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Green Supply Chain Management (GSCM): Rethinking implementation barriers based on Fuzzy DEMATEL method in the Textile Industries in Bangladesh

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Abstract
Emerging economy is lagging behind in advanced supply chain activities due to inefficient technological and financial support we know. Moreover, traditional supply chain creates a greater harm in the environment by its supply chain process finally by customers throwing consumed garbage which indirectly creates harm both for organization and in the environment. Knowing these effects our industries basically our textile industries are reluctant to adopt Green Supply Chain Management practices thinking it's complicated and primary adaptation barriers. This paper aims to investigate new thinking in Green Human Supply Management (GSCM) implementation barriers in the textile industries focusing on Bangladeshi textile industries. The methodology employs a mix method approach that combines a review of the literature with the insights of a few chosen experts from Bangladesh's textile sector to identify 10 barriers under two part of internal and external that are pertinent to the implementation of GSCM. For support in the investigation of the barriers in Bangladesh's textile industry, the Fuzzy DEMATEL method was used to prioritize GSCM implementation barriers and to analyze cause and effect relationship of these barriers. The findings showed that unfavorable working conditions and a lack of support from upper management were the most significant internal obstacles to the GSCM implementation, while pollution and a lack of government effort were the most significant external barriers. The present study offers a comprehensive summary of the barriers to the implementation of green supply chain management (GSCM) in Bangladeshi textile companies. It also highlights the need for researchers and academicians to concentrate on particular organizational tactics while implementing GSCM.

Keywords: Supply chain management, green supply chain management (GSCM), implementation barriers, textile industry, fuzzy dematel method

Introduction
Earth's resources are limited, but our needs are limitless; as one is met, a new one will inevitably arise. The harsh use of natural resources in modern manufacturing practices poses enormous problems for humans, including material waste and environmental destruction [1]. Bangladesh is focusing more and more on sustainability, green initiatives, and effective waste management techniques as a developing nation. The nation's adherence to these values is essential for establishing ethical business practices and advancing international sustainability objectives [2] but the textile industries in Bangladesh produce a significant amount of waste in addition to using a lot of natural resources. It is extremely difficult to turn all of the underlying obstacles into triumphs and to ensure sustainability in Bangladesh's textile industries [3]. In response to the growing environmental concerns facing manufacturing organizations, corporate environmental practices like Green Supply Chain Management (GSCM) and green innovation have emerged as innovative, coordinated environmental practices [4] As a result, there is a pressing need to incorporate environmental thinking into this function [5].
The integration of green concepts into industry operations has become a key problem for industries facing hurdles in green supply chain management (GSCM). This is a widespread issue in many different sectors [6]. The field of green supply chain management, or GSCM, has drawn increasing attention in recent years. The need for GSCM has grown as a result of growing public awareness as well as economic, environmental, or legal factors [7]. Green supply chain management (GSCM), its drivers, challenges, and implementation frameworks

have been the subject of an increasing number of studies due to growing awareness of climate change and the need for sustainable procedures. Notwithstanding the significance of environmental practices, enterprises exhibit reluctance to execute supply chain management (TSCM) operations due to the numerous challenges that may develop during the initiation of GSCM [8]. A new approach has been proposed that aims to reduce an organization's negative environmental effects and make a financial commitment to sustainability without sacrificing viability [9]. Green supply chain management (GSCM) is one of the recent revolutions to improve supply chain management services. Due to the presence of many obstacles, green business practices are not easy to adopt and implement. Therefore, industries must implement strategies to reduce the impact of their products and services on the environment [10].

Based on above discussion the study aims to get advance thinking and prioritizing specific factors in the field of GSCM barriers which faced by textile industries in Bangladesh and examine the following research questions (RQs):

RQ 1: What barriers do Bangladeshi textile industries presently face to adopt GSCM implementation?

RQ 2: What could be the priority based casual-effect relationship among these barriers?

The barriers to the implementation of GSCM are identified and classified using an extensive literature review. The expert opinion and literature is used to re-identify SSCM barriers based on Bangladeshi Textile industries; then the causal relationships among these barriers are analyzed by the fuzzy DEMATEL method. The remainder of this paper is organized as follows: In Section 2, current scenario of textile industry, green supply chain management and the barriers to implementing GSCM are summarized by referring to the literature. Section 3 presents the research methodology and the research framework with integrated techniques is elaborated. In Section 4, data analysis, in 5, detailed results and discussion are carried out to recognize the barriers to GSCM implementation, and then, managerial and policy implications relative suggestions based on the discussions are given in section 6. Finally, conclusions are drawn in Section 7.

Literature Review

Current State and Practices of Textile Industries in Bangladesh

The textile industry serves as the backbone of Bangladesh's $30 billion USD garment industry, which is a major factor in the country's economy's explosive expansion [11]. Bangladesh's ready-made garment (RMG) industry is expanding quickly and plays a major role in the nation's GDP and socioeconomic structure, which in turn drive economic growth. The RMG industry in Bangladesh moved into a quota-free market after 2005, however COVID-19, also known as the coronavirus, has infiltrated our environment and is something that humans are fighting both nationally and internationally. Year after year, the proprietors of RMG companies will put in endless effort to ensure our well-being, increase productivity, and establish the industry as the top exporter in the world [12].

Therefore, the textile and apparel industries are among the most polluting. It is mostly to blame for contamination of the air, water, soil, and other areas [13]. Because of its extensive consumption of natural resources without sufficient replenishment, the textile wet processing sector is regarded as a renowned polluter. Bangladesh is susceptible to environmental degradation because it is one of the world's top producers of textile items [14]. The shifting dynamics of strong demand and scarce resources provide a number of hazards and disruptions for the supply chains (SC) in the textile sector [15]. In general, the textile industry faces enormous challenges due to environmental concerns related to water footprint, wastewater treatment and hazardous chemicals [14]. The textile industry is facing significant resource and environmental challenges due to growing concerns about energy and water consumption, pollution, scarcity of natural resources, and greenhouse gas emissions. The textile industry has a significant environmental footprint from farming to manufacturing fabrics to disposing of post-consumer items in landfills [16]. Buyer-provided chemical management regulations are essential to the textile industries. Regarding textile chemical safety and security, there isn't currently a government policy. Multinational clothing businesses, also referred to as purchasers, supply chemical management standards that are highly dependent on the local textile industry. Chemical security is rarely addressed by the strict regulations that are based on various private and international chemical management programs, policies, treaties, and frameworks. These regulations primarily handle chemical safety and occupational health and safety [11].

Green Supply Chain Management

In the modern world, the growing concern about environmental sustainability has given rise to the Green Supply Chain Management (GSCM). "Green supply chain" is a word that has significance throughout the whole supply chain, from product design to raw material procurement to product manufacture to distribution to product end-of-life. Its primary goals are to reduce the detrimental effects of supply chain operations, maximize resource efficiency, and minimize waste production [17]. It has been acknowledged that implementing Green Supply Chain Management (GSCM) is a green strategy for lowering environmental issues in the building sector [18]. The term "green supply chain management" (GSCM) describes how environmental issues are incorporated into supply chain management procedures [7]. Green supply chain management (SCM) was presented as a concept that incorporates "green" principles into SCM in order to ensure that SCM is effective in decreasing its impact on the environment. In order to address the problems with carbon emissions and greenhouse gas emissions, GSCM is a more concentrated term that is especially focused on environmental factors [19]. Green design, initiation, materials management, building, operation and maintenance, and logistics are some examples of "green" activities [20, 21]. If supply chain is to thrive in the competitive environment and hold significant market shares, it wants to be assessed for the implementation of legislation pertaining to occupation strategies [22].

Green Supply Chain Management Barriers

Consumers' worries about the social and environmental impact of the items they buy are growing, but they do not always transfer into actual consumer behaviour. Numerous

studies have examined potential barriers between green products and academia, but there is a dearth of literature that thoroughly examines and evaluates the significance of these barriers. This problem has been noted in academic circles [23]. Implementing green practices within the company presents a number of problems, such as the requirement for coordination, cooperation, and cooperation among supply chain partners as well as the need to determine which green practices and technologies are most economical [17]. For the industries, adopting sustainable supply chain management techniques to remove or go around obstacles is a highly challenging challenge [24]. All of the obstacles to GSCM cannot be addressed at once by policymakers or government representatives. Rather, to better handle these obstacles and improve the application of GSCM techniques, it is imperative to organise them into distinct categories [25].

Internal Barriers

IB 1: Unfavorable working conditions

Bangladeshi product purchasers have exerted pressure on manufacturers to enhance working conditions and management in garment factories, and the factories have implemented numerous modifications in response to recommendations aimed at guaranteeing the health and safety of workers [12].

IB 2: Lack of top management support

Top management and staff members would be the primary participants, since they are thought to be the most crucial elements that would enable the execution of SSCM [26]. The proactive maintenance of an RM culture and the managers' strong commitment to sustaining sustainability in the SC are guaranteed by top management commitment. Proper implementation of SSCRM can be greatly aided by appropriate government and senior management support [27]. Furthermore, it implies that upper management have to demonstrate a stronger dedication to ecologically sustainable production methods while also considering the very competitive global market landscape [15]. Because of this, it is difficult to satisfy demand while adhering to all guidelines and regulations established by the relevant authorities in charge of managing business activities. Furthermore, top management in practically every industrial industry recognizes the value of GSCM but is still required to put it into practice [28] One of the most common obstacles to the implementation and adoption of SSCM in the literature is a lack of commitment and support from the top management level; this conclusion is in line with earlier research that examined how crucial the managerial board's commitment and support is to achieving sustainability values [29, 30]. Since top managers are crucial in determining the direction, goal, and organizational policies of a company, their lack of commitment serves as another obstacle to the implementation of GSCM methods [5]. Green logistics implementation is crucial for industries, and cooperation from all staff members from front-line workers to upper management is anticipated [31]. By appointing competent and appropriate human resources, top management can establish policies and demonstrate their support and commitment to the implementation of GSCM [32].

IB 3: Complex Internal policies

Despite certain management issues and a variety of policy flaws, perhaps they could grow over a typical time frame [12]. The main obstacles were ignorance and awareness as well as the leadership teams' lack of cooperation in the companies [33]. Green logistics implementation is crucial for industries, and cooperation from all staff members from front-line workers to upper management is anticipated [34].

IB 4: Financial constraints

Financial constraints, fear of failure, and cultural and worldview differences were internal obstacles to GSCM implementation [18]. Huge financial commitments are needed for the implementation from the manufacturer as well as from related partners including distributors, suppliers, and vendors. These regulatory agencies do not provide the industry with any financial help or incentive to adopt the GSCM [28]. It demonstrates that the biggest influence on the adoption of GSCM in different nations is caused by financial obstacles [30]. The results indicate that elements relating to finances and costs are given the highest weighting in relation to other factors. Businesses find it difficult to adopt GSCM processes and adhere to environmental requirements because they come with greater costs and require significant investments [5]. The high cost of implementing green supply chain techniques is one of the biggest obstacles mentioned by participants. A lot of business executives pointed out that green technologies, environmentally friendly materials, and sustainable processes come with a hefty upfront cost additionally companies also find it challenging to defend the expenditures because to the lengthy return periods of these investments, particularly in situations where immediate financial results are of utmost importance. Therefore, financial concerns continue to be a significant barrier to the broad implementation of green supply chain techniques [35].

IB 5: Resistance to change

Green supply chain adoption frequently necessitates a dramatic change in company operations and culture, which may encounter resistance from management and staff. This opposition is frequently caused by a lack of knowledge or comprehension of the advantages of eco-friendly practices, a fear of upsetting long-standing procedures, or doubts about the viability and effects of sustainability programs [35]. The need for qualified workers in the IT sector will increase as software, robotics, and data analytics become more widely used.Both low-skilled and traditional workers will be vulnerable to job loss [36].

External Barriers

EB 1: Lack of government initiative

Policymakers and government representatives should concentrate on offering SMEs financial support and training to expand their expertise. In addition, the government ought to conduct more research to lower the upfront costs associated with implementing green technologies, allowing SMEs to still reap the benefits of their adoption while still maintaining a healthy return on investment [25]. The absence of incentives and support from the government is another significant obstacle that participants brought up. Although there is growing regulatory pressure to implement sustainable practices, regional differences exist in the degree of support and enforcement. Numerous attendees conveyed their dissatisfaction with the absence of precise directives, irregular laws, and inadequate rewards for environmentally conscious investments. For organisations attempting to apply consistent sustainability standards throughout their

supply chains, this legislative uncertainty creates a difficult situation, especially for multinational corporations operating in many markets [35]. The necessary steps, such as boosting financial incentives, providing the required training to teach employees about sustainable practices, and creating supportive laws and regulations to adopt SSCM, may be taken by top executives of textile companies and the government [15]. The absence of government support programs, government rules and regulations, energy and waste management, organization encouragement, and government rules and regulations are all crucial [37]. Industry and government sectors must work together to successfully implement the GSCM system in order to achieve green practices in the building sector. Barriers in GSCM must therefore be removed [18]. To encourage enterprises to meet more GSCM requirements in order to provide goods or services to the public sector, the government may still need to properly incorporate its national green development principles into the public procurement laws [38].

Enforcing policies legally is essential for GSCM. Construction companies will begin implementing green practices in line with rules if they are developed with the intention of enforcing them. In addition, the government can assist businesses who are successfully using GSCM by funding them and giving tax-based incentives [32]. As a result, governments ought to promote and give greater thought to the need for GSCM implementation. GSCM is the process of combining environmental regulations with supply chain management. This integration covers the entire product design process as well as raw material procurement, manufacture, and transportation [39]. Inadequate information, training and expertise. Improving the structure of information presentation is essential for boosting consumers' faith in environmentally friendly products, among other barriers. Furthermore, it's critical to guarantee that the required amount of information is provided. More research is still needed to determine how to deliver relevant and sufficient information [23]. It is not always simple for people to comprehend the potentially harmful effects of a method or product. Additionally, it is not feasible to cover all industries and only a small number of members has the necessary ability in GSCM implementation. Therefore, there should be a rise in the number of highly qualified workers who possess in-depth understanding of GSCM and how to apply it before such practitioners infer it onto industries [28]. The biggest obstacle to implementing SSCM techniques was determined to be inadequate training and instruction on sustainability, a finding that is supported by literature [30].

EB 2: Pollution

In addition, clothing industries are located in cities. In Bangladesh, the urban environment is typically more polluted than the rural environment [12].

EB 3: Lack of awareness

The ISM model's lowest level, which indicates that it has the greatest influence, indicates that one of the main obstacles to sustainability is a lack of knowledge about its advantages [40]. The degree of awareness regarding the environmental impact of their operations and the regulations put in place to mitigate it were far higher than what was previously indicated by research on other industries and situations [41]. Similarly, consumers are seen as both the drivers and the hurdles to the adoption of green supply chain management (GSCM). The public's lack of information about GSCM, as well as consumers' desire and reluctance to pay more for environmentally friendly items, prevent businesses from putting this approach into effect [5]. To reduce the distance between obstacles and achievements, awareness needs to be raised among owners, officers, executives, and employees [3]. Additionally, businesses ought to launch environmental product advertisements to raise public and customer awareness. In order to do all of this, government assistance in the form of resources, incentives, rules, and their enforcement is crucial [32].

EB 4: Inadequate education and collaboration:

It is important to inform and educate customers about the consequences of their cooperative purchasing practices. It is now one of the most significant variables and has the potential to be crucial to the functioning of the entire system [23].

EB 5: Lack of technological advancement:

Modern technology is the most crucial factor in making GSCM implementation simple; in fact, some GSCM processes are impossible to imagine without it [42]. The adoption of green practices is hampered by the high costs of modern technology and the lack of technical skills, which makes it difficult for many enterprises to acquire and apply these innovations even with breakthroughs in green technologies. Furthermore, new technologies might not be compatible with the supply chain infrastructures that are currently in place, requiring expensive overhauls and integrations. The necessity for ongoing innovation and the spread of sustainable technologies is highlighted by these technological obstacles [35]. Furthermore, it's evident from the research's findings that one of the main obstacles to GSCM practice implementation is a lack of infrastructure and technology and employees in the textile and garment industries need to be capable leaders who can think forward while taking innovation and technology into account [36, 43].

Research Methodology

It is important to employ a scientific ranking tool in order to comprehend the intricate interdependencies among various sustainability hurdles. The DEMATEL technique is suggested in this study to analyze the barriers to sustainability adoption in the industrial sector due to its multifaceted uses. Additionally, the barriers and the cause-and-effect relationship were analyzed using the decision-making trial and evaluation laboratory (DEMATEL) approach [44]. The DEMATEL approach should be expanded to assess criteria in an uncertain environment that takes into account fuzzy or linguistic variables due to the ambiguous or unclear environment [45]. Fuzzy Decision Making Trial and Evaluation Laboratory (DEMATEL) approach was used to create relation matrixes that show how these aspects are interconnected [46], to analyze uncertain influential factors [45], to assess the most common diseases and to understand the complex multi-criteria relationship [47] to prioritize barriers and handles causal relationship [48].

A popular technique for examining several competing criteria is MCDM. The MCDM technique contributes to higher-quality decisions by making the decision-making process more efficient and reasonable. In this study, DEMATEL is employed to determine the fundamental reasons and consequences of manufacturing strategy

outputs. Expert opinion is consulted in order to suggest the relationship between these underlying factors. The ambiguity of experts' decisions during the prioritization of the chosen improvement activities is addressed by the fuzzy DEMATEL approach [49]. Drawing the causality map and gathering indications for each factor's degree of cause and influence are two steps in the fuzzy DEMATEL technique. After assessing each factor's important association path in respect to the predetermined threshold, it offers a number of management implications and suggestions based on more research and discussion. By calculating the center degree and cause a degree of each factor, creating a causal diagram, classifying factors (cause group or effect group), and identifying critical factors that will aid in problem solving more successfully, this method creates a visual structure based on the causal relationship between various factors [50]. An experienced expert panel shared their expertise opinion in regard of the issue green supply chain management implementation barriers. Their opinion was taken by means of Fuzzy DEMATTEL questionnaire and question were about interrelationship between externa and internal barriers of GSCM implementation. Data ware analyzed by MCDM online software (Fuzzy DEMATEL method). Most of their answer and literature gives an effect to evaluate relationship between barriers of internal and external relationship.

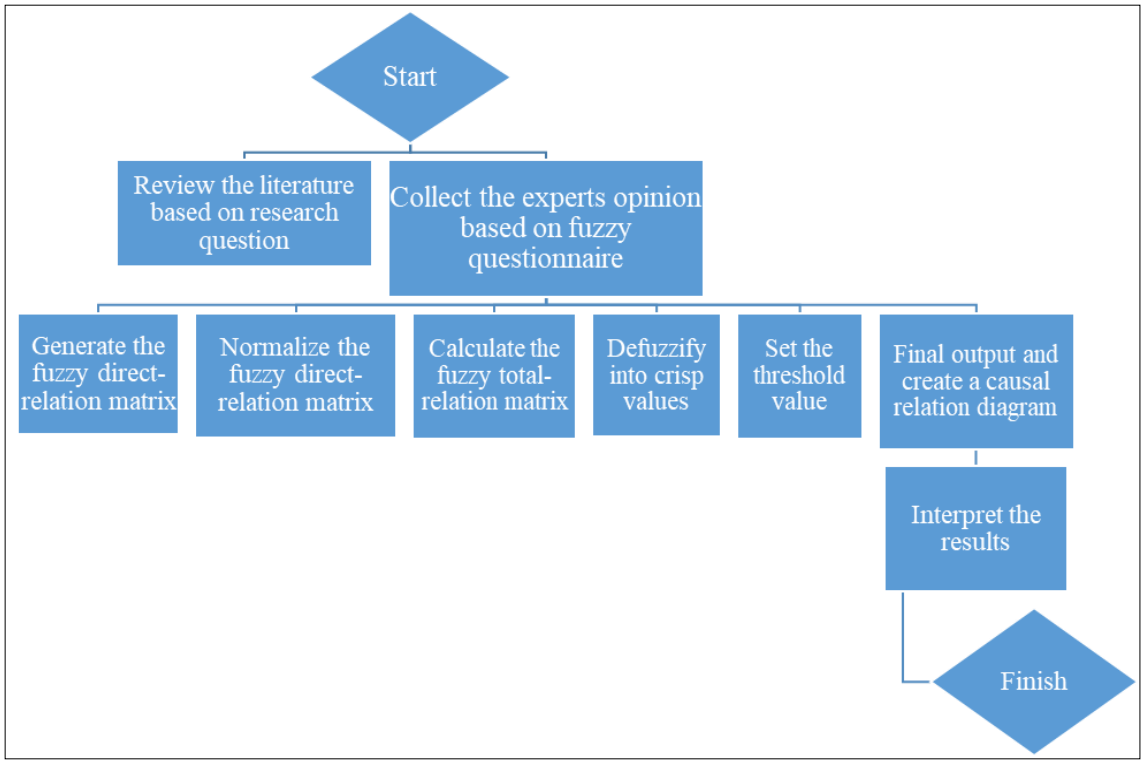

Fig 1: Conceptual Framework

Table 1: Source of Experts

Expert	Type of company	Working areas	Years of experience	Role
E1	Textile Company “A”	Business Administration	12 Years	Manager
E2	Textile Company “B”	Inventory Management	10+ Years	Supply Chain Manager
E3	Textile Company “C”	Supply Chain Management	10 Years	Logistics manager
E4	Textile Company “D”	Supply Chain Management	8 Years	Senior Manage

Data Analysis

Application of the Fuzzy DEMATEL Method in analyzing the Green Supply Chain Management Implementation Barriers:

A Fuzzy Number: A fuzzy number is a connected collection of potential values with a weight assigned to each value between 0 and 1. It is a generalization of a regular, real number. Consequently, a convex, normalized fuzzy set of the real line is a specific instance of a fuzzy number [51]. To reduce uncertainty in the subjective evaluation by expert’s fuzzy theory in the DEMATEL method applied to analyze elements influencing the eco-efficiency of remanufacturing [46]. Specific steps are shown as follows:

Step 1: Generate the fuzzy direct- relation matrix

Based on above literature, 10 GSCM implementation barriers are identified to rethink in textile industries supply chain system. To make an assessment on interdependent relationships among these factors, a consultative group of experts is established, which consists of four experts in business administration, inventory management and supply chain management and role of them are manager, supply chain manager, logistics manager and senior manager. In order to identify the model of the relations among the n criteria, an n × n matrix is first generated. The influence of the element in each row exerted on the element in each column of this matrix can be represented a fuzzy number. If multiple experts' opinions are used, all experts must complete the matrix. arithmetic mean of all of the experts' opinions is used to generate the direct relation matrix z.

$$z = \begin{bmatrix} 0 & \cdots & \tilde{z}_{n1} \\ \vdots & \ddots & \vdots \\ \tilde{z}_{1n} & \cdots & 0 \end{bmatrix} \quad (1)$$

The table below indicates the direct relation matrix, which is the same as pairwise comparison matrix of the experts of internal and external barriers.

Table 2a: The direct relation matrix (Internal Barriers)

	IB1	IB2	IB3	IB4	IB5
IB1	(0.000,0.000,0.000)	(0.063,0.313,0.563)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.250,0.500,0.750)
IB2	(0.500,0.750,1.000)	(0.000,0.000,0.000)	(0.438,0.688,0.938)	(0.000,0.250,0.500)	(0.250,0.500,0.750)
IB3	(0.125,0.375,0.625)	(0.500,0.750,1.000)	(0.000,0.000,0.000)	(0.250,0.500,0.750)	(0.375,0.625,0.875)
IB4	(0.750,1.000,1.000)	(0.250,0.500,0.750)	(0.625,0.875,1.000)	(0.000,0.000,0.000)	(0.000,0.250,0.500)
IB5	(0.625,0.875,1.000)	(0.063,0.313,0.563)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.000,0.000,0.000)

Table 2b: The direct relation matrix (External Barriers)

	EB1	EB2	EB3	EB4	EB5
EB1	(0.000,0.000,0.000)	(0.500,0.750,1.000)	(0.500,0.750,1.000)	(0.250,0.500,0.750)	(0.500,0.750,1.000)
EB2	(0.625,0.875,1.000)	(0.000,0.000,0.000)	(0.000,0.250,0.500)	(0.250,0.500,0.750)	(0.250,0.500,0.750)
EB3	(0.500,0.750,1.000)	(0.063,0.313,0.563)	(0.000,0.000,0.000)	(0.500,0.750,1.000)	(0.500,0.750,1.000)
EB4	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.688,0.938,1.000)	(0.000,0.000,0.000)	(0.250,0.500,0.750)
EB5	(0.625,0.875,1.000)	(0.500,0.750,1.000)	(0.500,0.750,1.000)	(0.250,0.500,0.750)	(0.000,0.000,0.000)

One crucial technique for making decisions in an uncertain setting is the fuzzy DEMATEL. In order to clearly display expert choices with linguistic variables, a fuzzy DEMATEL has to be created (45). Since mathematics provides more objective solutions, it is thought to be more logical to translate linguistic terms into fuzzy numbers rather than combining ideas, opinions, or conclusions that result from the knowledge of individuals or organizations. Thus, in order to address the issues associated with group decision-making, fuzzy number generation must be implemented (47).

Table 3: Linguistic expressions and their values/ Fuzzy scale

Linguistic Terms	Linguistic Values (L, M, U)		
No influence	0	0	0.25
Very low influence	0	0.25	0.5
Low influence	0.25	0.5	0.75
High influence	0.5	0.75	1
Very high influence	0.75	1	1

The relationship between the components is measured using five English phrases: "no influence," "very low influence," "low influence," "high influence," and "very high influence." The phrases are represented by the numbers 0 and 1. Table 2 shows the direct relationship matrix, which depicts the direct relationship among components, as recommended by the expert advisory panel.

Step 2: Normalize the fuzzy direct-relation matrix

The normalized fuzzy direct-relation matrix can be obtained using the following formula:

$$\tilde{x}_{ij} = \frac{\tilde{z}_{ij}}{r} = \left(\frac{l_{ij}}{r}, \frac{m_{ij}}{r}, \frac{u_{ij}}{r}\right) \quad (2)$$

Where,

$$r = \max_{i,j}\left\{\max_i \sum_{j=1}^{n} u_{ij}, \max_j \sum_{i=1}^{n} u_{ij}\right\} \; i,j \in \{1,2,3,\dots,n\} \quad (3)$$

Table 4a: The normalized fuzzy direct-relation matrix (Internal Barrier)

	IB1	IB2	IB3	IB4	IB5
IB1	(0.000,0.000,0.000)	(0.017,0.086,0.155)	(0.069,0.138,0.207)	(0.069,0.138,0.207)	(0.069,0.138,0.207)
IB2	(0.138,0.207,0.276)	(0.000,0.000,0.000)	(0.121,0.190,0.259)	(0.000,0.069,0.138)	(0.069,0.138,0.207)
IB3	(0.034,0.103,0.172)	(0.138,0.207,0.276)	(0.000,0.000,0.000)	(0.069,0.138,0.207)	(0.103,0.172,0.241)
IB4	(0.207,0.276,0.276)	(0.069,0.138,0.207)	(0.172,0.241,0.276)	(0.000,0.000,0.000)	(0.000,0.069,0.138)
IB5	(0.172,0.241,0.276)	(0.017,0.086,0.155)	(0.069,0.138,0.207)	(0.069,0.138,0.207)	(0.000,0.000,0.000)

Table 4b: The normalized fuzzy direct-relation matrix (External Barriers)

	EB1	EB2	EB3	EB4	EB5
EB1	(0.000,0.000,0.000)	(0.133,0.200,0.267)	(0.133,0.200,0.267)	(0.067,0.133,0.200)	(0.133,0.200,0.267)
EB2	(0.167,0.233,0.267)	(0.000,0.000,0.000)	(0.000,0.067,0.133)	(0.067,0.133,0.200)	(0.067,0.133,0.200)
EB3	(0.133,0.200,0.267)	(0.017,0.083,0.150)	(0.000,0.000,0.000)	(0.133,0.200,0.267)	(0.133,0.200,0.267)
EB4	(0.067,0.133,0.200)	(0.067,0.133,0.200)	(0.183,0.250,0.267)	(0.000,0.000,0.000)	(0.067,0.133,0.200)
EB5	(0.167,0.233,0.267)	(0.133,0.200,0.267)	(0.133,0.200,0.267)	(0.067,0.133,0.200)	(0.000,0.000,0.000)

Step 3: Calculate the fuzzy total-relation matrix

In step 3, the fuzzy total-relation matrix can be calculated by the following formula:

$$\tilde{T} = \lim_{k \to +\infty} (\tilde{x}^1 \oplus \tilde{x}^2 \oplus \dots \oplus \tilde{x}^k) \quad (4)$$

If each element of the fuzzy total-relation matrix is expressed as $\tilde{t}_{ij} = (l''_{ij}, m''_{ij}, u''_{ij})$, it can be calculated as follows:

$$[l''_{ij}] = x_l \times (I - x_l)^{-1} \quad (5)$$

$$[m''_{ij}] = x_m \times (I - x_m)^{-1} \quad (6)$$

$$[u''_{ij}] = x_u \times (I - x_u)^{-1} \quad (7)$$

In other words, the normalized matrix the inverse is first calculated, and then it is subtracted from the matrix I, and finally the normalized matrix is multiplied by the resulting matrix. The following table shows the fuzzy direct-relation matrix of GSCM implementation barriers (Internal and External).

Table 5a: The fuzzy total-relation matrix (Internal Barriers)

	IB1	IB2	IB3	IB4	IB5
IB1	(0.041,0.219,1.092)	(0.039,0.230,1.050)	(0.097,0.313,1.222)	(0.084,0.265,1.056)	(0.084,0.272,1.091)
IB2	(0.170,0.418,1.421)	(0.027,0.172,1.009)	(0.147,0.378,1.364)	(0.029,0.232,1.100)	(0.098,0.300,1.191)
IB3	(0.097,0.361,1.386)	(0.155,0.355,1.252)	(0.049,0.233,1.188)	(0.088,0.290,1.168)	(0.126,0.331,1.235)
IB4	(0.244,0.512,1.444)	(0.105,0.328,1.204)	(0.211,0.460,1.401)	(0.035,0.195,0.995)	(0.046,0.278,1.161)
IB5	(0.206,0.451,1.383)	(0.042,0.251,1.110)	(0.106,0.342,1.291)	(0.092,0.289,1.116)	(0.028,0.176,0.982)

Table 5b: The fuzzy total-relation matrix (External Barriers)

	EB1	EB2	EB3	EB4	EB5
EB1	(0.097,0.385,2.668)	(0.184,0.475,2.627)	(0.195,0.513,2.736)	(0.124,0.417,2.537)	(0.193,0.499,2.740)
EB2	(0.209,0.499,2.434)	(0.051,0.253,2.018)	(0.061,0.349,2.228)	(0.100,0.355,2.140)	(0.113,0.384,2.275)
EB3	(0.201,0.529,2.788)	(0.082,0.375,2.471)	(0.084,0.341,2.449)	(0.176,0.453,2.503)	(0.189,0.485,2.658)
EB4	(0.140,0.462,2.540)	(0.110,0.389,2.313)	(0.229,0.521,2.460)	(0.056,0.273,2.110)	(0.127,0.418,2.418)
EB5	(0.247,0.591,2.879)	(0.189,0.488,2.627)	(0.200,0.527,2.736)	(0.128,0.429,2.537)	(0.081,0.346,2.530)

Step 4: Defuzzify into crisp values

The CFCS method proposed by (52) has been used to obtain a crisp value of total-relation matrix. The steps of CFCS method are as follows:

$$l_{ij}^n = \frac{\left(l_{ij}^t - \min l_{ij}^t\right)}{\Delta_{min}^{max}}$$

$$m_{ij}^n = \frac{(m_{ij}^t - min\ l_{ij}^t)}{\Delta_{min}^{max}}$$

$$u_{ij}^n = \frac{(u_{ij}^t - min\ l_{ij}^t)}{\Delta_{min}^{max}}$$

So that

$$\Delta_{min}^{max} = \max u_{ij}^t - \min l_{ij}^t$$

Calculating the upper and lower bounds of normalized values:

$$l_{ij}^s = {m_{ij}^n}\Big/{(1 + m_{ij}^n - l_{ij}^n)} \quad (8)$$

$$u_{ij}^s = {u_{ij}^n}\Big/{(1 + u_{ij}^n - l_{ij}^n)} \quad (9)$$

The output of the CFCS algorithm is crisp values.
Calculating total normalized crisp values:

$$x_{ij} = \frac{[l_{ij}^s\left(1 - l_{ij}^s\right) + u_{ij}^s \times u_{ij}^s]}{[1 - l_{ij}^s + u_{ij}^s]} \quad (10)$$

Table 6a: The crisp total-relation matrix (Internal Barriers)

	IB1	IB2	IB3	IB4	IB5
IB1	0.366	0.364	0.459	0.391	0.403
IB2	0.568	0.315	0.529	0.369	0.439
IB3	0.517	0.491	0.393	0.424	0.469
IB4	0.64	0.461	0.595	0.328	0.414
IB5	0.588	0.388	0.49	0.417	0.312

Table 6b: The crisp total-relation matrix (External Barriers)

	EB1	EB2	EB3	EB4	EB5
EB1	0.772	0.831	0.879	0.767	0.869
EB2	0.829	0.56	0.671	0.66	0.708
EB3	0.904	0.727	0.701	0.794	0.847
EB4	0.813	0.716	0.847	0.59	0.757
EB5	0.965	0.841	0.889	0.776	0.716

Step 5: Set the threshold value

The threshold value must be obtained in order to calculate the internal relations matrix. Accordingly, partial relations are neglected and the network relationship map (NRM) is plotted. Only relations whose values in matrix T is greater than the threshold value are depicted in the NRM. To compute the threshold value for relations, it is sufficient to calculate the average values of the matrix T. After the threshold intensity is determined, all values in matrix T which are smaller than the threshold value are set to zero, that is, the causal relation mentioned above is not considered.

In this study, the threshold value is equal to 0.4450.445 and in external barriers, the threshold value is equal to 0.7770.777

All the values in matrix T of internal barriers which are smaller than 0.4450.445 are set to zero, that is, the causal relation mentioned above is not considered. The values in matrix T which represents external barriers are smaller than 0.7770.777 are set to zero, that is, the causal relation mentioned above is not considered. The model of significant relations is presented in the following table.

Table 7a: The crisp total- relationships matrix by considering the threshold value (Internal Barriers)

	IB1	IB2	IB3	IB4	IB5
IB1	0	0	0.459	0	0
IB2	0.568	0	0.529	0	0
IB3	0.517	0.491	0	0	0.469
IB4	0.64	0.461	0.595	0	0
IB5	0.588	0	0.49	0	0

Table 7b: The crisp total- relationships matrix by considering the threshold value (External Barriers)

	EB1	EB2	EB3	EB4	EB5
EB1	0	0.831	0.879	0	0.869
EB2	0.829	0	0	0	0
EB3	0.904	0	0	0.794	0.847
EB4	0.813	0	0.847	0	0
EB5	0.965	0.841	0.889	0	0

Step 6: Final output and create a causal relation diagram

The next step is to find out the sum of each row and each column of T (in step 4). The sum of rows (D) and columns (R) can be calculated as follows:

$$D = \sum_{j=1}^{n} T_{ij} \quad (11)$$

$$R = \sum_{i=1}^{n} T_{ij} \quad (12)$$

Then, the values of D+R and D-R can be calculated by D and R, where D+R represent the degree of importance of factor i in the entire system and D-R represent net effects that factor *i* contributes to the system.

The table below shows the final output of internal barriers.

Table 8a: The final output (Internal Barriers)

	R	D	D+R	D-R
IB1	2.68	1.983	4.663	-0.697
IB2	2.018	2.219	4.237	0.201
IB3	2.465	2.294	4.758	-0.171
IB4	1.929	2.437	4.366	0.508
IB5	2.037	2.195	4.232	0.158

The following figure shows the model of significant relations. This model can be represented as a diagram in which the values of (D+R) are placed on the horizontal axis and the values of (D-R) on the vertical axis.

The position and interaction of each factor with a point in the coordinates (D+ R, D-R) are determined by coordinate system.

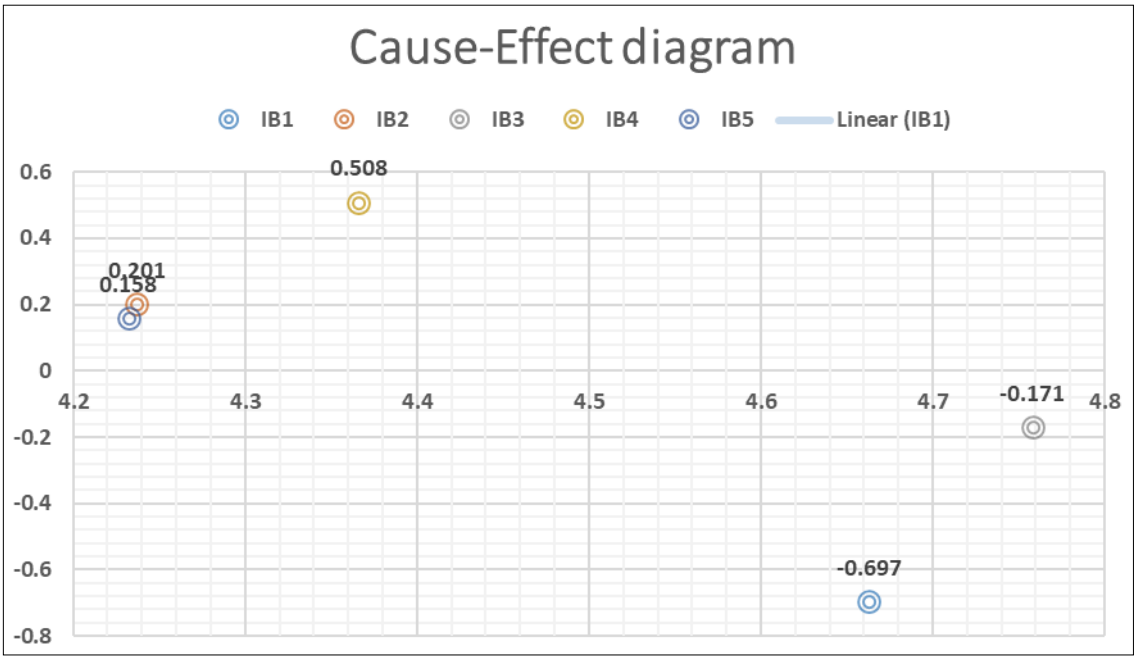

Fig 1: Cause-effect diagram (Internal Barriers)

The table below shows the final output of external barriers.

Table 8b: The final output (External Barriers)

	R	D	D+R	D-R
EB1	4.283	4.117	8.401	-0.166
EB2	3.674	3.428	7.102	-0.247
EB3	3.986	3.972	7.959	-0.014
EB4	3.587	3.724	7.311	0.137
EB5	3.898	4.187	8.085	0.29

The following figure shows the model of significant relations. This model can be represented as a diagram in which the values of (D+R) are placed on the horizontal axis and the values of (D-R) on the vertical axis. The position and interaction of each factor with a point in the coordinates (D+ R, D-R) are determined by coordinate system.

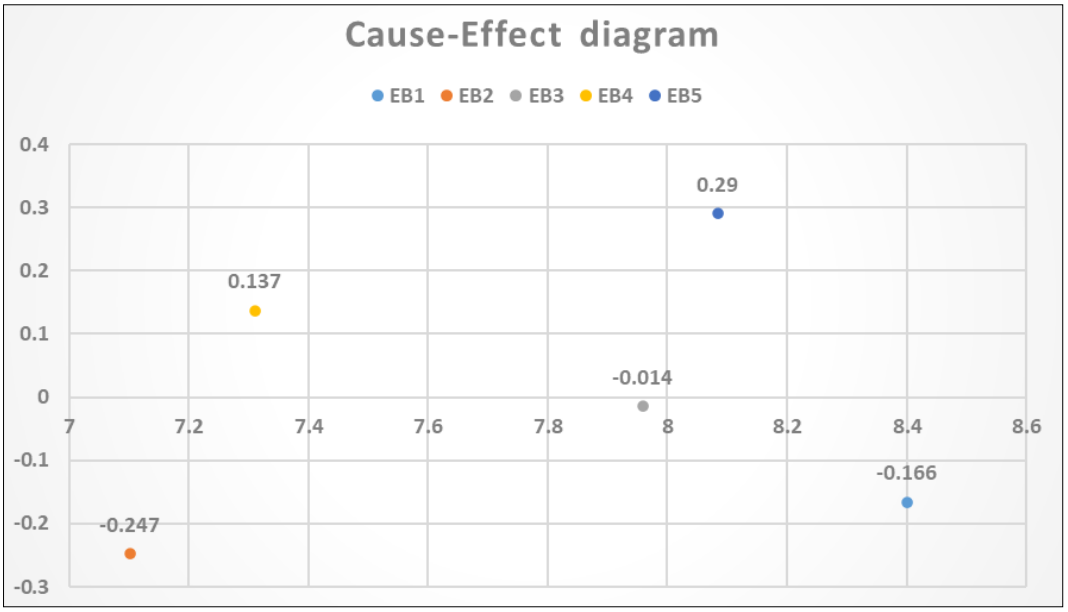

Fig 3: Cause-effect diagram (External Barriers)

Step 7: Interpret the results

According to the diagram and table above, each factor can be assessed based on the following aspects:

Horizontal vector (D + R) represents the degree of importance between each factor plays in the entire system. In other words, (D + R) indicates both factor i's impact on the whole system and other system factors' impact on the factor. The vertical vector (D-R) represents the degree of a factor's influence on system. In general, the positive value of D-R represents a causal variable, and the negative value of D-R represents an effect. In terms of degree of importance in internal variables, IB3 is ranked in first place and IB1, IB4, IB2 and IB5, are ranked in the next places. In this study, IB2, IB4, IB5 are considered to be as a causal variable, IB1, IB3 are regarded as an effect.

In terms of degree of importance in external barriers, EB1 is ranked in first place and EB5, EB3, EB4 and EB2, are ranked in the next places. In this study, EB4, EB5 are considered to be as a causal variable, EB1, EB2, EB3 are regarded as an effect.

Result and Discussion

Green supply chain management is a green concept of early supply chain definition with inbound, operational, outbound and reserve logistics. Green thinking, new knowledge, new idea, green supply chain activities from production to manage end life of a product or service is simply connected to the concept of green supply chain management (GSCM) for improving environmental health. GSCM is a technique for assuring environmental protection by minimizing waste, and carbon emissions also it is the idea of assisting in the improvement of research attitudes in several industrial sectors. Most of the researchers come to the point that only adding green activities can protect environment pollution side by side can increase sustainability in business. The perspective of industry experts is the primary focus of this study; analysis of barriers based on numerous stakeholders may offer a more comprehensive picture of an industry in the future. However, the outcomes shown in the textile business could not apply to other industries (23). The findings showed that roughly 40% of the studies examined the advantages of GSCM implementation, while roughly 10% dealt with the difficulties in doing so. Consequently, it follows that future research should focus on studies that could help to lessen and/or remove implementation difficulties related to GSCM [19].

Causal and Effective: Findings and Comments Using the mathematical methodology detailed above, the graph showing the cause–effect relationship (Fig. 1 and 2) has been separated into two groups: the cause group and the effect group. The results and implications of the causes and effects of the diseases have been examined and interpreted below-

Cause Factors: Examining and interpreting the cause and effect groups we obtained is necessary for understanding the relationships among the 10 barriers among them 5 are internal and rest of 5 are external barriers of green supply chain management activities in textile sectors in Bangladesh. While investigating Fig. 1, IB 1: Lack of top management support has the highest D-R value (-0.171) among internal barriers. This means that IB 1 impacts all the other barriers the most. Moreover, IB 5: Resistance to change D-R value (0.158) makes it the second most crucial cause factor. In external barriers the most critical barriers among all others is EB 4: Inadequate education and collaboration with D-R= 0.137. This sequence continues with EB 5: Pollution with 0.29. The other cause factors appear to have relatively moderate impacts on the other internal diseases.

Effect Factors: Influential effect factors can undoubtedly be easily affected by other diseases. Analyzing the effect factors (GSCM implementation barriers) that could lead to take effective initiative in greening the supply chain activities. According to the cause-and-effect relation diagram depicted in Fig.1 and 2, IB 3: Unfavorable working conditions is clearly seen to have the highest D-R value (-0.014) among the effect factors group. Moreover, its influenced impact index IB 2: Financial constraints, EB 1: Lack of government initiative, EB 2: Lack of technological advancement, EB 3: Lack of awareness were the value respectively -0.247, -0.247, -0.014 among the whole process of internal and external barriers and have incontrovertibly great influences on all the diseases as effect factors.

Table 9: Barrier wise Cause-Effect status and Rank of each barriers

SL No.	Category	Barriers	Cause-Effect Status	Rank
1.	Internal Barriers	IB 1: Lack of top management support	Cause	2nd
2.		IB 2: Financial constraints	Effect	4th
3.		IB 3: Unfavorable working conditions	Effect	1st
4.		IB 4: Complex internal policies	Cause	3rd
5.		IB 5: Resistance to change	Cause	5th
6.	External Barriers	EB 1: Lack of government initiative	Effect	1st
7.		EB 2: Lack of technological advancement	Effect	5th
8.		EB 3: Lack of awareness	Effect	3rd
9.		EB 4: Inadequate education and collaboration	Cause	4th
10.		EB 5: Pollution	Cause	2nd

Managerial and Policy Implications

There are not enough authoritative certification standards for the textile industry in Bangladesh, which may discourage enterprises from adopting GSCMP. Banking and others financial companies like Bangladesh are showing little interest in giving loan facilities for GSCM activities, besides the lack of government subsidies and other financial incentives is especially forcing these sectors to stagnate in green activities by the textile industries. As a result, suppliers show indifference in the supply of eco-friendly materials, many times market research shows that these materials are very insufficient in the market. So there is no interest or less interest in GSCM practices by top management of the textile industry. So, in this case everyone is losing enthusiasm in production of green materials. This study will help researchers, supply chain manager and academician to rethink the barriers and which barriers need to focus more can be analyzed by this. In this thinking of top management adding additional thinking this is not pushing by customers and government, which is another major barrier to adopting GSCM practices by Emerging Countries Industries. Investigated the effects of government budgetary measures on GSCM adoption. The government might also motivate a company by offering technical support and insufficient knowledge about green practices. Literature shows that, poor coordination and lack of proper flow of information between various supply chain department, customers, suppliers, top management, government, GSCM experts add extra cause to the barriers of green supply chain management need to investigate and analyzed.

Conclusion

Most of the vital sectors which consists of an economy and most contribution to the economy came from this textile sectors. Bangladesh as an emerging economy mostly depends on textile industry basically on garments industry. Textile industries are continuing numerous supporting activities in the story of industrial revolution and the progress of a country. The industry sector continues to contribute directly and indirectly in addition to huge employment, earning foreign exchange, achieving self-reliance, city oriented mindset of village people, work arrangements of women workers, improvement of standard of living etc. Businesses that integrate green supply chain principles into their operations reap a number of advantages. These advantages include lower expenses due to decreased consumption and waste production. Adopting green practices improves the organization's brand image and increases consumer loyalty, among other benefits (17). Although GSCM has many crucial contributions to the industrial sector and economy, it is not possible to accelerate its activities in the face of various obstacles in developing countries like Bangladesh. Basically, more investigation is required to find out the reasons for GSCM implementation barriers, which is very less observed. Moreover, among the obstacles, which one should be prioritized first and which one should be prioritized later, there have doubt in the research area, but this is the most important issue in this case. Lack of top management support, financial constraints, unfavorable working conditions, complex internal policies, resistance to change are identified as internal barriers from which unfavorable working conditions need to give most priority and lack of government initiative, lack of technological advancement, lack of awareness, inadequate education and collaboration, pollution are identified external barriers from which lack of government initiative is the most prioritized barriers which need to give more attention by government. In addition, this paper deals with some fundamental barriers like supply chain complexity, lack of customer demand for sustainable products for high cost and intention to buy, a weak government regulatory system, little aware and consciousness about environmental consequences, a lack of promotion of sustainable products, financial obstacles, suppliers indifference for supply eco-friendly materials, technical obstacles and overall absence of proper coordination in the textile sector can be the most significant barriers to green supply chain adoption in Bangladesh's textile industry which need to lessen for implementing GSCM practice.

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