Challenges To Sustainable Supply Chain Management And Their Interrelation In The Apparel Sector Of Bangladesh: A Dematel Approach

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Abstract

The apparel industry is the prime driving force of the Bangladesh economy, contributing 83% to the total export earning with 27.94 billion USD in 2019-2020. The apparel industry has to deal with an intricate supply chain globally. While many apparel-exporting countries adopt sustainable supply chains, Bangladesh is still under the traditional supply chain umbrella. Sustainable supply chain in the apparel sector of Bangladesh is in the nascent stage yet. This study explores the challenges to the sustainable supply chain and their interrelation in the apparel sector of Bangladesh. This study incorporates thirty barriers in five categories (environmental, economic, societal, knowledge & technology, and Management & Stakeholders). This study is quantitative in nature, and data collection was completed two-fold. Two questionnaires were designed to garner a response. The first questionnaire was used to collect responses from experts (academic, buying-house, and industry people)to determine the most prominent barriers and shortened number of obstacles from thirty to eighteen. The second questionnaire was designed to collect responses from hundred respondents as input in the comparison matrix of DEMATEL. Finally, DEMATEL based

method was applied to investigate the interrelation among the barriers. From the result of the study, according to prominence value, lack of stakeholder involvement, high costs of sustainability adoption, insignificant financial gains, lack of supply chain integration are the prime barriers to SSCM. Moreover, this study unravels the cause-effect relationship among the barriers, ten barriers fall in the cause group, and eight barriers fall in the effect group, and finally, proposed corrective action to address the cause barriers.

Keywords: DEMATEL, Sustainable Supply Chain Management, Interrelation Of Challenges, Bangladesh Apparel Sector

Introduction

Supply chain management is an integral part of businesses and is essential to company success and customer satisfaction. These practices help improve financial position, improve customer services, and reduce operating costs (Majumdar & Sinha, 2019). Lesser known is the role of sustainable supply chain management in business and society. SSCM integrates both social and environmental dimensions with economic considerations, and it is still one of the newer concepts to be applied in companies (Moktadir et al., 2018). Moreover, if the textile and apparel industry is focused explicitly on, it becomes apparent that the rising level of outsourcing from developing countries has also increased the importance of sustainability. As the consumer lifestyle and demands keep changing, it puts pressure on the existing supply chain formats to modify and merge sustainability concepts in the upgraded system (Taghikhah et al., 2019). Thus, many well-known retailer brands have shifted from regular supply chain practices to SSCM. Sustainable supply chain management also creates additional advantages during the applied approach because it considers social, environmental, and economic factors (Gardas et al., 2018). The RMG sector in Bangladesh has become the economy's backbone as the largest export earnings source (84% of the total export) and employment (4.5 million direct employment and 20 million indirect employment)(Bank, n.d.). However, at the current growth pace, the target is not possible to achieve.

Furthermore, the industry has witnessed the collapse of around 200 firms in recent times, which indicated the newly added factories are fully compliant and are here to stay (*Coronavirus: Bangladesh's Garment Industry Risks Collapse | Asia| An in-Depth Look at News from across the Continent | DW | 25.03.2020*, n.d.). Therefore, though the number of new industries every year decreases, the freshly launched industries' quality is far better, taking Bangladesh to the next level as a role model of green initiatives and sustainable practices. Industry transformation phase, will propel a significant shift from regular supply chain systems into a sustainable supply chain. Both the textile

and the apparel sector stand to gain vastly from this, as less information and more dependency on developing countries for resources was what prompted this shift globally in the first place.

In the apparel industry, traditional supply chain management needs to be upgraded into a sustainable one. In this regard, SSCM practices may help make the traditional supply chains more sustainable by considering the Triple Bottom Line (economic, social, and environmental) and considering knowledge and technology and management and stakeholder participation (Craig R. Carter & Easton, 2011). Implementing SSCM practices in the Bangladeshi apparel industry will be challenging due to the numerous barriers that currently exist. In this sense, this research raises some questions:

    a. What are the key barriers to implement SSCM practices in the apparel supply chain?
    b. What are the contextual (cause-effect) relationship among barriers
    c. How can managers interpret cause and effect relationships among selected barriers?

 This study has set the below objectives:

    a. To identify the critical barriers to the adoption of SSCM practices in the T&A. industry of Bangladesh.
    b. To understand the cause and effect relationships between selected barriers.

Literature Review

The term 'supply chain management' started evolving in the 1980s (Harland, 1996). In just a few years, this has emerged as a phenomenon of exceptional interest due to its applications in a wide array of domains. Several studies have explored the concepts of SCM and its importance in a variety of fields. Seuring & Müller (2008) defined supply chain management as a set of tasks that ensure the flow of information, finance, and goods from suppliers to end-users . The supply chain ensures the flow of material, information, and capital through proper channels among firms considering all three sustainability wings. Lambert et al. (1998) defined SCM as integrating pivotal business activities from suppliers to the customer, which provide products, services, and information for the value addition to customer and stakeholders. Customer need satisfaction and effective logistics management drive the maximization of value creation among stakeholders and enterprise. Management of relationships among key stakeholders and enterprise functions is supply chain management (Walters & Lancaster, 2000). A typical supply chain framework evolved, integrating environmental and social issues and economic concerns with the advancement of sustainable operations management (Seuring & Müller, 2008). Supply chain management plays a pivotal role in today's business arena where sustainability has called for

industrialist and researchers' attention from different aspects (Islam et al., 2020). Regardless of business organizations' size or nature, sustainability has become an inseparable part of their business (Kaur et al., 2018). Sustainability is the term that describes the capability to perform business with a vision of maintaining the society, environment, and economy (Hassini et al., 2012). Slawinski & Bansal (2011) defined sustainability as creating flexible firms by aligning economic, social, and environmental systems without sacrificing long-term goals. Sustainability practices pose different challenges to decision-makers, supply chain managers, and policymakers in the organization's supply chain (Marshall et al., 2015). Sustainable or green management initiatives have been launched to curtail cost and improve efficiency, customer satisfaction, market share, and sales. The acknowledgment of environmental impact due to efficient supply chain management led to the development of Green Supply Chain Management. GSCM focuses on the environment and economic aspects but fails to communicate social concerns, leading to unveiling Sustainable Supply Chain Management (Bansal & Roth, 2000; Lintukangas et al., 2016).

Seuring & Müller (2008) reported SSCM as an alignment of sustainable development and supply chain management, combining social and environmental concepts. SSCM is the extension of traditional supply chain management, merging all three-dimension (social, economic,and ecological) sustainability (Ciliberti et al., 2008; Font et al., 2008). Sticking to the traditional supply chain led to the downgrade of organizational performance. Hence, a sustainable supply chain shift is emphasized (Sarkis, 2012; Tseng et al., 2019). The concepts of sustainable development depend on the Triple Bottom Line (TBL) dimensions (economic, environmental, and social). The sustainability progression in the supply chain has also seen a notable contribution from two pillars: a combination of sustainability: socio-economic, socio-environmental, and eco-environmental dimensions (Rajeev et al., 2017). Most of the articles between 2003-2018 shed light on all three dimensions of sustainability. Environmental and economic dimensions in combined or economic and social dimension jointly get focus in less article. Sustainability's social dimension solely received the most attention in the papers (Koberg & Longoni, 2019). Carter & Liane Easton (2011) and Svensson & Wagner (2015) have indicated social, economic, and environmental as three wings of SSCM. Building up parity between profit, planet, and people in the clothing industry, it is substantial to address three sustainability pillars (Jabbour & Santos, 2008; Khan et al., 2018; Pomponi et al., 2019). Implementation of social sustainability magnifies operational performance and organizations' financial success (Schönborn et al., 2019). Lack of environmental regulations is often regarded as critical challenges for SSCM adoption (Wittstruck & Teuteberg, 2012), whereas rigid and expensive

environmental policy may impede a company's environmental proactivity (EM & C., 1995). Businesses with a target to reach minimal prerequisites may turn down the capacity to develop new technologies and solutions to boost environmental performance (Sajjad et al., 2015). Investment in SSCM needs to be mirrored by economic restoration; otherwise, organizations become unwilling to participate in SSCM practices without benefits (Sajjad et al., 2015). The observation of an uncertain economy stem from integrating SSCM practices may falter the organization's venture (Giunipero et al., 2012). (Mont et al., 2014) suggested stakeholder involvement as crucial to SSCM initiatives, while (Lorek & Spangenberg, 2014) reported a sheer number of stakeholders, primarily from non-developed countries lacking knowledge about sustainability. Top management's commitment is critical to the initiation of SSCM, but disinterest from the top and mid-level management may shrink the organization's capability to facilitate SSCM initiatives (Wittstruck & Teuteberg, 2012).

Table 1. Key challenges to SSCM

Author	Challenges	Method	Industry (Country)
(Q. Zhu et al., 2005)	Absence of central government environmental regulations, Lack of buying firms environmental mission,	Regression analysis	Manufacturing (China)
(Walker et al., 2008)	High costs of sustainability adoption, fear of exposure of poor environmental performance, lack of information, inertia by project stakeholders, supplier's (manufacturer) reluctance to change, Disbelief about environmental benefits	Exploratory factor analysis	Manufacturing (The U.K.)
(Diabat & Govindan, 2011)	Reverse logistics, a collaboration between product designers and suppliers to reduce and eliminate product environmental impacts	ISM	Manufacturing (India)
(Luthra et al., 2011)	Lack of top management commitment, lack of information technology	ISM	Automobile (India)
(Kannan Govindan et al., 2014)	The Complexity of measuring/monitoring environmental practices of suppliers, Lack of corporate social responsibility	AHP	Manufacturing (India)
(Mathiyazhagan et al., 2013)	The problem in maintaining the environmental awareness of suppliers, lack of top management involvement, Complexity in measuring and monitoring the environmental practice of suppliers	ISM	Auto component (India)
(Qinghua Zhu & Geng, 2013)	Insignificant financial gains, lack of resource and capability	Exploratory factor analysis	Manufacturing (China)
(Jalalifar et al., 2013)	Lack of top management support, lack of information and data, lack of supply chain integration	DEMATEL	Manufacturing (Iran)
(Luthra et al., 2016)	Lack of government support and policies, lack of management support, lack of resource and expertise, lack of stakeholders involvement	AHP	Plastic manufacturing (India)

(Wang et al., 2016)	Lack of adequate training and progress monitoring, low customer awareness, lack of pressure for widespread adoption	DEMATEL	Food packaging (India)
(Gandhi et al., 2015)	Top management commitment, human technical expertise, adoption of new technology and processes	DEMATEL	Manufacturing (India)
(Xia et al., 2015)	Less profit in remanufacturing Lack of cooperation with research institutes	DEMATEL	Automotive (China)
(K. Govindan et al., 2015)	Customer pressure	Fuzzy AHP	Manufacturing (India)
(Rao & Holt, 2005)	Fear of failure	SEM	Southeast Asia
(Silvestre et al., 2018)	Strong perception of low economic returns	Theoretical Framework	Beef Industry Brazil
(Moktadir et al., 2018); Shibin et al., 2018)	Ineffective supplier selection strategies The inefficient performance measurement system Ineffective employee training for sustainability	DEMATEL	Leather Industry (Bangladesh)
(Majumdar & Sinha, 2019)(Koberg & Longoni, 2019)	Lack of effective interdepartmental communication Non-consideration of human factors	ISM	Southeast Asia Textile and Apparel Industry
(Kannan Govindan et al., 2014)	High cost for disposing of hazardous wastes Cost of environmentally friendly packaging Non-availability of financial assistants	ISM	Auto component (India)
(Prakash & Barua, 2015)	Demand for lower price	AHP-TOPSIS	
(Sarker et al., 2018)	Market competition and uncertainty	Delphi study approach	Leather Industry (Bangladesh)
(Hasan, 2016) (Shi et al., 2008)	Weak regulatory environment	AHP	SME China

A closer look at the literature reveals several gaps and shortcomings

   a. Although a few attempts have been made to address these issues, it is still limited to a subset of the dimension of sustainability in supply chain management.

   b. There are no previous literature reports that explored challenges to adopt SSCM in the T&A of Bangladesh.

   c. Previous research typically investigated the implementation of GSCM in various fields, taking into account environmental sustainability only.

   d. Finally, it is pivotal to identify challenges from a cause-effect relationship perspective.

Methodology

Table 2. Category of key challenges in SSCM

SL No.	Challenges Type	Challenges Name	Code
B1	Economical	High costs of sustainability adoption	EC1
B2		Insignificant financial gains,	EC2
B3		Lack of resource and capability	EC3

| B4		High cost for disposing of hazardous wastes	EC4
B5		Cost of environmentally friendly packaging	EC5
B6		Non-availability of financial assistants	EC6
B7	Environmental	Lack of Reverse logistics	EN1
B8		Market competition and uncertainty	EN2
B9		Complexity in measuring and monitoring the environmental practice of suppliers	EN3
B10		Weak environment regulatory	EN4
B11		Lack of buying firms environmental mission	EN5
B12	Societal	Absence of government support and policies	SC1
B13		Lack of corporate social responsibility	SC2
B14		Insufficient society pressure	SC3
B15		Poor customer awareness & demand	SC4
B16		Demand for a lower price	SC5
B17		Lack of employee motivation	SC6
B18	Knowledge & Technology	Disbelief about environmental benefits	KT1
B19		Lack of eco-literacy among supply chain stakeholders	KT2
B20		Ineffective supplier selection strategies	KT3
B21		The ineffective performance measurement system	KT4
B22		lack of information technology	KT5
B23		Lack of adoption of new technology and processes	KT6
B24		Lack of cooperation with research institutes	KT7
B25	Management & Stakeholders	Manufacturer's reluctance to change	MS1
B26		Lack of top management commitment	MS2
B27		Lack of stakeholders involvement	MS3
B28		Lack of supply chain integration	MS4
B29		Lack of effective interdepartmental communication	MS5
B30		Non-consideration of human factors	MS6

Research methodology flowchart
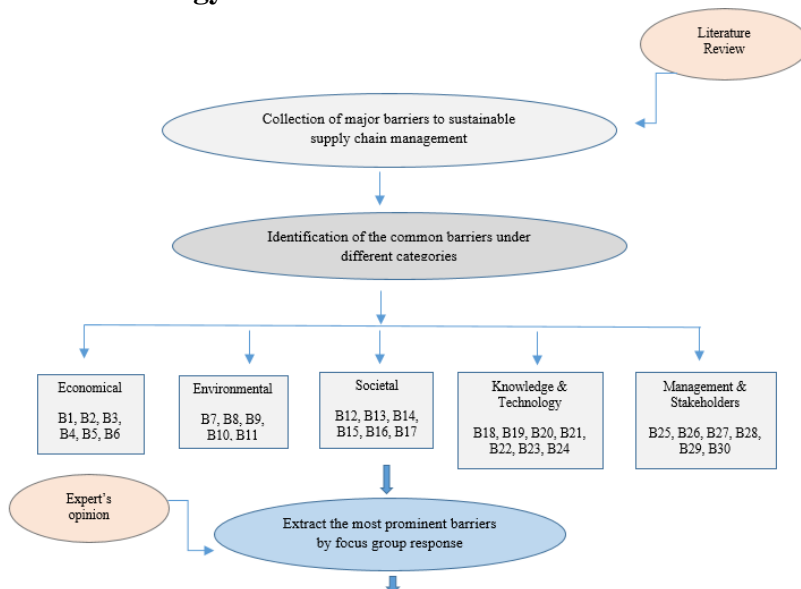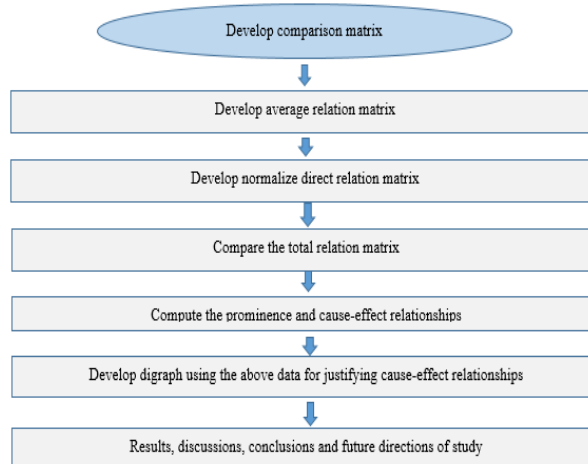
Fig 1. Process flowchart of research methodology

Firstly, a list of thirty barriers to sustainable supply chain management in the manufacturing field was enlisted by an extensive literature review. Secondly, collected barriers were grouped into five categories: economic, environmental, societal, management and stakeholder, and knowledge and technology that cover all aspects of sustainability. Applying thirty barriers to DEMATEL will be challenging to handle. So, the authors felt the urgency to narrow down the list of barriers. Thirdly, a group of experts in the apparel sector was formed, including academic, buying-house, and industry people. Fourthly, a questionnaire was designed and asked for a response from experts in a Likert scale range of 1-5 (where 5 = most prominent and 1 = least prominent). Finally, upon analyzing the experts' response, twelve barriers were excluded, and eighteen barriers were ready for the DEMATEL approach.

DEMATEL approach

The DEMATEL technique has gained popularity in recent decades, is a multi-criteria decision-making (MCDM) tool, usually used to analyze the interdependence of variables (R. J. Lin, 2013). In DEMATEL, variables are divided in cause and effect group to identify their causal relationship (Awasthi et al., 2014). This method has been applied in different fields previously, for example, manufacturing in Iran (Jalalifar et al., 2013), food packaging (Wang et al., 2016) and manufacturing (Gandhi et al., 2015) in India, the automobile industry in China (Xia et al., 2015) and leather industry in Bangladesh (Moktadir et al., 2018). DEMATEL ease the way of assigning value to influential factors (C. J. Lin & Wu, 2008). Another reason to choose DEMATEL over ISM and AHP is to uncover relationships among variables based on the severity of the effect on each other (Gandhi et al., 2015). It permits the transformation of qualitative research design into quantitative

analysis. Moreover, the application of DEMATEL in various domains has been fruitful (Wang et al., 2016). Therefore, it is apparent that the DEMATEL approach is practical for complex situations, and that is why it is selected for this study.

Step 1 (Direct Relation Matrix)
        In this stage, respondents are requested to provide the degree of influence of one element on the other based on the DEMATEL scale. If there are p variables in a study, then $p \, x \, p$ the matrix will form and the level of influence a_i on a_j denoted as a_{ij}.

Table 3. DEMATEL scale

Variable	Scale
No influence	0
Very low influence	1
Low influence	2
High influence	3
Very high influence	4

$$A = \begin{vmatrix} a_{11} & a_{1j} & a_{1n} \\ a_{i1} & a_{ij} & a_{in} \\ a_{ni} & a_{nj} & a_{nn} \end{vmatrix}$$

        The $p \, x \, p$ average matrix Z is the average of the respondents' feedback.

$$Z = \begin{vmatrix} 0 & Z_{1j} & Z_{1n} \\ Z_{i1} & Z_{ij} & Z_{in} \\ Z_{n1} & Z_{nj} & 0 \end{vmatrix}$$

Step 2 (Normalised Direct Relation Matrix)
        Normalized direct relation matrix X is obtained by dividing the direct relation matrix Z by S where, $S = \max\left(\sum_{j=1}^{n} Zij, \sum_{i=1}^{n} Zij\right)$, $X = Z/S$ and $X = [x_{ij}]_{nxn}$ where $0 \leq x_{ij} \leq 1$

Step 3 (Total Relation Matrix)

The total relation matrix T provides both direct and indirect influence of variables instead of only indicating direct relations as of normalized direct matrix. Following equation of T :

$$T = X \, (I - X)^{-1}$$

Where I is the identity matrix

Step 4 (Net cause-effect Values)

Let R_i denotes the sum of the i th row, and C_j denotes the sum of the j th column in the total relation matrix T, where, $i = j = k = 1,2,3,4 \ldots n$. Moreover, ($R_i + C_j$) represents a degree of influence of the variables, known as prominence value. Variable with higher the prominence value, more it can affect or be affected by other variables. The value of ($R_i - C_j$) reflects the total effect it can provide to the problem. If ($R_i - C_j$) is positive, then variables are classified as cause group. If ($R_i - C_j$) is negative, then variables are classified as effect groups.

Step 5 (Threshold Value)

A threshold value ∂ is fixed to separate variables from the total relation matrix T, which have negligible effects. It is necessary to choose (∂) value wisely. A higher (∂) value may miss some essential variables, while a lower (∂) value may invite some insignificant variables in the problem.

Results and Analysis

Table 4. Average Direct Relation Matrix

	EC1	EC2	EC3	EN1	EN2	EN3	EN5	SC1	SC3	SC5	SC6	KT2	KT5	KT6	KT7	MS2	MS3	MS4
EC1	0.000	3.286	3.429	2.571	2.429	1.714	1.857	2.286	1.429	3.286	1.714	2.286	2.714	2.571	2.857	2.714	3.429	3.000
EC2	3.429	0.000	3.143	3.714	3.000	3.000	2.429	2.714	2.000	3.143	1.714	1.571	3.143	3.429	3.714	2.714	3.000	3.143
EC3	4.000	3.429	0.000	0.714	0.429	2.857	2.429	0.714	1.714	2.143	0.571	1.857	1.714	1.857	3.000	2.714	2.857	2.143
EN1	3.714	3.143	0.286	0.000	0.429	2.571	3.571	0.857	3.000	1.857	2.429	3.143	0.857	1.000	3.429	2.857	2.571	3.143
EN2	2.857	3.000	0.857	1.000	0.000	0.714	0.429	0.857	2.286	2.857	2.429	2.571	0.571	0.714	2.286	3.143	3.714	3.000
EN3	1.857	2.714	2.000	2.286	0.000	0.000	2.714	2.429	3.000	1.429	3.429	3.143	1.714	1.714	2.857	3.143	2.857	3.429
EN5	4.000	3.143	3.286	4.000	0.571	3.000	0.000	4.000	3.143	1.429	2.000	3.143	1.143	1.143	1.429	2.429	3.286	3.000	2.571
SC1	3.000	3.429	0.143	0.286	0.714	3.143	3.286	0.000	1.143	0.429	2.000	2.857	1.571	2.000	2.286	1.429	3.000	2.000
SC3	1.714	2.143	1.000	3.143	3.000	3.000	3.429	1.714	0.000	1.714	2.429	2.429	1.143	1.571	2.143	0.429	2.714	2.429
SC5	4.000	3.143	0.143	1.286	3.143	1.857	1.000	0.286	1.429	0.000	2.571	2.714	0.143	0.143	2.000	0.429	3.000	3.143
SC6	2.143	2.143	0.000	2.571	3.000	3.571	1.714	2.429	2.714	2.714	0.000	2.000	0.429	0.857	1.571	3.000	2.857	2.714
KT2	3.143	2.286	1.714	3.143	2.857	3.143	3.429	2.143	3.143	2.000	2.286	0.000	0.571	0.429	3.857	3.143	3.571	3.429
KT5	3.286	3.000	0.571	0.429	0.286	0.571	7.143	0.429	0.429	0.000	0.286	0.571	0.000	4.000	2.571	0.429	2.857	1.714
KT6	3.429	3.571	0.286	0.000	0.143	0.571	2.857	0.429	0.714	0.143	0.000	0.429	3.286	0.000	0.571	0.571	2.714	2.429
KT7	4.000	3.714	1.857	2.857	0.571	2.286	3.714	0.857	3.143	0.429	3.571	3.571	0.429	1.857	0.000	4.000	3.857	2.857
MS2	2.429	2.429	2.857	2.714	3.714	3.000	2.714	1.571	0.429	0.286	3.143	2.714	0.429	0.429	1.857	0.000	3.143	3.286
MS3	3.857	2.571	3.143	2.143	3.429	2.857	2.714	3.000	3.286	3.000	2.714	3.857	3.000	3.143	3.000	3.143	0.000	2.857
MS4	3.429	3.429	1.857	3.571	2.857	2.857	1.714	1.857	2.571	3.000	2.429	3.571	2.286	2.857	3.286	3.429	3.143	0.000

Table 4 depicts the average direct relation matrix, representing responses garnered from a focus group of experts, including academia,

industry, and buying-house. After receiving the individual respondent's initial
response, the average of the responses was taken for the next step.

Table 5. Normalized Relation Matrix

	EC1	EC2	EC3	EN1	EN2	EN3	EN5	SC1	SC3	SC5	SC6	KT2	KT5	KT6	KT7	MS2	MS3	MS4
EC1	0.000	0.064	0.066	0.050	0.047	0.033	0.036	0.044	0.028	0.064	0.033	0.044	0.052	0.050	0.055	0.052	0.066	0.058
EC2	0.066	0.000	0.061	0.072	0.058	0.058	0.047	0.052	0.039	0.061	0.033	0.030	0.061	0.066	0.072	0.052	0.058	0.061
EC3	0.077	0.066	0.000	0.014	0.008	0.055	0.047	0.014	0.033	0.041	0.011	0.036	0.033	0.036	0.058	0.052	0.055	0.041
EN1	0.072	0.061	0.006	0.000	0.008	0.050	0.069	0.017	0.058	0.036	0.047	0.061	0.017	0.019	0.066	0.055	0.050	0.061
EN2	0.055	0.058	0.017	0.019	0.000	0.014	0.008	0.017	0.044	0.055	0.047	0.050	0.011	0.014	0.044	0.061	0.072	0.058
EN3	0.036	0.052	0.039	0.044	0.000	0.000	0.052	0.047	0.058	0.028	0.066	0.061	0.033	0.033	0.055	0.061	0.055	0.066
EN5	0.077	0.061	0.064	0.077	0.011	0.058	0.000	0.077	0.061	0.028	0.039	0.061	0.022	0.028	0.047	0.064	0.058	0.050
SC1	0.058	0.066	0.003	0.006	0.014	0.061	0.064	0.000	0.022	0.008	0.039	0.055	0.030	0.039	0.044	0.028	0.058	0.039
SC3	0.033	0.041	0.019	0.061	0.058	0.058	0.066	0.033	0.000	0.033	0.047	0.047	0.022	0.030	0.041	0.008	0.052	0.047
SC5	0.077	0.061	0.003	0.025	0.061	0.036	0.019	0.006	0.028	0.000	0.050	0.052	0.003	0.003	0.039	0.008	0.058	0.061
SC6	0.041	0.041	0.000	0.050	0.058	0.069	0.033	0.047	0.052	0.052	0.000	0.039	0.008	0.017	0.030	0.058	0.055	0.052
KT2	0.061	0.044	0.033	0.061	0.055	0.061	0.066	0.041	0.061	0.039	0.044	0.000	0.011	0.008	0.075	0.061	0.069	0.066
KT5	0.064	0.058	0.011	0.008	0.006	0.011	0.138	0.008	0.008	0.000	0.006	0.011	0.000	0.077	0.050	0.008	0.055	0.033
KT6	0.066	0.069	0.006	0.000	0.003	0.011	0.055	0.008	0.014	0.003	0.000	0.008	0.064	0.000	0.011	0.011	0.052	0.047
KT7	0.077	0.072	0.036	0.055	0.011	0.044	0.072	0.017	0.061	0.008	0.069	0.069	0.008	0.036	0.000	0.077	0.075	0.055
MS2	0.047	0.047	0.055	0.052	0.072	0.058	0.052	0.030	0.008	0.006	0.061	0.052	0.008	0.008	0.036	0.000	0.061	0.064
MS3	0.075	0.050	0.061	0.041	0.066	0.055	0.052	0.058	0.064	0.058	0.052	0.075	0.058	0.061	0.058	0.061	0.000	0.055
MS4	0.066	0.066	0.036	0.069	0.055	0.055	0.033	0.036	0.050	0.058	0.047	0.069	0.044	0.055	0.064	0.066	0.061	0.000

Dividing each cell value by the maximum value of the sum of the rows
(51.71), the normalized relation matrix (Table 5) is calculated.

Table 6. Total Relation Matrix

	EC1	EC2	EC3	EN1	EN2	EN3	EN5	SC1	SC3	SC5	SC6	KT2	KT5	KT6	KT7	MS2	MS3	MS4
EC1	0.215	0.259	0.181	0.202	0.175	0.198	0.217	0.164	0.174	0.187	0.179	0.216	0.156	0.172	0.230	0.219	0.269	0.244
EC2	0.300	0.300	0.220	0.239	0.234	0.237	0.248	0.260	0.200	0.197	0.196	0.222	0.176	0.201	0.264	0.237	0.284	0.268
EC3	0.252	0.229	0.104	0.147	0.118	0.111	0.198	0.118	0.155	0.146	0.136	0.180	0.123	0.140	0.204	0.112	0.225	0.199
EN1	0.185	0.242	0.121	0.153	0.133	0.206	0.235	0.136	0.196	0.155	0.187	0.223	0.115	0.134	0.230	0.214	0.241	0.236
EN2	0.222	0.212	0.113	0.147	0.111	0.148	0.151	0.115	0.113	0.111	0.166	0.188	0.095	0.112	0.185	0.194	0.233	0.108
EN3	0.238	0.239	0.151	0.195	0.127	0.162	0.226	0.165	0.198	0.148	0.206	0.225	0.133	0.150	0.223	0.221	0.250	0.244
EN5	0.299	0.268	0.188	0.241	0.150	0.235	0.195	0.206	0.215	0.162	0.196	0.144	0.135	0.159	0.236	0.242	0.274	0.250
SC1	0.223	0.218	0.101	0.133	0.116	0.190	0.205	0.101	0.140	0.109	0.154	0.190	0.115	0.137	0.183	0.163	0.218	0.187
SC3	0.214	0.208	0.250	0.266	0.165	0.197	0.217	0.139	0.129	0.142	0.172	0.195	0.111	0.134	0.192	0.156	0.226	0.207
SC5	0.231	0.205	0.094	0.145	0.160	0.159	0.150	0.100	0.140	0.101	0.161	0.182	0.083	0.096	0.172	0.139	0.210	0.201
SC6	0.221	0.100	0.103	0.183	0.169	0.209	0.185	0.152	0.178	0.160	0.131	0.189	0.098	0.120	0.182	0.201	0.229	0.214
KT2	0.281	0.250	0.159	0.226	0.191	0.235	0.252	0.171	0.216	0.172	0.202	0.187	0.120	0.137	0.258	0.139	0.282	0.263
KT5	0.211	0.194	0.185	0.120	0.092	0.125	0.257	0.099	0.111	0.088	0.105	0.130	0.078	0.163	0.169	0.127	0.195	0.162
KT6	0.180	0.174	0.266	0.088	0.074	0.100	0.155	0.078	0.093	0.074	0.078	0.101	0.124	0.074	0.109	0.103	0.162	0.147
KT7	0.294	0.272	0.163	0.255	0.150	0.219	0.257	0.150	0.214	0.144	0.221	0.248	0.120	0.163	0.186	0.253	0.285	0.251
MS2	0.235	0.221	0.160	0.192	0.184	0.205	0.254	0.142	0.144	0.123	0.263	0.207	0.102	0.250	0.195	0.157	0.242	0.230
MS3	0.319	0.279	0.196	0.222	0.214	0.246	0.263	0.198	0.232	0.203	0.222	0.272	0.178	0.201	0.262	0.255	0.242	0.274
MS4	0.298	0.281	0.286	0.238	0.197	0.235	0.234	0.170	0.211	0.195	0.209	0.257	0.158	0.188	0.257	0.250	0.286	0.211

Threshold Value $(\partial) = 0.187$

Table 7. Sum of influence given and received on barriers

Barriers	Ri	Cj	Ri+Cj	Ri-Cj
EC1	3.658	4.417	8.074	-0.759
EC2	4.282	4.152	8.434	0.130
EC3	2.898	3.041	5.939	-0.143
EN1	3.342	3.390	6.731	-0.048
EN2	2.723	2.760	5.483	-0.037
EN3	3.501	3.417	6.918	0.084
EN5	3.793	3.898	7.692	-0.105
SC1	2.883	2.664	5.547	0.219
SC3	3.319	3.059	6.377	0.260
SC5	2.730	2.617	5.346	0.113
SC6	3.024	3.183	6.207	-0.159
KT2	3.742	3.558	7.300	0.184
KT5	2.611	2.220	4.830	0.391
KT6	2.179	2.730	4.910	-0.551
KT7	3.844	3.737	7.582	0.107
MS2	3.507	3.381	6.888	0.125
MS3	4.278	4.354	8.632	-0.076
MS4	4.162	3.896	8.058	0.265

R_i+C_j denotes the degree of the relative importance of barriers known as prominence value. Variables with a higher R_i+C_j value, more likely to affect or be affected by other variables. The R_i-C_j value represents the total effect it cast on the overall problem. The positive value of R_i-C_j means it will affect others, while the negative value of R_i-C_j says it will be affected by other variables.

Table 8. Degree of the relative importance of each barrier

Rank	Barriers	Ri+Cj
1	MS3	8.632
2	EC2	8.434
3	EC1	8.074
4	MS4	8.058
5	EN5	7.692
6	KT7	7.582
7	KT2	7.300
8	EN3	6.918
9	MS2	6.888
10	EN1	6.731
11	SC3	6.377
12	SC6	6.207
13	EC3	5.939
14	SC1	5.547
15	EN2	5.483
16	SC5	5.346
17	KT6	4.910
18	KT5	4.830

Table 9. Cause-effect group

Rank	Cause group	Ri-Cj
1	KT5	0.391
2	MS4	0.265
3	SC3	0.260
4	SC1	0.219
5	KT2	0.184
6	EC2	0.130
7	MS2	0.125
8	SC5	0.113
9	KT7	0.107
10	EN3	0.084
Rank	Effect group	Ri-Cj
1	EC1	-0.759
2	KT6	-0.551
3	SC6	-0.159
4	EC3	-0.143
5	EN5	-0.105
6	MS3	-0.076
7	EN1	-0.048
8	EN2	-0.037

From Table 8, according to prominence value, lack of stakeholder's involvement (MS3), High costs of sustainability adoption (EC2), Insignificant financial gains (EC1), lack of supply chain integration (MS4), Lack of buying firms environmental mission (EN5) are the top five barriers to consider. From Table 9, barriers with positive R_i-C_j value are cause group, and barriers with negative R_i-C_j value are effect group. Under cause group, there are ten barriers, namely, lack of information technology (KT5), Lack of government support and policies (MS4), Insufficient society pressure (SC3), Lack of supply chain integration (SC1), Insignificant financial gains (KT2), Lack of eco-literacy among supply chain stakeholders (EC2), Lack of top management commitment (MS2), Complexity in measuring and monitoring the environmental practice of suppliers (SC5), demand for a lower price (KT7), Lack of cooperation with research institutes (EN3). Among the cause group, Lack of information technology (KT5), Lack of government support and policies (MS4), Insufficient society pressure (SC3) ranked highest.

Under effect group, there are eight barriers which are, High costs of sustainability adoption (EC1), lack of resource and capability (KT6), Lack of Reverse logistics (SC6), Market competition and uncertainty (EC3), Lack of buying firms environmental mission (EN5), Lack of employee motivation (MS3), Lack of adoption of new technology and processes (EN1), Lack of stakeholders involvement (EN2). Among the effect group, High costs of sustainability adoption (EC1), lack of resource and capability (KT6), Lack of Reverse logistics (SC6) ranked as the top three.
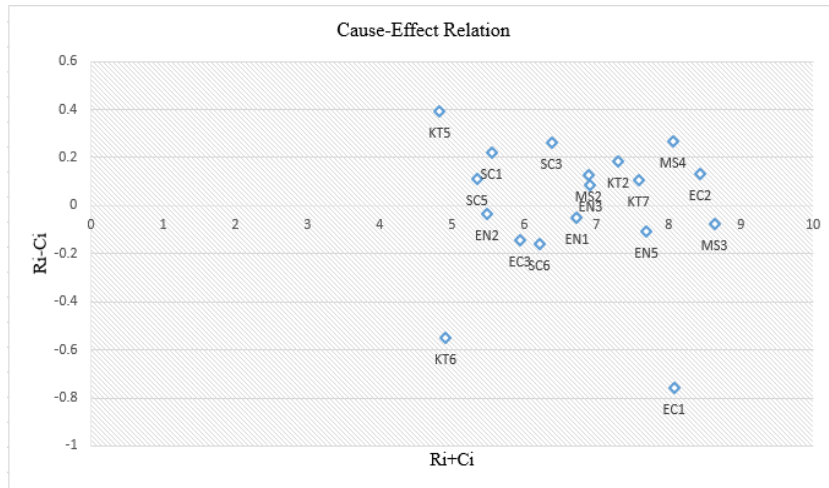
Fig 2. Causal Diagram

From the causal diagram, KT5, MS4, and SC3 are the critical barriers for SSCM adoption in the T&A sector of Bangladesh. According to relative importance, MS3, EC2, and EC1 are the top three barriers among eighteen barriers.

Discussion

Research outcome shows ten cause barriers and eight effect barriers. In this section, the authors tried to delineate how each of the cause barriers stirs each effect barrier. The authors proposed corrective action to address each cause barriers, which consequently mitigate the effect barriers.

Lack of information technology can result in a lack of adoption of new technology and processes. The scarcity of information technology and experts in this particular area hinders the adoption of new technology and operations. The textile and apparel industry should adapt itself with relevant information technology and prepare experts to smooth the latest technology transfer, installation, and adaptation to address this challenge.

Absence of government support and policies trigger the high cost of sustainability adoption. Without government financial support and sustainability-friendly policies, the textile and apparel sector cannot make any significant footsteps in their way to achieving sustainability in supply chain management. To address this issue, the government should offer financial incentives to the textile and apparel industry and construct a set of guidelines that will be easy to integrate.

Lack of insufficient society pressure for sustainable products influences the absence of reverse logistics. It is the society (customers, consumers) from where the demand for sustainability (through sustainable products) should come forward in the first place. Upon massive pull for

sustainable products, manufacturers will integrate reverse logistics in their supply chain. To address this barrier, dissemination of sustainability concepts and advantageous facets of sustainability can be handy.

Lack of supply chain integration engenders the effects of reverse logistics, market competition, and uncertainty. Forward and backward integration is a prerequisite for supply chain management to keep reverse logistics functional. The textile and apparel sector should extend its supply chain on the supplier's side and customer's side to reuse, remake, and recycle textile and apparel products.

Insignificant financial gains breed the effects of lack of resources and capability and lack of employee motivation. Predisposed concept of less economic turn out from sustainability endeavour deters organization from acquiring new resource and uplift caliber. High investment but less turn out, which is true partly initially, sway the industry from sustainability. In the end, financial gains outnumbered the initial cost. The textile and apparel sector should be well informed about the societal, environmental benefits, and economic outcome, which may change the organization's perception and facilitate new resource acquisition and capability enhancement.

Lack of eco-literacy causes a downfall of stakeholder involvement. Stakeholders in the textile and apparel supply chain feel uninterested in complying with the sustainability approach without convincing financial gain and tangible benefits. Extensive training and seminar program about sustainable supply chain management can be a potent tactic to educate the stakeholders. Eco-literacy programs can engender the urge among stakeholders to participate in the sustainability movement for economic, societal, and environmental gain and confirm the generations' wellbeing.

The lack of top management's commitment is reflected in the absence of resources, capability, and stakeholder involvement. It is the top management of the organization who beholds the power of decision-making. The mission and vision of organizations reflect top management's strategic planning and level of thinking. To address this barrier, top management from all the textile and apparel supply chain firms should come forward simultaneously and comply with sustainability initiatives. Top management should evince their commitment through active participation to ease new resource acquisition and confirm stakeholder's involvement.

Difficulty in measuring and regulating environmental practices resulted in lack of buying house's environmental mission. Buying firms can be the harbinger of sustainability adoption in the textile and apparel supply chain. To some extent, buying firms can create pressure on manufacturers. Measuring and monitoring suppliers' environmental practices in the tortuous textile and apparel supply chain has never been easy to resist buying firms from fulfilling their environmental mission. It is essential to install a flexible

method to measure and monitor all the participatory firms' environmental practices in the textile and apparel supply chain, which may increase firms' accountability for their practices. Demand for lower prices instigates market competition and uncertainty. One of the fundamental barriers to sustainability is the demand for lower prices from the consumer end. To satiate customers with cheap products, manufacturers act crazy and unsettled the whole market. Manufacturers often show no mercy to the environment to stay competitive and gain a small profit margin. Consumers have to be willing to pay a little extra for sustainable products. Consumers' commitment to sustainable goods can positively drive the textile and apparel supply chain.

Conclusion

This study explores the challenges to sustainable supply chain management in Bangladesh's textile and apparel sector with the DEMATEL technique. At the first stage of this study, challenges to sustainable supply chain management in the manufacturing, automobile, leather, and textile industry in India, China, Bangladesh, and other south Asian countries are collected through extensive literature review. Secondly, collected barriers are categorized into economic, environmental, societal, knowledge and technology, management, and stakeholder groups. Thirdly, opinion from expert focus groups is taken into account to justify the barriers and narrow down the list of barriers to ensure the most influential ones. Finally, the collection of data and analysis are completed using the DEMATEL approach.

This study is the first of its kind, in the textile and apparel sector of Bangladesh. Previous research explores sustainability adoption in supply chain management, sticking to the limited subset of sustainability concepts and dealing with environmental concerns only. Aggregation of sustainability subset: knowledge and technology, management, and stakeholder's commitment strengthen this study's outcome. Moreover, this study unravels the cause-effect relationship between the barriers and proposed corrective action to address the cause of barriers.

There are a few limitations in this study, which set the direction for future works. There is a scope to identify and collect more barriers from the extensive literature review. It is possible to include more categories of barriers to make the research work more comprehensive. Response for the DEMATEL matrix can be increased. This study can be stretched to a similar field in other countries. Different MCDM tools like ISM, AHP, and TOPSIS can be deployed to see the research outcome's difference.

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