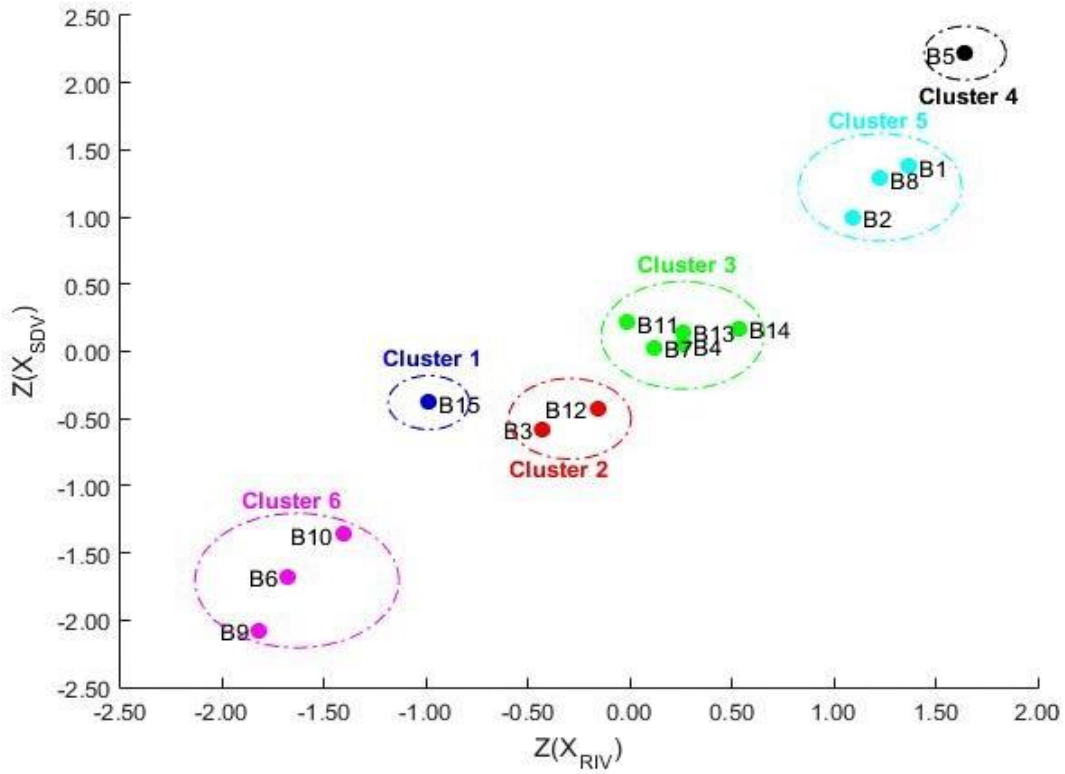


Figure 2: Values of Silhouette index

As presented in Figure 2, the optimum number of clusters is 6, where Silhouette index has the maximum value (0.515). This is the optimum number of clusters for generating perfect clustering results. The six clusters are presented in Figure 3 in a two-dimensional plot where $Z(X_{RIV})$ is the ordinate and $Z(X_{SDV})$ is the abscissa.



B1 Lack of attention to develop theories
B2 Lack of collaboration due to complexity
B3 Lack of incentives from the government
B4 Lack of effective efforts of stakeholders
B5 Financial constraints
B6 Unskilled workforce
B7 Organizational culture resistance to change
B8 Lack of top management commitment
B9 Lack of third parties to recollect used products
B10 Lack of IT implementation
B11 Lack of producer's responsibility
B12 Technological obstructions
B13 Lack of government regulations
B14 Low demand from customers
B15 Lack of promotion of sustainable products

Figure 3: Clusters in the two-dimensional plot

It is visible that Cluster 1 containing GSCMP barrier B15 has a relatively low value of X_{RIV} and an average level of X_{SDV}, indicating that respondents were consistent in finding out that the influence of the barrier within this cluster is relatively low. Cluster 2, comprising B3 and B12, has a descent level of X_{RIV} and X_{SDV}, meaning that the impact of the barriers in this cluster is more or less the same. Cluster 3, comprising five barriers, has a relatively high level of X_{RIV} and X_{SDV}, meaning that the importance of the barriers within this cluster is relatively high, with some

variation in the opinions of the respondents. Cluster 4 is comprised of barrier B5 and has the highest value of X_{RIV} and the highest value of X_{SDV}, meaning that Cluster 4 is considered as the most significant barrier cluster, but with noticeable differences in views among respondents. Cluster 5, comprising three barriers, has the second highest value of X_{RIV} and the second highest value of X_{SDV}, indicating that Cluster 5 is considered as a very impactful barrier cluster, but respondents have very distinctive views among themselves about its importance. Cluster 6 has the lowest value of X_{RIV} and X_{SDV}, indicating that the respondents agreed that the barriers in this cluster have the lowest importance.

6 Discussion and implications

This study aims at answering the question of what the barriers of GSCMP in the textile industry in emerging countries like Bangladesh are and how the practitioners opine their criticality. Through answering this research question, it contributes to the literature and help the practitioners and policy makers in strategy formulation. This section discusses the results of the study and implications and theoretical contributions of the study findings.

6.1 *Discussion*

Indicating 15 barriers within the 6 clusters, the most significant barriers towards GSCMP adoption in the textile industry in Bangladesh can be found. It is found that respondents agreed that barriers in clusters 1, 2, and 3, with high RIV and relatively low SDV, are critical barriers to GSCMP adoption. High relative importance and relatively low variance in cluster 1, 2 and 3 enables us to decide that the barriers within these clusters are most important barriers in GSCMP adoption in the context of textile industries in Bangladesh. Practitioners shed distinctive views on the importance of the barriers in clusters 4 and 5.

6.1.1 *The consensus*

The barrier “low demand of green textile products from customers due to lack of awareness” in Cluster 3 is considered to be a very critical barrier by most of the practitioners. This result suggests that consumers’ purchasing decisions for textile products in Bangladesh are mainly affected by price, quality, and durability, rather than the green features of the textile products. Therefore, low customer demand for green textile products significantly lowers practitioners’ keenness for implementing green supply chain initiatives. The findings are also supported with previous studies

conducted by (Khan and Qianli, 2017), and (Khosla, 2009) highlight that buyers of developing countries are more price sensitive as compare to developed countries, which negatively associated with the adoption of GSCMP.

In this study, "less incentives from the government" is found as another critical barrier, which hinders the adoption of GSCMP in the textile industry of Bangladesh. A plausible explanations of this result is that there are not enough incentives to encourage practitioners to promote and engage a green manufacturing processes in Bangladesh, although special benefits by awarding green buildings, such as Leadership in Energy and Environmental Design (LEED) exists (GBIG, 2017). Another possible explanation is that the existing incentive policies fail to bear the additional cost of adopting green processes, which discourages the practitioners to adopt GSCMP. Although conducted in the context of garment industry of Bangladesh, the result is consistent with that of (Anisul Huq et al., 2014) who highlight that incentives from government through different subsidies on green materials/products while embossing heavy financial penalties on polluting practices are needed to increase the adoption of GSCMP. This scenario is also consistent with other studies conducted in the context of other emerging economies (Blok et al., 2015); (Nazzal et al., 2013). For example, Majumdar and Sinha (2019) find that financial incentives from the government, such as financial rewards or private-public investments to improve green capabilities, are effective in motivating the practitioners of emerging countries of Southeast Asia to adopt GSCMP.

"Lack of government regulations and legislative framework" is another crucial barrier accepted by all practitioners in Bangladesh. Consistent with the findings of Lettenmeier et al. (2012), this result suggests that legislative framework is necessary for ensuring a supportive business environment to implement GSCMP initiatives by undertaking strategic policy frameworks. As a result, many countries, including developing countries, already take appropriate legislations to increase the adoption of GSCMP. For example, Majumdar and Sinha (2019) report that in April 2015, Indian Government have passed a legislation for those textile manufacturers which discharge 25KL or more water per day. The legislation stated that those manufacturers must conform to zero liquid discharge norms by building effluent treatment plants and using multi-effect evaporators and reverse osmosis. The result also means that in developing countries like Bangladesh, due to lack of government rules and regulations in adopting eco-friendly process, the textile industrialists

are reluctant to introduce sustainable production processes. As a result, in spite of being a major income source for the national economy, Bangladesh's textile industry is lagging behind in sustainability.

"Lack of promotion of green textile materials in the local market" is also perceived as critical barrier to adopt GSCMP initiatives in the Bangladeshi textile industry. The result suggests that green textile materials are rare in Bangladesh, thus local dealers purchase green textile materials from other countries where green textile materials are more available. The main reasons why unavailability of local green materials hinders the adoption of GSCMP is that the cost of sourcing increases when manufacturers source from overseas, such as importing from European and Western countries. For example, purchasing of green materials from overseas incur a huge cost in the supply chain systems through different heavy import duties, transportation cost, long lead-time and insurance cost (Islam et al., 2018). Similar findings also noted in the context of the other emerging countries, which further strengthen the results of this study. For example, (Khan and Qianli, 2017) conduct a research on the green supply chain practices in the context of Pakistan and their results confirm that due to a scarcity of green material in the local market, firms are avoiding to adopt green supply chain practices into their manufacturing processes.

"Technical obstructions with implementing GSCMP" is also another significant barrier for textile industry of Bangladesh. This result suggests that some green textile processes require machinery that cannot be operated by an untrained workforce. Moreover, the result means that to make the whole supply chain greener, changing the whole infrastructure including the transportation medium is also needed. One government document (Alam, 2009) indicates that most of the aged industries in Bangladesh do not have treatment facilities and, therefore, they tend to unload industrial, untreated effluents into the water bodies of the country. Studies have already pointed out that textile dyeing and printing industries unload harmful effluents into water bodies (Choudhury, 2017). The Asian Development Bank report (ADB, 2008) suggested the need for determining treatment technologies that are economical for the most harmful and polluting industries. Therefore, the technical problems associated with green supply chain discourages the textile practitioners to adopt GSCMP. The results are also supported by previous studies (Govindan et al., 2014); (Barua and Ansary, 2017) conducted in India and Bangladesh, respectively. Their findings highlighted that due to the lack of green technology and expertise in

Asian emerging economies, firms poorly dumbed their industrial untreated effluents into the soil and/or unloaded into the nearest river/canals, which not only destroy to the fauna and flora lives but also create several human-related diseases (Khan and Qianli, 2017).

6.1.2 *Opinions divergence*

"Financial constraints" is found to be a major obstacle in adopting the GSCMP in textile industries of Bangladesh with opinions divergence. (Khan et al., 2016) and (Khan and Qianli, 2017) explore in the context of emerging economies that firms are afraid to adopt GSCM processes and green practices due to huge investment required. However, finding of this study indicates that all firms do not perceive this barrier in the same manner as we found divergence in opinions. As Lee (2008) reported, this barrier is more critical for the practitioners of SMEs since they deemed additional costs as a vital barrier since the investment on GSCMP can be significant and ruin their financial performance. On the other hand, large firms may not perceive this as a major barrier because they suffer less from resource constraints. This observation is consistent with the findings of Besbes et al. (2013) that large firms are unwilling to implement GSCMP mainly because of their unawareness of the concepts of life cycle costs and they focus on short term financial performance, rather than resource constraints.

"Lack of top management commitment" and "organizational culture resistance to change" are two other critical barriers for GSCMP adoption. While the results of previous studies (e.g., Zhu and Geng, 2013) generalize this barriers in the context of all companies and indicate that top management of all firms are not committed and supportive towards eco-friendly processes because they focus on short-term financial returns and resist to change, the result of this study shows the divergence in opinions on this barrier. Such a difference in the findings reflects that the level of internal commitment is not same across all the firms. Probably SMEs consider this as a severe obstacle since they generally lack a strategic plan in adopting GSCMP (Lee, 2008). However, this scenario may not be same for leading companies who would like to invest more for making processes greener to improve their brand image and competitive advantage.

The result also shows that "lack of collaboration among supply chain partners due to complex supply chain" is also a critical barrier although the opinions varied. This observation exactly echoes the result of Zhu et al. (2017) who report that without the presence of relational governance GSCM fail to improve business performance, therefore, firms do not show interest in adopting

GSCMP when there is a lack of collaboration. This barrier may be more crucial for the textile firms having less experience. It is because they generally fail to maintain long-term association with eco-friendly suppliers and their suppliers are reluctant to share the quality performance of their products (Lee et al., 2012). On the other hand, leading companies have a strong relationship with their suppliers. As a result, they can get information from their suppliers about the performance and effects of their textile materials, therefore, may not consider this barrier as a critical one. While there is an opinion divergence, consistent with the findings of previous studies (AlKhidir and Zailani, 2009); (Luthra et al., 2011), the result of this study also shows that IT implementation within the organization is required to keep track of both forward and backward flow of materials and other resources for greening the supply chain efficiently.

"Lack of attention to developing theories and grounded research in the context in GSCMP implementation" is a hurdle encountered with great importance but with some opinion divergence. This means that while practitioners who want to learn about GSCMP in their context, they see less investigation is done in the textile industry of emerging economies like Bangladesh and, therefore, struggle to find the relevant research. However, as suggested in previous studies (Diabat and Govindan, 2011); (Zhu et al., 2008), companies only who are conscious of their environmental impacts feel the need for in-depth research that analyzes the barriers encountered in GSCMP implementation. The respondents who perceive this barrier is not a critical one for GSCMP probably ignore the need of learning from empirical investigation and focus more on financial capabilities and governmental supports.

6.2 Implications of the findings

Using the opinions of 30 respondents in the textile industry of Bangladesh, this study reveals that while some of the barriers of adopting GSCMP are critical to all firms (opinion consensus) others are only crucial for few firms (opinion divergence). This difference means that firms in the textile industries of the emerging countries face numerous but diverse obstacles. This also means that same strategies for all firms may not provide desired outcomes in improving the GSCMP of entire industry. While same strategies can be taken to overcome the opinion consensus barriers, different strategies for opinion divergence barriers are needed.

Among the consensus barriers, this study finds that low demand of green textile products from customers are the most critical barriers. Therefore, proper strategies are needed to improve the awareness levels of the customers. While involving with a contract with the foreign buyers, textile firms can discuss and encourage the buyers to buy green products. In this regard, they also can highlight the long-term benefits of green products and how GSCMP is related with the image of the seller (Ageron et al., 2012). Both textile firms and policy makers of the industry, such as government, can implement appropriate campaigns to improve the awareness of local buyers. Educating customers about the environmental impact of the industries will make them aware of green supply chain process, resulting in greater customer demand for sustainable products. For example, governmental bodies can build consumer awareness on green products and their advantages on their atmosphere through different TVs commercials, signboards, and environmentally friendly training (Khan et al., 2019). In addition to campaigns to improve awareness levels of buyers, government of emerging countries such as Bangladesh should also introduce proper incentives to encourage the textile manufacturers to implement GSCMP as this is also found as another barrier. In this regard, the government can implement green taxation and subsidization to motivate the manufacturers within the country to adopt GSCMP, as these are found effective by Sheu and Chen (2012). The government of developing countries can also implement strategic incentive policies, such as financial rewards, by learning from the developed countries, as they already have such incentives in place (Koebel et al., 2015). In order to ensure that a good portion of textile manufacturers are practicing GSCMP, the government also need to formulate strict environment friendly policies to protect green industries/projects for better socio-environmental sustainability. Moreover, government must need to ensure that the green materials are available in the local market as the practitioners think this is also a crucial barrier. The Bangladeshi government can provide some tax benefits or waive the registration fees for the business who involve in supplying green materials.

For the convergence barriers of adopting GSCMP, it is important to differentiate which group opine a barrier as critical and which group not. This is important since it will lead to understand why this barrier is perceived as critical by some but not by all. Then appropriate strategies need to be formulated by considering the specific group that rated the barrier as critical so that they also can tackle. Among the divergence barriers, most critical one is found as financial constraints. Obviously, this financial issue is more critical for SMEs due to their lack of financial resources

(Chowdhury et al., 2019). Similarly, SMEs generally have lack of top management commitment in implementing GSCMP. For example, around one-fifth of the Bangladeshi SMEs do not have environmental clearance and more than 50 per cent are not familiar with the green practices such as using renewable energy (Bangladesh SME Foundation, 2013). Since Lee et al. (2012) have already found that GSCMP positively impact the business performance of SMEs, practitioners of SMEs need to commit and invest for the improvement of green supply chain infrastructure. GSCMP can provide long-term benefits to SME practitioners, which will make up the high initial cost of GSCMP implementation. However, they need to ensure that their scarce financial resources are used efficiently so that it does not immediately impact other activities of the firms. Even large firms, who do not have resource constraints, need to invest carefully and efficiently to achieve the maximum benefits of GSCMP. In order to tackle the barriers of GSCMP, practitioners, especially less expensive group, also need to focus on improving collaboration with their supply chain partners such as buyers and suppliers. This is because the respondents of Bangladeshi textile industry noted this as a crucial barrier. On the other hand, a proper GSCMP is only possible when there is good coordination among the players within a supply chain (Zhu et al., 2017). In this regard, the practitioners can focus on leveraging social capital, which a recent study (Chowdhury et al., 2019) in the context of Bangladesh apparel industry finds very effective.

Looking at several barriers that require actions from the government, it can be inferred that practitioners perceive having several governmental supports as a precondition of implementing GSCMP. This is probably why (Khan and Qianli, 2017) argue that the green market cannot survive without governmental protections and supports. Therefore, policy makers should not expect managers to adopt environmental- friendly processes without implementing a strong regulatory system. This study also suggests a combined effort from policy makers, textile firms and their supply chain players to tackle all the barriers of GSCMP effectively.

6.3 Theoretical contributions

This study makes several contributions to the theory. First, it contributes to the knowledge on green supply chain in the context of emerging countries. While plenty of studies are available in the

643 literature that discuss several issues on green supply chain, only a few researches are conducted in
644 the context of emerging economies, and specifically in the context of Bangladesh (Majumdar and
645 Sinha, 2019). The findings that are derived in the context of developed countries may not be
646 applicable to firms of the developing countries. Therefore, through investigating green supply
647 chain barriers in the context of an emerging country, this research supplements the inadequacy in
648 research in this regard. Second, this study reveals the barriers in adopting GSCMP in the context
649 of textile industries. In spite of being a major industrial sector, there is not enough research that
650 studies the barriers to GSCMP implementation in textile industry that considers issues of the
651 emerging economy context like Bangladesh (Nayak et al., 2019). Such a gap in research makes it
652 difficult to ensure an environment that encourages GSCMP adoption in the textile industry. This
653 study also supplements in this adequacy.

654 Third, this study does not merely explore the barriers, rather critically analyze them by using
655 hierarchical cluster analysis to provide most important barriers. Moreover, the findings empirically
656 confirm that there are some barriers that are common to all firms (consensus barriers) and that are
657 some that are specific to certain group (divergent barriers). This mean that a barrier of GSCMP
658 should not be generalized to all firms without proper analysis. Such a perspective is not explored
659 in the literature of green supply chain management and an original contribution of this study
660 (Oliveira et al., 2018). Finally, through the comprehensive discussion on results and implications,
661 this study sheds some light on the strategies for alleviating the barriers. For example, the study
662 found that less government incentive is a critical consensus barrier, and it also provide some
663 suggestions, based on literature survey, how to alleviate this barrier.

664 **7. Conclusions and future research scopes**

665 This study was conducted to create awareness among the textile practitioners of a developing
666 country like Bangladesh about the potential significance of greening the supply chain process, and
667 to identify the most critical barriers towards green supply chain implementation within the
668 Bangladeshi textile industry. This study incorporated a hierarchical cluster analysis technique in
669 order to identify the critical barriers and reveal the cause of opinion divergence among the
670 respondents.

671 It is found that financial constraints, lack of top management commitment, and complexity in
672 supply chain are the most critical barriers for some of the practitioners, and lack of demand from
673 customers for sustainable products, weak government regulatory system, lack of promotion of
674 sustainable products, and technical obstructions are the commonly accepted important barriers
675 towards green supply chain adoption in the textile industry of Bangladesh. It is also found that
676 there are very few research projects undertaken within the textile industry of emerging economy
677 context to analyze the barriers in GSCMP adoption. As a result, lack of awareness prevails among
678 consumers, managers, policy makers and government bodies there.

679 This study will assist managers and relevant government bodies of developing countries towards
680 policy making and strategy development to mitigate the green supply chain adoption barriers. In
681 the future, studies can be carried out considering other industrial sectors or other countries'
682 scenarios to improve the generalizability of the findings. This study uses hierarchical cluster
683 analysis to analyze the data, which was collected via a questionnaire survey with 30 supply chain
684 professionals of the textile industry of Bangladesh. While the sample size of this study is adequate
685 to claim the validity of the results considering the nature of the study, yet a large-scale survey with
686 the textile manufacture could be undertaken in future to text the impact of major barriers on the
687 adoption of green supply chain. Such a study will benefit from two perspectives. First, this will
688 allow to investigate the causal relationships between barriers and adoption of green practices
689 empirically through using regression or structural equation modelling (Gimenez et al., 2005). This,
690 in turn, will enhance the generalizability of the results of this study. Second, this will allow to
691 further scrutinize the findings of this study by considering several demographic variables. For
692 instance, the findings of this study show that the low demand of customers for green products as
693 one of the main barriers of adopting green supply chain. However, buyers from developed
694 countries, such as USA and UK, are more environmentally conscious (Luthra et al., 2014) and,
695 hence, may prefer paying more for textiles manufactured using green processes and technologies.
696 Therefore, such a study will allow to investigate the moderating role of the location/origin of the
697 buyers in the relationship between low demand of customers and adoption of green supply chain
698 practices, which provide further insight about the relationship. Finally, a research to reveal why
699 there is a divergence in the opinions of the respondents regarding GSCMP will provide further
700 information, which will be helpful to formulate proper strategies for enhancing the adoption of
701 GSCMP.

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