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RESEARCH ARTICLE

ANALYZING AND PRIORITIZING THE FACTORS OF GREEN SUPPLY CHAIN MANAGEMENT PRACTICES IN SINDH, PAKISTAN

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Abstract

Green supply chain management (GSCM) has become a prevalent practice around the world due to increasing awareness of environmental protection and sustainability. Small and Medium Sized Enterprises (SMEs) are under tremendous pressure to transform their supply chain practices into green operations to strengthen their green image and ensure environmental sustainability. The GSCM aims to accomplish sustainable development goals (SDGs) by reducing ecological damage generated by traditional supply chain practices. Thus, it is important to reorganize SMEs' supply chain operations into GSCM practices such as green design, green production, green purchase, a green warehouse, logistics, and reverse logistic operations. This study has undertaken the case of four SMEs for assessing GSCM practices in the context of Sindh. In this research study, the Analytical Hierarchy Process (AHP) is proposed to evaluate and rank six GSCM factors (criteria) and sixteen sub-factors (sub-criteria). The AHP findings show that green design is a top priority factor following green purchasing and green production for implementing the GSCM practices. This study intends to aid SMEs in adopting GSCM practices in Sindh.

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Introduction:-

Since 1990, researchers and policymakers have become progressively more concerned about environmental and climate change issues, and they have become eager about green supply chain practices. Green supply chain management (GSCM) has evolved as a crucial organizational concept for achieving profits and market share targets while decreasing environmental risks and potential consequences and increasing the ecological efficiency of these firms and their collaborators (Huo et al., 2019). Because of the rising awareness of environmental protection and long-term sustainability, GSCM has become a very popular practice. Green practices are required of industries in order to strengthen the green image and for the comprehensive improvement of and related to the environment (Tippayawong et al., 2016). In that perspective, several Small and Medium Enterprises (SMEs), such as those in the goods, services, fashion, manufacturing, construction, hospital, agriculture, and mining industries, practice GSCM around the globe. As a consequence, SMEs should impose more robust environmental requirements and controls on their operations to avoid harmful environmental activities, for instance, excessive waste and the exploitation of raw materials from locations. (Cosimato and Troisi, 2015). The primary objective of GSCM is to achieve long-term development goals by reducing the environmental harm caused by supply chain operations. As a result, GSCM activities make reorganizing design, buying, manufacturing, storage, and logistics processes necessary and

achievable for businesses. Furthermore, in order to maximize the value of used items and resources or to properly recycle them, reverse logistics is a fundamental aspect of GSCM operations (Lee et al., 2014).

Furthermore, despite the widespread adoption and implementation of GSCM methods in many countries, there is still potential for practical and research implications. Several motives for organizations to adopt GSCM techniques have been documented in earlier study (Gurtu et al., 2016; Habib et al., 2020; "Integration of Green Practices in Supply Chain Environment The practices of Inbound, Operational, Outbound and Reverse logistics," 2011; Tseng and Chiu, 2013). According to prior research, some businesses use GSCM to meet consumer expectations, while others do so to comply with environmental standards. Globalization has compelled governments to implement environmentally, socially, and economically sustainable actions (Cosimato and Troisi, 2015). As a result, creating industrial value is crucial for a long-term sustainable manufacturing process. One of the previous studies reveals that certain challenges are faced while implementing sustainable supply chain development (Bastas and Liyanage, 2018). The goals are set, and they aim to promote global equity and long-term health by preserving a positive and harmonious interaction between people and the planet. Another study takes a macro and micro approach to look at the economic, ecology, and social prospects for industrial value generation in Fourth Industrial Revolution and finds that creating industrial value contributes positively to long-term sustainable development (Piccarozzi et al., 2018).

To address the matters above, two objectives were set. The primary goal of this research is to provide a comprehensive set of factors and sub-factors that can be used to analyze SMEs' SCM practices using the AHP method. This research aims to consider GSCM factors in SMEs in Sindh, Pakistan. Furthermore, this is the very first study to use the AHP method to assess green SCM practices with respect to the SMEs of Sindh. The AHP approach is applied to rank and assess the essential green factors and sub-factors of Sindh in GSCM practices. These factors and sub-factor may also be benchmark tools for evaluating SMEs GSCM practices.

Literature Review:-

GSCM is a rising area of attention in professional and academic sectors, emphasizing green process improvement, reverse flow or waste minimization, quality of product life cycle improvement, and reduced hazardous environment activities (Piccarozzi et al., 2018). GSCM focuses on green activities closely linked to sustainable and environmentally friendly processes. In the meanwhile, traditional SCM practices are harmful and precarious for the environment, for instance, the production of raw materials, goods distribution, and unwanted material, which is capable of having a dangerous effect on the environment while being a potential cause of different kinds of pollution (Mathivathanan et al., 2018). Thus, to protect the environment and minimize the hazardous effects, it is important to consider the GSCM practices such as green production, green manufacturing, green purchasing, green design, green packaging, and reverse logistics with SCM procedures as a whole (Tippayawong et al., 2016). Several countries have come up with plans to create environmental standards and rules for enterprises in order to safeguard the environment from harmful events. For sustainable environmental, economic, and social growth, these guidelines urge enterprises to implement green and environmentally friendly techniques throughout their SCM activities.

In earlier research studies, numerous green SCM activities have been discussed with several distinct goals and objectives. Multi-Criteria Decision Making (MCDM) methods are frequently employed to identify suitable solutions for implementing GSCM operations in businesses (Keshavarz Ghorabae et al., 2016). Multi-Criteria Decision Making is an integral part of operations research approaches that help to reduce a complex decision-making issue to a much more manageable problem (Zardari et al., 2015). From 2008 to 2018, Mirko et al. (Stojčić et al., 2019) performed a literature review on sustainability engineering difficulties utilizing MCDM applications. The study's findings show that MCDM approaches are well suited to tackling decision problems related to sustainability. MCDM aids decision-makers in organizing and highlighting the decision issued by assisting them in analyzing, selecting, and ranking options based on the assessment of numerous decision-problem criteria. This research examines green supply chain management techniques from the standpoint of SMEs in Sindh, Pakistan.

The Proposed Factors and Sub-Factors for Green Supply Chain Practices

This research study recognizes various factors and sub-factors for the successful implementation of GSCM practices. The green factors determined in this study are the supporting means for SCM operations. A complete set of literature studies was reviewed to determine the key factors in the context of green supply chain operations. Following a thorough literature survey, six main factors and sixteen sub-factors were found. These factors are Green design (F1), green purchasing (F2), green production (F3), green warehousing (F4), green logistics (F5), and reverse logistics (F6) are the green factors. The GSCM factors and sub-factors are summarized in Table 1.

It is considered that the MCDM techniques have been widely employed in the adoption of GSCM practices. Such methods are used because they are essential in unveiling multifaceted decision-making problems. According to the best knowledge of the authors, this is the very first attempt to examine GSCM practices according to the point of view of SMEs in Sindh. In the current review, an AHP strategy was utilized to assess the GSCM practices among SMEs of Sindh.

Table 1:- The proposed main factors and sub-factors of GSCM.

Main Factor	Sub-Factor
Green Design (F1)	Eco-friendly items (F11) Minimize the use of hazardous items (F12) Minimize the use of materials (F13)
Green Purchasing (F2)	Eco-friendly supplier (F21) Eco-friendly raw material purchase (F22) Eco-friendly actions from suppliers (F23)
Green Production (F3)	Minimize the environmental impact on operations (F31) Cleaner production (F32) Minimize the amount of scrap material (F33)
Green Warehousing (F4)	Eco-friendly packaging (F41) Minimize the inventory levels (F42) Sale of scrap material (F43)
Green Logistics (F5)	Reduce the consumption of fuel (F51) Eco-friendly transportation (F52) Using the Eco-friendly distribution (F53)
Reverse Logistics (F6)	Develop an eco-friendly environment management system (F61) Usage of alternative energy sources (F62) Recycle the end-of-life products (F63)

Research Methodology:-

Saaty developed the AHP approach in the 1970s (Saaty, 1990). The current study uses the AHP method to identify the important and relevant factors and sub-factors for assessing the GSCM techniques in SMEs of Sindh. First and foremost, this study reviews comprehensive literature to discover the significant factors and sub-factors. The AHP technique is utilized to decide the weight and rank of factors (criteria) and sub-factors (sub-criteria) for the effective adoption of GSCM practices that are environmentally friendly.

The detailed steps of AHP method have been discussed in the following paper (Saaty, 2008). The results of the factors and sub-factors for adopting and implementing GSCM in Sindh can be obtained by completing the steps of the AHP technique.

Results and Discussions:-

In this study, a framework for making decisions, i.e., AHP has been utilized to analyze the case of authentic SMEs (manufacturing industries) of Sindh. The established decision methodology was validated using a case study of Sindh taking into account the vagueness and ambiguity of real-life cases. To comply with environmental management requirements, the enterprises in the case study are expected to upgrade and turn their industrial processes into green activities. So, SMEs need to use GSCM factors or criteria in order to meet environmental standards. This decision-making methodology lays forth a mechanism for managers to evaluate and rank six key factors for supply chain operations systematically and practically. The AHP method assessed six factors (criteria) and sixteen sub-factors (sub-criteria).

Case Information

SMEs play a significant role in any country's economic development, such as creating jobs and increasing income and wealth (Glonti et al., 2021). It is an important asset for any country in developing economies through imports and exports, allowing global economic success (Prasanna et al., 2019). Currently, various SMEs are playing a critical part in producing a large share of manufacturing products in Sindh. To comply with the rules and regulations of the environment, as suggested by the government, SMEs are developing green technologies, practices, and

products. Thus, to sustain in the fast-paced competitive markets, SMEs must adopt and implement green practices and GSCM.

SMEs need to comprehend the role and significance of GSCM practices for successfully implementing and developing sustainable manufacturing processes. This research develops GSCM factors and sub-factors for SMEs to transform their activities into green activities. Four manufacturing SMEs were investigated in this research. Due to privacy considerations, the identities of the SMEs are not disclosed in the successful adoption of GSCM practices. The results of this study's analysis will give recommendations to SMEs, as well as be extremely valuable in the execution of GSCM that is both effective and efficient.

Results of the AHP Method

The AHP method was used to estimate the weights of the various main factors and sub-factors with regard to the study's decision process. In the following subsections, the findings of the Analytic Hierarchy Process have been examined and discussed.

Ranking of Main Factors

Fig. 1 shows the weight and rank of the main factors for the GSCM practices in the SMEs of Sindh. The results presented in Fig. 1 reveal that Green Design (F1) with a weight of 0.2583 is the most significant green factor for successfully implementing green SCM techniques in Sindh. The next most significant factor is Green Purchasing (F2), with a 0.2008 weight. The third important factor is Green Production (F3), with a weight of 0.1637. The remaining factors are listed in the order of ranks hereunder: Green Warehousing (F4) with a weight of 0.1597, Green Logistics (F5) with a weight of 0.1155, and lastly, Reverse Logistics (F6) with a weight of 0.1021. The rankings of the green factors show the significance of each factor for the sustainable development of the GSCM practices in SMEs of Sindh.

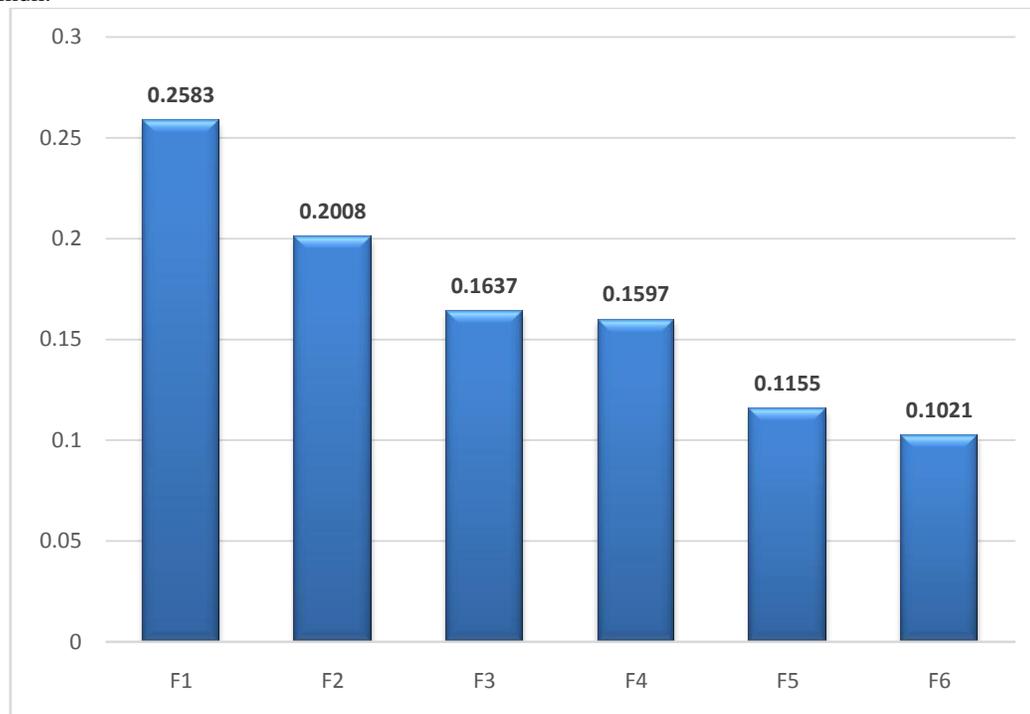


Figure 1:- The results of the main factors of GSCM.

Overall Ranking of Sub-Factors

Table 2 shows the overall ranking of sub-factors with respect to the objective of this research. In general, sixteen sub-factors were analyzed for the assessment of GSCM practices. The results show that eco-friendly items (F11), minimizing the use of hazardous items (F12), and eco-friendly suppliers (F21) are the most important sub-factors (sub-criteria), whereas reducing the consumption of fuel (F51), recycling the end of life products (F63), and using

alternative energy sources (F62) are considered least significant sub-factors for the implementing the GSCM practices in SMEs of Sindh.

Table 2:- The weights and final results of overall sub-factors.

Code	Sub-Factor	Weight	Rank
F11	Eco-friendly items	0.0996	1 st
F12	Minimize the use of hazardous items	0.0951	2 nd
F21	Eco-friendly supplier	0.0846	3 rd
F22	Eco-friendly raw material purchase	0.0666	4 th
F32	Cleaner production	0.0659	5 th
F13	Minimize the use of materials	0.0635	6 th
F41	Eco-friendly packaging	0.0583	7 th
F31	Minimize the environmental impact on operations	0.0567	8 th
F42	Minimize the inventory levels	0.0507	9 th
F43	Sale of scrap material	0.0507	10 th
F23	Eco-friendly actions from suppliers	0.0495	11 th
F61	Develop eco-friendly environment management system	0.0428	12 th
F33	Sale of scrap material	0.0410	13 th
F52	Eco-friendly transportation	0.0392	14 th
F53	Using the Eco-friendly distribution	0.0385	15 th
F51	Reduce the consumption of fuel	0.0378	16 th
F63	Recycle the end-of-life products	0.0315	17 th
F62	Usage of alternative energy sources	0.0278	18 th

Discussion:-

The complex decision problem has been successfully solved through the proposed decision-making methodology. Moreover, the results of the AHP methodology suggest revealing that green design (F1) ranked in the first place, green purchasing (F2) in the second priority, and green production (F3) in the third place. This is the first study to identify the factors and sub-factors for GSCM practices in SMEs of Sindh. Several studies look into an SME's green performance; however, in this study, the AHP method is applied to assess and prioritize the SME's general GSCM practices. The evaluation technique allows SMEs to compare their green practices to other SMEs and gain valuable insight into areas where they may improve. As a result, our research will help managers and governments implement GSCM techniques across the country.

Conclusion:-

In this research, great attention has been given to the significance of green factors. GSCM practices in SMEs have been reviewed and evaluated from the standpoint of Sindh in this study. The primary goal of this study was to use the AHP method to determine relevant factors for analyzing GSCM practices. Consequently, this is the first research study to examine GSCM practices for reducing the adverse environmental effect of supply chain operations. The ability of SMEs to implement green practices based on environmental rules and regulations, and activities must be improved. Based on the literature review, the research contributes to GSCM methods and identifies critical factors for development. As a result, numerous essential and verified factors for effectively implementing GSCM in SMEs of Sindh were identified. To accomplish sustainable development goals, Sindh's SMEs must focus on green practices. The foundations of GSCM implementation methods have been thoroughly covered in numerous studies; nevertheless, this is a significant concern nowadays to investigate and assess the growth of GSCM practices in SMEs of Sindh.

This decision-making technique would aid policymakers, managers, and another concerned workforce in exploring and selecting the most advantageous and appropriate GSCM practices in the case of Sindh.

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