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Supply Chain Sustainability Through Green Practices in Manufacturing: A Case Study from Pakistan

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ABSTRACT

The study aimed to determine the effect of green warehousing, logistics optimizations, social values & ethics, and supply chain risk on supply chain sustainability leading to the economic performance of manufacturing firms in Pakistan. The natural resource-based view (NRBV) theory has been used to understand the phenomenon from a general perspective. Data was collected from 213 supply chain professionals through the purposive sampling technique. PLS-SEM approach has been used for data analysis using Smart PLS (version 3.2.9) and estimated measurement and structural model. Results showed that green warehousing, social values & ethics, and supply chain risk significantly positively affect supply chain sustainability. However, logistics optimization has a positive but statistically insignificant effect on supply chain sustainability. Managers should foster good investor views about the green management system. Managers should also support the use of a green management system, which may boost financial and non-financial performance, making the firm more competitive and increasing corporate value in various ways. Managers could gain a more holistic view of supply chain risk by understanding mature and emerging themes in the field, as well as tools into the scope of supply chain risk, and the significant growth in sustainable supply chain management reflects the need for new business models that are particularly focused on social and environmental issues.

Keywords: *Green supply chain, Social values, Ethics, Quantitative, Sustainability*

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1. Introduction

The emission of greenhouse gas, unsuitable waste management, non-biodegradable product manufacturing, and inappropriate usage of chemical products in supply chains (SC) have led to the destruction of the environment, climate change, global warming, and the end of human life (Le, 2020). Companies use green and social practices in their SCs to reduce their environmental impact, assure social security, increase efficiency, fulfil stakeholder demand, and obtain access to new products. These socially and ecologically aware strategies are employed to minimize greenhouse gas emissions, waste, resource, and energy consumption to safeguard workers' and other stakeholders' safety and good health (Raza et al., 2021). Similarly, supply chain management (SCM) has shifted to emphasize the environmental consequences of manufacturing and the preservation of earth resources due to rising environmental concerns, possible economic advantages, and legislative pressure. As a result, many managers are now using sustainable supply management (SSCM) to drive their supply networks (Govindan et al., 2020).

Likewise, storing, receiving, and transporting raw materials, work-in-progress, and finished goods are all included in green warehousing (GWH), an important part of the SSCM process. Companies that operate sustainable warehouses balance the warehouse's operational influence on the surrounding environmental and social issues and financial ones, such as ordering costs and holding prices. Because one element can influence another, social and environmental variables, a balance between economics must be maintained. Tree planting, carbon credits, and material handling equipment modification are three actions that may be used to decrease the environmental effect of warehouse operations (Torabizadeh et al., 2020). Logistical operations, in general, are environmentally unfriendly. Environmental pollution and greenhouse gas emissions significantly contribute to transportation and logistics activities. This demonstrates the negative impact of logistics operations on the environment and human lives (Mangla et al., 2020). Logistical activities must be improved to minimize negative environmental consequences and ensure environmental sustainability. Businesses must optimize their routes and use clean fuels to reduce pollution that affects human life (Mosteanu et al., 2020; Baloch & Rashid, 2022; Shaheen, 2022).

Additionally, performance is assessed to see how well share-holder funds entrusted to their care have been used to benefit all stakeholders. A company's performance has been measured from various angles (Zhu et al., 2017). Çankaya and Sezen (2019) defined performance as the financial and non-financial results of company processes, activities, policies, capabilities, and resources. Many factors determine firm success, the most significant of which is economic performance. Furthermore, "sustainability" is often used in all key corporate operations and among SC experts. According to Foo et al. (2018), adopting sustainable development principles may entail adjusting company operations and policies to mitigate negative social and environmental consequences. Agyabeng-Mensah et al. (2020) define supply chain sustainability (SCS) as quantifying the positive impact of social policies and green practices on energy and resource conservation and environmental preservation.

Moreover, demand, suppliers, cost, delivery, natural catastrophes, human mistakes, technological boundaries, and security incidents pose risks and uncertainties to SC, leading to significant societal losses. If not properly handled, sustainability risks can result in severe monetary and reputational damages (Fagundes et al., 2020). As a result, developing a sustainable SC requires firms to recognize risks, analyze and monitor how their suppliers manage those risks, and diversify their supplier portfolio to mitigate vulnerabilities (Chowdhury & Quaddus, 2021).

1.2 Problem Statement

Industrial operations have resulted in global environmental challenges and the loss of human lives. As a result of the growing severity of the global environmental crisis, several stakeholder groups, including policy experts and environmental activists, have been compelled to push for more rigorous government rules (Khan et al., 2018; Kumar & Dixit, 2018). Governments have reacted by establishing stronger laws and regulations requiring industries and enterprises to adhere to certain sustainability requirements (Bai et al., 2019). Responding to these multi-stakeholder concerns and demands is crucial for the sustainable development goal. As a result, businesses have begun to include sustainability in their operations and SC (Bai & Sarkis, 2018). Firms have begun to respond to these multi-stakeholder pressures by recognizing the benefits and necessity of sustainability in gaining a competitive edge (Bai et al., 2017). Organizations and SC are being forced to reconsider their processes, technology, goods, and business strategies as the pursuit for sustainability have begun to shift the competitive environment. Sustainable manufacturing and development (industrial ecology) is a path to sustainability. Organizations can use sustainable innovation methods to help them deal with sustainable challenges in their manufacturing processes and SC. On the other hand, firms are having difficulty implementing long-term SC innovation. These organizations encounter numerous obstacles when striving to innovate for long-term sustainability (Gupta et al., 2020). These obstacles must be identified and overcome for SCS ideas to be adopted, implemented, and scaled up. However, due to a lack of resources, it is almost difficult for these groups to simultaneously eradicate all of these hurdles. This necessitates that these organizations first identify the sources of these hurdles, examine the barriers, and then offer solutions to overcome them (Gupta & Barua, 2018).

Several researchers developed long-term SCM frameworks and underlined the necessity of long-term innovation in SSCM. There has been no research specifically attempting to define sustainable innovation implementation criteria for sustainable SC, nor have they been explored in an industrial setting (Kusi-Sarpong et al., 2019). Therefore, this study aimed to determine the effects of Green Warehousing (GWH), Social Values and Ethics (SVE), Logistics Optimizations (LO), and Supply Chain Risk (SCR) on Supply Chain Sustainability (SCS), leading toward the Economic Performance (EP) of the manufacturing firms of Pakistan. Further, the research question for this study is to find the effect of SVE, GWH, LO, and SCR on SCS in the manufacturing firms of Pakistan.

2. Literature Review and Development of Hypothesis

2.1 Green Warehousing and Supply Chain Sustainability

Internal and external logistics and distribution both rely on warehousing. Due to the numerous processes associated with warehouse operations, Abushaikha (2018) indicates that warehouses might be a source of non-value-added activities. In order to limit their negative influence on the environment and human life, warehousing activities create a substantial quantity of rubbish in the supply chain, necessitating the deployment of waste-reduction strategies and policies. This demonstrates that warehousing is a logistics sector in which SCS project implementers must pay special attention to fulfil stakeholder demands and acquire a competitive advantage (Abushaikha, 2018). Several scholars (Çankaya & Sezen, 2019) have recognized the importance of warehouse sustainability and advocated for using environmentally friendly energy sources and methods and energy-efficient handling technology to manage warehouses and related difficulties. Green packaging can also save money by lowering the materials needed and maximizing warehouse space utilization (Agyabeng-Mensah et al., 2020).

Further, Sukjit and Vanichchinchai (2020) determined the extent of GWH and its motives and the influence of motivations on GWH in Thailand. Two hundred sixty-one warehouse managers were polled for information. For data analysis, descriptive statistics and multiple regressions were used. The greatest score for GWH was utilities for GWH, while the lowest score was green management. Regarding motivations, the greatest score was for social duty, while the lowest was for law and regulation. The commitment of top management has a big impact on GWH. Therefore, we propose:

H1: GWH has a significant impact on SCS.

2.2 Social Values & Ethics and Supply Chain Sustainability

Researchers have recently paid too much attention to the role of Social V&E in sustainable development. According to Dubey et al. (2017), the issue has sparked many controversies. Social V&E is acting ethically and socially acceptable behaviors to enhance SCS (Agyabeng-Mensah et al., 2020). Corporate sustainability programs require firm management to motivate employees by including them in company operations, allowing them to grasp the firm's most important issues and accept its freshly carved ideas. Ethical sourcing and buying, according to academics, leads to better environmental performance (Croom et al., 2018). Obtaining non-harmful items and inputs from ethically sound vendors is considered ethical purchasing. Ethical purchasing guarantees that the finest sourcing methods are used to protect the environment and human lives by selecting and acquiring new items and raw materials from suppliers who do not harm people or the environment (Agyabeng-Mensah et al., 2020). Engineering ethics is critical in designing and developing an environmentally SCS. Further, the impact of social values and ethics on SCS and economic performance was investigated by Agyabeng-Mensah et al. (2020). Data were collected from 200 managers of manufacturing businesses in Ghana as part of a quantitative research approach. PLS-SEM was used to evaluate the data. The data demonstrated that social values and ethics positively impact SCS and economic performance. Therefore, we propose:

H2: SVE has a significant impact on SCS.

2.3 Logistics Optimization and Supply Chain Sustainability

Operations involving logistics are an important element of the SC. In general, the nature of logistical activities renders them unfavourable to the environment. Transportation and logistics operations considerably impact pollution and greenhouse gas emissions (Khan et al., 2018). Due to increased demand for products and services, the amount of energy required to transport goods on the road is increasing faster, resulting in the creation of greenhouse gases that are harmful to human health and the environment (Hishan et al., 2019). This demonstrates that logistical activities negatively influence the environment and human lives. Logistical activities must be improved to reduce negative environmental effects and ensure environmental sustainability (Agyabeng-Mensah et al., 2019). The implementation of methods to reduce externalities and increase profitability in green SC operations is referred to as logistics optimization (LO). According to Agyabeng-Mensah et al. (2020), logistics optimization methods positively influence environmental and social performance, and firms may be required to share resources and expertise with SC partners to meet ecological and social sustainability objectives. Therefore, we propose:

H3: LO has a significant impact on SCS.

2.4 Supply Chain Risk and Supply Chain Sustainability

The rise of risk in the SC is not a new topic, and businesses are constantly faced with uncertainty over financing and timely delivery of their goods. The reliance of SC members on one another has grown in recent years; although such reliance has numerous benefits, it also has the potential to create hazards (Shahin et al., 2019). Environmental and organizational variables are factors in supply chain risk (SCR), and they depend on the supply chain. They are not always expected and have an impact on SC output variables. The apparent feature of SCR factors is that they rely on SC structure (Gouda & Saranga, 2018). SCR is a stumbling block for SSCM. SCR contributes to significant issues like tumultuous settings, unclear supply and demand, and unanticipated diseases, all too frequent nowadays (Shafiq et al., 2017). Many SC managers find it difficult to respond to these issues. SCRM research, according to Shahin et al. (2019), has mostly ignored the importance of sustainability problems. Many studies have been done on the SCR and SCS, independently, based on literature. Further, Shahin et al.

(2019) looked at how SCR affects SCS. Data was collected from senior and intermediate managers using a structured questionnaire. PLS-SEM was used to analyze the data, where SCR found a substantial effect on SCS. Therefore, we propose:

H4: SCR has a significant impact on SCS.

2.5 Theoretical Background

The RBV of the company asserts that a business's resources and competencies give a long-term competitive advantage when they are valued, uncommon, unique, and non-substitutable (Barney, 1991). At the same time, the NRBV considers the planet's natural resource limits (Hart, 1995). As a result, SCM operations should be re-engineered to achieve commercial and environmental sustainability simultaneously. Hart (1995) advocates three interconnected methods: pollution prevention, product stewardship, and sustainability for corporate and environmental sustainability. A pollution-prevention approach employs continual improvement strategies to minimize emissions (Hart, 1995). Internally, a company may take this approach by investing in production techniques that reduce waste and pollution (Hart, 1995). Also, environmentally aware suppliers must offer specified eco-friendly raw materials, and direct consumers must provide or recycle the final goods as part of the pollution prevention strategy. Consequently, upstream and downstream SCM partners must be completely committed for a focused firm to implement a pollution control strategy effectively. Environmental stakeholder concerns are included in a company's goods as product stewardship.

Furthermore, during the past 15 years, most NRBV applications have focused on pollution management, with little attention paid to empirical research on product stewardship or sustainable development techniques. Indeed, whether and under what conditions it pays to be green is a major topic in organizational and environmental studies (Berchicci & King, 2007; Hart & Ahuja, 1996). Furthermore, NRBV resources are intended to aid in the adoption of SSCM. The NRBV is a popular concept in SSCM, although it is not being used at a vast (Golicic & Smith, 2013), resulting in a gap between theory and practice (Hart & Dowell, 2011). Therefore, figure 1 expresses the research framework.

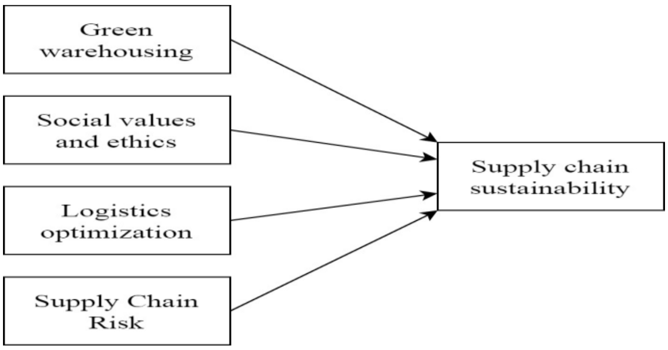

Figure 1: A research framework

3. Research Methodology

The quantitative research method was used to test the study hypotheses using a survey questionnaire (Rashid & Amirah, 2017; Rashid et al., 2019). The researcher can be benefitted from this approach as it enables to conduct theory development based on hypothesis-testing efficiently. This approach is useful in generalizing the results compared to the qualitative (Hashmi & Mohd, 2020; Rashid et al., 2021; Agha et al., 2021). Further, this study targeted SC professionals working in the manufacturing firms of Pakistan. The sample size estimation was done using the *50+8k* formula, in which *k* is the number of variables present in this research (Krejcie & Morgan, 1970). The research contains five variables; therefore, it must gather a minimum of 90 responses. Hence, the researcher has aimed to collect 150 sample responses (150 > *50+8 (4)* = 90) from the target population using purposive sampling, which selects people from the target population purposefully (Rashid et al., 2021). The major advantage of this sampling is that it helps to target people with specific characteristics as those people can eventually provide meaningful data that can result in logic-based conclusions (Vehovar et al., 2016; Victory et al., 2022; Amjad, 2022; Hunaid et al., 2022).

The data was collected using a survey method through a close-ended questionnaire on a five-point Likert scale that increases the significance of the results and conclusion as well (Alrazehi et al., 2021; Baker, 2003; Rashid et al., 2020). Moreover, the study includes five research variables; where, "Green Warehouse" includes eight items, "Social Value and Ethics" consists of nine items, "Logistics Optimization" comprises six items, and "Supply Chain Sustainability" contains six items adopted from Agyabeng-Mensah et al., (2020). The nine items of "Supply Chain Risk" were adopted from Wang et al. (2020).

3.1 Statistical Technique

There are various analysis techniques in which regression analysis has been identified as a first-generation technique. This technique works effectively to examine the relationship between two variables, and it can easily handle a large sample size as well. The regression analysis is best applied for hypothesis-testing and generating the main results of research (Ranganathan et al., 2017). Reliability analysis has also been conducted in this research using Cronbach's alpha. This analysis focuses on examining the reliability of the research and its instrument based on Cronbach's alpha, whose threshold is ≥ 0.70 (Anwar, 2022; Bonett & Wright, 2015; Hashmi et al., 2020a).

4. Research Results

The PLS-SEM analysis technique generates an in-depth variance (Hair et al., 2019; Khan et al., 2022). In PLS-SEM, the measurement model identifies the research instrument's reliability, and the structural model conducts hypothesis-testing (Hair et al., 2019; Khan et al., 2022). As a result, PLS-SEM with SmartPLS version 3.2.9 was used to generate relatively more significant results (Khan et al., 2021). Before the measurement model, the instrument's internal consistency was assessed, followed by detailed discussions on data screening and the demographic profile of the respondents (Rashid & Amirah, 2017; Rashid et al., 2019; Hashmi et al., 2020b). Further, the measurement model comprising outer loadings, convergent validity, and discriminant validity using the PLS algorithm was assessed. The structural model using PLS-SEM encompassing path analysis and mediation analysis using PLS bootstrapping while predictive relevance using PLS blindfolding was used. Finally, the study validated the findings in the light of previous studies. The reliability of constructs was tested through Cronbach's Alpha values. Rashid and Rasheed (2022) and Khan et al. (2021) suggested that an alpha coefficient higher than 60 per cent should be considered substantially reliable for analysis. In this regard, all the constructs with a higher than 60 per cent alpha coefficient, such as the GWH with eight items, had alpha reliability of 0.671, LO with six items, had an alpha coefficient of 0.764, SCR with nine items, and alpha coefficient of 0.863, SCS with six items, had an alpha coefficient of 0.874, and lastly, SV&E with nine items, had alpha coefficient 0.796 (Das et al., 2021; Haque et al., 2021; Rashid et al., 2020b). Hence, all the constructs met the minimum level.

4.1 Data Screening

Among various data screening and cleaning techniques and methods, DeSimone et al. (2015) suggested that data screening and cleaning technique was followed by following a four-step process before data analysis, i.e. (1) out-of-range values, (2) missing value analysis, (3) univariate outliers, and (4) multivariate outliers. In this regard, the study has used frequency measures for out-of-range and missing value analysis and found zero out-of-range and missing values among the dataset of 213 responses. Furthermore, the study has used standardized value (Z-Score) analysis for detecting univariate outliers, and as Tabachnick et al. (2007) suggested, the Z-Score should range between +3.29 and -3.29. Therein, the study found zero univariate outliers in the dataset; hence, final 213 responses were used for multivariate outliers. Lastly, the study used Mahalanobis Distance (D^2) for multivariate outliers based on the recommended threshold of $D^2 < 0.001$ (Tabachnick et al., 2007). Hence, the study has found no-multivariate outliers in the dataset, and finally, the study used 213 responses for data analysis.

4.2 Profile of the Respondents

The demographic profile of the 213 respondents was analyzed, where the highest proportion of firm size with employees between 250-500 was (64, 30%) than employees lowest proportion of employees between 500-1000 (22, 10.3%). All employees from different manufacturing sectors had different proportionate, like, pharmaceutical (33, 15.5%), food and beverage (33, 15.5%), Textile (84, 39.4%), automotive (32, 15%), and others (31, 14.6%). Likewise, all the employees were from managerial positions, with a far greater proportion of procurement managers (84, 40.4%) than supply chain managers (52, 24.4%), warehouse managers (33, 15.5%), and logistics managers (42, 19.7%). The work experience of all respondents was diverse, ranging from 33 (15.5%) with experience less than one year, 64 (30%) with 1-5 years, 96 (45.1%) with 5-10 years, and 20 (9.4%) with greater than ten years.

4.3 Measurement Model

4.3.1 Construct and convergent validity

The results of the measurement model for construct reliability and validity of the latent constructs are shown in Table 1. According to Khan et al. (2022), outer loadings greater than 0.70 are strong enough to indicate reliability. Whereas the outer loadings of 0.50 are adequate. Further, Cronbach's alpha should be greater than 0.70 for substantial internal consistency based on inter-item correlation, and composite reliability should be greater than 0.70 for constructs' composite internal consistency (Hashmi et al., 2020). Lastly, for a significant correlation between indicators and their latent constructs, AVE should be more than 0.50 (Rashid et al., 2020; Hashmi et al., 2021). Table 1 indicates the least indicator reliability of 0.546 for GW5, whereas "Green Warehousing" has the least alpha coefficient of 0.700 and composite reliability of 0.815, and the least AVE coefficient of 0.530. However, all constructs have higher values and sufficiently fulfilling the test assumptions. Therefore, it has been manifested that the measurement model has provided substantial results.

Table 1: Measurement model

Variables	Items	Loadings	Alpha	CR	AVE
Green Warehousing	GW4	0.682	0.700	0.815	0.530
	GW5	0.546			
	GW7	0.786			
	GW8	0.860			
Logistics Optimization	LO4	0.799	0.862	0.913	0.779
	LO5	0.926			
	LO6	0.918			
Supply Chain Risk	SCR4	0.743	0.871	0.904	0.655
	SCR5	0.927			
	SCR6	0.806			
	SCR8	0.757			
	SCR9	0.802			
Supply Chain Sustainability	SCS2	0.833	0.913	0.935	0.744
	SCS3	0.781			
	SCS4	0.897			
	SCS5	0.920			
	SCS6	0.874			
Social Values and Ethics	SVE1	0.640	0.872	0.900	0.564
	SVE3	0.672			
	SVE4	0.880			
	SVE5	0.727			
	SVE6	0.743			
	SVE7	0.810			
	SVE9	0.758			

Source: SmartPLS output

4.3.3 Discriminant validity using HTMT ratio

Henseler et al. (2015) suggested that the discriminant validity method of the Heterotrait-Monotrait (HTMT) Ratio test is widely used and recommended. Therefore, Table 2 shows the HTMT ratio results for discriminant validity using PLS-SEM. Henseler et al. (2015) suggested that "theoretically different constructs should have HTMT ratio below the threshold of 0.90 for considerable discriminant validity." Table 2 indicates that the highest HTMT ratio of 0.896 was found between SCS (supply chain sustainability) and SVE (social value and ethics). Hence, the study has achieved discriminant validity between latent constructs based on the HTMT ratio.

Table 2: Heterotrait-Monotrait ratio (HTMT)

	GW	LO	SCR	SCS	SVE
Green Warehousing					
Logistics Optimization	0.641				
SC Risk	0.864	0.843			
SC Sustainability	0.594	0.675	0.839		
Social Values and Ethics	0.785	0.705	0.880	0.896	

Source: SmartPLS output

4.3.4 Predictive relevance using PLS blindfolding.

In PLS-SEM, the predictive power of the outcome constructs in the structural model has been estimated based on R-Square using the PLS algorithm (Hair et al., 2011). While the predictive relevance of latent outcome constructs has been estimated based on cross-redundancy statistics (Q-Square) using PLS blindfolding (Geisser, 1975; Stone, 1974). Hair et al. (2011) indicated that a latent construct's predictive power (R^2) should be > 25% for significant predictability, while > 50% is moderate, and > 75% is considered strong predictability of the latent construct. Furthermore, Hair et al. (2013) proposed that in the structural model, Q^2 > 2% be estimated as having weak significance, > 15% as moderate, and > 35% considered as strong relevance in the structural model. Table 3 expresses that "Supply Chain Sustainability" has strong predictability relevance of 78.9 per cent.

Table 3: Predictive relevance

	R Square	R Square Adjusted	Q Square
Supply Chain Sustainability	0.789	0.785	0.578

Source: SmartPLS output

4.4 Structural Model

4.4.1 Path analysis

Table 4 explains the bootstrapping results of the research model for "Supply Chain Sustainability" using PLS bootstrapping at 5000 subsamples. SCS is positively reflected from the construct GWH, LO, SCR, and SVE. The results in Table 4 indicate that GWH has a positive and significant effect on SCS *(β = 0.0.175, $p < 0.000$)*, SVE *($\beta = 0.632$, $p < 0.000$)*, LO *($\beta = 0.052$, $p < 0.089$)*, and SCR *($\beta = 0.381$, $p < 0.000$)*. Hence, hypotheses H^1, H^2, and H^4 are supported. Whereas hypothesis H^3 is rejected.

Table 4: A path analysis

Hypotheses	Path	Estimate	*p*
H1	GWH -> SCS	0.175	0.000
H2	SVE -> SCS	0.632	0.000
H3	LO -> SCS	0.052	0.089
H4	SCR -> SCS	0.381	0.000

Source: SmartPLS output

5. Discussions and Conclusion

5.1 Objective One: Green Warehousing and SC Sustainability

The findings suggested that GWH has a significant positive effect on SCS. The previous studies showed the same results as Agyabeng-Mensah et al. (2020). The findings found that the warehousing activities, such as vehicle mobility, increase environmental carbon dioxide emissions. Therefore, to gain a competitive advantage and to meet the stakeholder's requirements, the warehousing areas need serious attention so that SC sustainability can be undertaken. Similarly, Ali et al. (2020) suggested that the greatest impact on sustainability can be made with the help of a location of primary importance in green warehousing logistics activities. Many firms focus on GWH to save money and energy. Therefore, with the implementation of green warehousing, the cost is decreasing, which provides help in ensuring SC sustainability. Likewise, Trivellas et al. (2020) observed that green warehousing is important to improve the overall SC's efficiency. Since it is a critical component of a distribution network, it impacts SC sustainability directly. Thus, to improve and enhance SC sustainability, green warehousing is critically important.

5.4 Objective Two: Social Values and Ethics and SC Sustainability

The study found that SVE had a significant positive impact on SCS. The findings are consistent with the findings of Dubey et al. (2017). Dubey et al. (2017) found that for SCS, employees must be involved in business activities that include the firm's newly cared vision as well as grasp the firm's primary concerns. Through SVE's successful application, employees' welfare and safety are secured. Similarly, Agyabeng-Mensah et al. (2020) found that social values and ethics play a huge role in ensuring sustainable developments. Engagement in morally and socially acceptable activities is important for enhancing SC sustainability as it comprises the social values and ethics. Likewise, Zhu et al. (2017) proposed improving green competitiveness, performance, and sustainability by including SVE in the design and development of an eco-friendly SC. Implementing such ethical and social values enhanced the SC sustainability as it offers a win-win opportunity for stakeholders.

5.2 Objective Three: Logistics Optimization and SC Sustainability

The study found that logistics optimization has an insignificant positive effect on SC sustainability. The findings indicate that optimizing logistics activities is necessary to avoid negative environmental effects and assure SCS at manufacturing firms in Pakistan. In other words, to enhance profitability and reduce externalities that would significantly impact SC sustainability, the firms have to adopt practices that improve logistics optimization. According to Agyabeng-Mensah et al. (2020) and Delmonico and Bezerra (2020), companies should optimize their activities to advance SC sustainability, such as building their warehouses to ensure eco-friendly transportation. Moreover, supplier and customer collaborative efforts can enhance SC sustainability when logistics optimization is properly implemented.

5.3 Objective Four: SC Risk and SC Sustainability

Supply chain risk found a significant positive effect on supply chain sustainability. The findings of Wang et al. (2020) support the findings. That shows that if SC risks related to logistics and transportation operations arise, SCS can be reduced or negatively impacted. Due to unreliable and uncertain resources, the risk could be developed, which would affect the SC sustainability by creating SC interruption. Pinheiro et al. (2019) also argued similarly and indicated that logistics operations could be harmed and effective by delays, damages, and loss, categorized as impacts, consequences, and errors. Due to SC risk, the normal logistics activities get affected and subsequently affect SC sustainability as it acts as a threat.

6. Research Implications, Recommendations, and Limitations

This study has provided several managerial recommendations. Firstly, the advantages of a green management system improve the economic performance of manufacturing firms. Practitioners argued that the benefits of green management should be communicated to organizational decision-makers. As a result, this research will enlighten managers about the competitive benefit of a green management system. Managers should also foster good investor views about GMS since firms are more likely to take action in implementing a GMS if they feel it would result in positive consensus. The study also assisted in the development of GMS subjective norms. Firms are more willing to adopt GMS due to societal expectations, such as legal rules and social belonging. Managers should also support the use of GMS, which may boost financial and non-financial performance, making the firm more competitive and increasing corporate value in various ways. Second, the findings establish a logical basis for implementing SCS efforts such as GWH, LO, and SVE. Similarly, this study provides a blueprint and strong explanation for supply chain managers to push for adopting social and ethical policies and practices. Managers should encourage using LO, GWH, and SVE to improve SCS. Managers should also encourage companies to work with their suppliers and customers to share resources in the implementation of GWH, LO, and SVE to reduce waste and gas emissions, improve employee and community welfare, and increase sales, market share, and profitability, and return on investment.

Likewise, firms may effectively manage their relationships with SC members to transform them into competitive advantages and improve economic performance. Employees are more likely to build skills and green capabilities to help the firm achieve a competitive edge and increase EP while engaging with SC members (customers and suppliers) on green warehousing, logistics optimization, and social values and ethics. As a result, firms should not underestimate the benefits of working with suppliers and customers to adopt GHW, LO, and SVE. Managers should also use sustainable strategies that have both social and environmental effects. Moreover, information and communication technology is driving modern employment innovation by allowing individuals to engage, and it may also contribute to networked action in the area of firm social responsibility. As a result of managers' awareness of firm social responsibility, the concept of close communication and information exchange between internal stakeholders (workers, managers, owners) and external stakeholders (suppliers, consumers, society, government, etc.) has come to the fore. As a result, stakeholders may seek the most cost-effective global solutions to lower total expenses and increase profitability. Lastly, SC risk has grown in popularity as a study and practice topic. Using objective measurements such as co-word, co-citation, and coupling networks, managers may expose the field's literary identity and identify crucial areas where decision models and support systems are developed. As a result, managers should gain a more holistic view of SCR by understanding mature and emerging themes in the field, as well as tools into the scope of SCR, and the significant growth in SSCM reflects the need for new business models that are particularly focused on social and environmental issues.

To improve the generalizability of the findings, future research might gather data from other professionals in more nations and locations. Study findings may be improved by a future study using longitudinal data. Furthermore, empirical evidence in this field will aid researchers in rationalizing the causal linkages between the study variables.

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