European Business & Management
2025, Vol. 11, No. 3, pp. 54-66
https://doi.org/10.11648/j.ebm.20251103.12

Research Article

Fostering Environmental Performance Through Green Supply Chain Practices: An Empirical Evidence from Manufacturing Firms of Pakistan

Umme Rubab[1, *], Muhammad Rahies Khan[2], Muhammad Mutasim Billah Tufail[2]

[1]Visiting Faculty, Bahria University, Karachi, Pakistan

[2]Department of Management Sciences, Bahria University, Karachi, Pakistan

Abstract

Sustainable performance is the foremost dream of every manufacturing concern. The environmental consequences of business operations in developing nations were noted at higher levels. Green initiatives are primitive measures to address ecological issues. The purpose of this study is to research how green supply chain management practises affect company performance. The explanatory method was utilized to investigate the connection between GSCM and green performance. A total of 214 participants were randomly selected to provide responses for this study. AMOS was used to do the analysis on the data. The findings showed a favorable correlation between environmental performance and eco-design, green purchase, and reverse logistics. This paper provides practical and managerial implications for industries that help them to promote green practices in their business operations. In developing nations, most producers' top goals are to better their economic condition and minimize economic hazards. Businesses that focus on short-term profitability, on the other hand, would not be possible in the remote future if they neglect the environment. In the future, different GSCM practices can be used to enhance the GSCM understanding at the national level. Lastly, this research has used convenience sampling that compromised the generalization of results. In the future, probability sampling can be adopted after gaining the sampling frame.

Keywords

GSCM, Environmental Performance, Eco-design, Reverse Logistics, Green Purchasing, Supply Chain Management

1. Introduction

Given the sudden destructive environmental disasters of bushfires, floods, and earthquakes throughout the world, governments and experts have become increasingly concerned about climate change and global warming [1]. High levels of air pollution have been caused by ever-increasing CO_2 emissions, the most hazardous form of air pollution because it infects the environment, and disperses quickly within seconds, with the potential of causing worldwide environmental damage [4].

Environmental challenges such as accelerated resource degradation, environmental contamination, climate changes, and a reduction in biological divergence are causing the eco-

*Corresponding author: umrubab97@gmail.com (Umme Rubab)

Received: 10 June 2025; **Accepted:** 1 July 2025; **Published:** 26 August 2025

logical equilibrium to deteriorate. Since these environmental problems are expected to worsen over time, individuals, governments, and businesses are increasingly concerned about environmental security [7]. Businesses that receive public and governmental scrutiny for contributing to environmental degradation should review their production methods and other operations [16]. Green supply chain management (GSCM) is an established practice, as is the acceptance of corporate accountability for impacts caused by supply chain activities [8]. With the growing interest of customers, the public, and legislators throughout the globe in environmental issues, businesses have created a wide variety of ecologically friendly initiatives and "green" commodities [19]. Hoffmann [30], Zhu et al. [75], and Yung et al. [68] all discuss the rise of "green" businesses and products. Since more and more foreign consumers and buyers are now asking their manufacturers to deliver goods that do not contain harmful and hazardous chemicals, it is becoming increasingly important for businesses to become more environmentally conscious. So, to minimize the damage to the environment by harmful manufacturing, they are now gradually lowering the use of naturally obtained resources for their production processes [18]. According to Green et al. [24], Compliance with cost savings and rules and regulation is the key factor for the introduction of environmental protection. According to Bowen et al. [9], GSCM activities would be more widely adopted by enterprises if they were accompanied by both financial and organizational incentives. Green Supply Chain Management (GSCM) is the most studied topic of the past two decades because of the widespread worry about environmental contamination, aggressive methods, and enhanced international understanding of environmental concerns [28].

The environmental impact of organizational operations affects this factor. It is important for the organization to recognize the causes of environmental issues within its reach to understand the environmental problems thoroughly, and to provide successful solutions (such as manufacturing, shipping, and procurement, as well as the final product). Businesses use scarce energy and create environmental degradation when manufacturing products and services to satisfy demands by discarding hazardous air, soil, waste, and water that they discharge into the outside world damaging the environment [2]. The performance of an organization to minimize emissions, reduce the production of waste, avoid the usage of toxic and hazardous chemicals and lower environmental incidents are calculated by environmental performance. Any action taken by a company to lessen the negative effects of its products or services on the environment is considered part of its GSCM efforts [23].

A manufacturer’s efforts to innovate green products and emerging technology can be improved by well-designed environmental standards. Shrivastava [58] argues that through product and process advances, firms can distinguish their products and increase product quality along with lowering production costs. They may also expand the environmental principle through their considerations of packaging design.

Although Green Supply Chain Management has been studied and established for some time [17], further research is needed. However, research is still lacking in developed countries like Pakistan. Many scholars have proposed that, as a way of organizational implementation methods in the developed world, there is potential for more study on GSCM. Further, other green practices have been critically elaborated on in the previous literature. However, reverse logistics was not adequately explored in the context of environmental performance. Therefore. This paper has operationalized reverse logistics in the context of manufacturing firms in Pakistan and examines its role in environmental performance. The inspiration is from the concept that usually an isolated implementation routine practice for environmental checks and balances is not a fully secured way to have a significant effect on the atmosphere and industry [20]. They can have a greater effect as separate environmental practices function as single interconnected power [28].

Understanding the extent to which green supply chain management (GSCM) practises affect environmental performance is crucial to this study since it reveals the limits to a company's sustainability. Green purchasing, eco-design, reverse logistics, and environmental performance are some of the dimensions that would be explored in this research. This paper proposes adapting green emission control policies to big corporations' supply chains so that they can pass the practices to smaller peers . As a result, the paper has created a theoretical structure that incorporates green activities, collaborative drivers, and collaborative frameworks to address the existing research gap and to identify opportunities for research in the future specifically in GSCM. The paper is supposed to answer the question Do GSCM practices significantly influence environmental performance in manufacturing firms?

This study’s findings are important for enhancing environmental sustainability, which has been a hurdle for industrial companies and attempts to justify the implementation of GSCM practices. This paper refers to the development of productive industries that can increase the productivity and economic efficiency of a business by applying GSCM. In numerous ways, this paper can assist the reader. This aims to address the gaps in current GSCM protocols in the following ways: It shows empirical findings that encourage the correlation between GSCM along with environmental performance. By expanding the GSCM literature to address the importance of GSCM practices influencing the environment and leading to improved environmental performance, it advances GSCM studies. To achieve greater environmental performance in the GSCM context, it proposes an original matrix proposal to explain the relationship and the positive aspects of green purchasing, eco-design, and reverse logistics.

Consequently, the focus of this paper would be on the Pakistani context, since it is largely under-researched. We are gathering survey data from Pakistani manufacturing companies to conclude our investigation. In the literature on Opera-

tions and Environmental Management, Pakistan has not gained much coverage, so we had the opportunity to enter the Pakistani development market. To increase the attractiveness of Pakistani manufacturing firms, GSCM is particularly important and helps them to be recognizable by the global networks of many multinational companies.

2. Literature Review

2.1. Environmental Performance

Green supply chain management (GSCM) is becoming more important in conventional supply chain management (SCM) in recent years. Some studies have shown in the literature that incorporating vendors more closely into the process of product innovation will increase the overall efficiency of a business. In other research, however, contradictory data has been found, where they indicate that such integration [27].

The term "green supply chain management" describes the creation of strategic instruments from the perspective of conserving natural resources [9]. Strategic tools make it easier to incorporate GSCM, simultaneously enhancing environmental efficiency and business performance. By reducing the intake of waste, harmful substances, and toxic chemicals, reducing the occurrence, and ensuring the well-being of the community. Additionally, these activities positively affect the improvement of environmental sustainability [17]. These rules of green practices have very much lowered material and use of water and lowered the waste generation to a very low level in Lee [41] case report on green practices for SMEs. Green methods, according to Azevedo et al. [5], increase environmental performance by minimizing business-induced wastage. In brief, according to evidence green activities has a great effect on reducing the production of hazardous waste through different practices for example, minimizing the production of waste and materials and utilizing resources (e.g., Zhu and Sarkis [72]; Rao and Holt [48], Kung et al. [40]). Environmental success assesses the beneficial consequences on the natural environment of the application of GSCM and green engineering activities that impact organizations' internal or external ecosystems. This study examined the connections between GSCM and green innovation for manufacturers, with the first result being the environmental success of these enterprises after the implementation of GSCM plus green innovation activities. However, only a select few institutions can publicly provide statistics on environmental outcomes.

2.2. Green Supply Chain Management (GSCM) Practices

Several scholars have examined the significance of implementing a green supply chain in achieving sustainable development (Green et al. [24]; Sarkis et al. [54]). The natural resource-based view (NRBV), as exemplified by Hart [26], posits that environmental initiatives may serve as a lucrative source of profits for enterprises. The implementation of sustainable practices is expected to provide positive outcomes for company sustainability via the reduction of power consumption and resource use, the enhancement of stakeholder engagement, the decrease in pricing, and the improvement of market efficiency. The use of sustainable practices is expected to provide positive outcomes for company sustainability via the reduction of power consumption and resource utilization, enhanced stakeholder engagement, decreased costs, and improved market efficiency. Several studies have examined the effects of Green Supply Chain Management (GSCM) on economic performance, environmental performance, and social performance [29]. These studies include the works of Schmidt et al. [56], Zhu et al. [74, 73, 76], and Eltayeb et al. [17]. According to the study conducted by Younis et al. [67], This research focused on analyzing the effects of GSCM on economic and environmental performance, while neglecting to address social performance, which is a crucial component of sustainability. A disparity also exists among poor nations, since research examining the relationship between Green Supply Chain Management (GSCM) and its consequences is mostly undertaken in economically affluent countries [20]. The implementation of Green Supply Chain Management (GSCM) has a notable influence on the environmental outcomes associated with supply chain activities, hence enhancing the overall sustainability efficiency of an organization [33]. The predominant emphasis of study in the field of Green Supply Chain Management (GSCM) encompasses a wide range of subjects, including organizational analysis and GSCM activities. The emergence of the green supply chain sector has led to contradictory impacts on green supply chain management practices. In this context, many hypotheses have been established to encourage the effective application of green supply chain management approaches [56]. The use of Green Supply Chain Management (GSCM) practices encourages organizations to adopt environmentally friendly technology to enhance their overall operational efficiency. Nevertheless, the existing scientific data is insufficient to establish a definitive connection between Green Supply Chain Management (GSCM) and the implementation of green innovation initiatives aimed at enhancing overall organizational efficiency. Consequently, it is anticipated that more progress will effectively meet the needs and expectations of all parties involved [45].

2.2.1. Eco-design and Environmental Performance

The concept of eco-design, also known as environmental design, encompasses the many stages at which companies engage in the development of products and/or manufacturing processes that have a restricted impact on the environment [75]. According to Porter and Van Der Linde [46], the enhancement of a company's competitive advantage is heavily reliant on the factor of innovation. As environmental regulations grow stricter, it becomes essential to have a comprehensive understanding of the whole life cycle of a product in

order to make informed decisions on product and design processes. According to Porter and Van Der Linde [46], the utilization of green and ecologically sustainable goods not only contributes to the preservation of the environment, but it also has the potential to provide a competitive advantage to the enterprise. The primary objective of eco-design is to minimize the environmental impact of a product, while simultaneously ensuring that it adheres to other essential design requirements such as cost-effectiveness and functionality. The emphasis placed on investment recovery and the use of ecologically friendly design practices would undoubtedly provide a discernible and beneficial impact on environmental performance [34]. In a similar manner, the environmentally sustainable product has a substantial influence on the organization's viability and functions as a mechanism for generating a tangible competitive edge in the company. Numerous companies use environmentally sustainable practices in their production processes with the aim of gaining a competitive advantage and distinguishing themselves from their rivals [49]. B üy ük özkan, çif çi, and G. [10] assert that the adoption of green design methodologies by enterprises would result in a reduction of the negative impact of their products and processes on the environment by a certain percentage. In research done by Zhu et al. [73], an observational investigation was carried out on China's automotive industry. The findings of the study revealed that the implementation of ecologically sustainable construction methods resulted in a significant reduction in the adverse environmental effects associated with the sector. Furthermore, it was seen that the adoption of such techniques also led to an increase in corporate dedication to sustainability. Gonzalez-Benuito and Gonzalez Benito [22] assert that eco-design enterprises aim to restrict the use of hazardous substances throughout the production phase, while concurrently achieving substantial reductions in energy consumption. The use of eco-design techniques has been shown to have positive effects on a company's financial and environmental efficiency, as shown by the results of R-J. Li et al. [42]. Additionally, these approaches have been found to contribute to the generation of competitive advantage and the enhancement of business credibility and brand within the industry, as highlighted by Zailani et al. [71]. Clauson et al. [12] conducted a comprehensive investigation within the computer and telecommunications sector to examine the impact of eco-design advancements on competitive advantage. In contrast, Noci and Verganti [44] used a qualitative methodology to investigate this phenomenon. Nevertheless, there exists a want for a greater dissemination of scientific data throughout diverse enterprises.

2.2.2. Green Purchasing and Environmental Performance

Green purchasing refers to the practice of making purchases while keeping environmental factors in mind [48]. In achieving the environmental priorities of a business, selecting the best supplier has a big impact. However, the choice of the right provider alone is not adequate to enhance environmental efficiency. It is also necessary to determine, the management and procurement of the supplier, if the supplier gets the environmental requirements of the company. Customers and buyers are extremely concerned with environmental issues and policies and expect their manufacturers to deliver goods and materials that understand the environmental issues [35]. Moreover, it is also important to understand manufacturers to eliminate materials and packaging early in the product production process, which may have a detrimental effect on the environment Rao and Holt [48] noted that green buying programs contribute to greener suppliers and greener technologies. The different studies, however, that those integrations could lead to unfortunate performance, such as, increasing the time along with the cost of the development (Zirger and Hartley [77]; Ragatz et al. [47]). Green et al. [24] suggest that green procurement and supply strategies are likely to contribute to greater environmental results. Additionally, to increase the environmental performance of manufacturing firms, GSCM activities are explicitly developed. Practices such as green shopping, consumer cooperation, eco-design, and recovery of investments are intended to have beneficial results of the above methods on environmental performance [36]. Finally, analysis has shown that green purchasing is the most important reason for the effectiveness of the adoption of environmental management schemes plus practices [72]. Purchases can improve their sustainability impact by training suppliers about their environmental challenges and assisting them in environmental management systems plans, according to Hamner [25]. Several research has sought to construct environmental management frameworks for strategic sourcing [6]. We present our first theory to get if there is a beneficial link between both suppliers' greening and green innovation. Most research appeared to concentrate on only green products and innovation in processes.

2.2.3. Reverse Logistics and Environmental Performance

Reverse logistics is known to be part of supply chain management, but in the terminologies of research and priority, it has often been underrated and missed as a field [69]. Therefore, extensive models involving reverse logistics methods across green-supply chains are uncommon. Reverse logistics is usually defined as the reverse transport of goods, typically for recycling, remanufacturing, or disposal purposes, from the customer to the producer [15]. The reverse logistics processes emphasize the use of products with fewer resource substances and environmentally harmful raw materials, as well as the replacement or recycling of parts of items or substances [66]. Although academic research is rising, firstly the reverse logistics was in the run for a long time in strategic practice [21]. Using reverse logistics in the management of the green supply will transform the process which was causing damage into a positive thing giving us an advantage to minimize inventory cost, effective product management along

with improvement in final revenue. Also, this increases consumer expectations of product quality, purchasing risk, and while reinforcing consumers' concept of corporate citizenship, especially about environmental responsibility [43]. Existing literature reveals that the most critical and dynamic operation within a green supply chain can be viewed as reverse logistics. Few reports do prefer to treat green supply chain terms similarly in reverse logistics [37]. They have formed an overall positive relationship, particularly about reverse logistics and environmental efficiency [70].

2.3. Research Hypotheses

H_1: Eco-Design positively impacts firms' Environmental Performance.

H_2: Green Purchasing positively impacts firms' Environmental Performance.

H_3: Reverse Logistics positively impact firms' Environmental Performance.

2.4. Research Framework

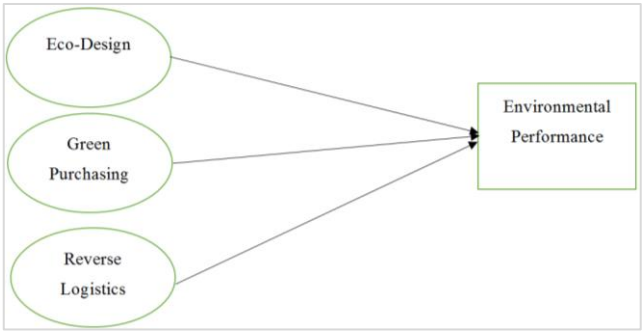

Figure 1. *Research Framework.*

3. Methodology

This study used a deductive approach and quantitative technique. Data were collected from 250 supply chain professionals of small medium and large-scale manufacturing firms in Pakistan through a convenience sampling technique. Convenience sampling was used because no proper sampling frame was available, and the population is unknown. The sample size was calculated by Saunders et al. [55]. This method of research is categorically based on the testing of hypotheses and validating or rejecting them based on analysis. The information is gathered with the use of a well-crafted questionnaire that uses a Likert scale from 1 (strongly disagree) to 5 (strongly agree). This study uses a causal or explanatory design. It places an emphasis on big picture thinking to grasp how different factors relate to one another. The questionnaire was developed on Google forma and distributed among participants through all possible mediums including LinkedIn, email, WhatsApp, Facebook, and lead generation technique. Structure Equation Simulation (SEM) was used to analyze the data. This technique combines factor analysis and multiple regression analysis to evaluate the structural relationship between measured variables using Amos software, despite the fact that SEM is a multivariate statistical analysis method for assessing structural links. Amos was used as it is a well-known data analysis software used in social sciences with well-defined threshold values.

4. Data Analysis

4.1. Descriptive Analysis

The primary purpose of descriptive analysis is to provide a concise summary of the most salient aspects of the data in this research. It provides a brief overview of how respondents from different industries have used green supply chain techniques to improve environmental performance. Table 1 displays the average company size of the sample. Almost a third (63 out of 124) of the enterprises in the sample had less than 200 workers. Out of a total of 214 responders, 47 (or 22%) represent businesses with 200-399 staff members. In addition, 23.9% of the businesses are small businesses, and there are 34 of them. whereas 32.7% of businesses have more than 1000 workers (70 enterprises). Therefore, most of the respondents are corporations of medium or large size. In Table 2, there's the respondents' information broken down by sector. Most responders (almost 50%) come from a variety of industries: Food products & beverages, Computer & Electronic Products, Car and Transport Equipment, and the Chemical/Rubber Industry.

Table 1. *Demographic Profile of Employees.*

Demographic Profile of Employees					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	between 200 and 399	47	22.0	22.0	22.0
	between 400 and 599	14	6.5	6.5	28.5

Demographic Profile of Employees				
	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
between 600 and 899	2	.9	.9	29.4
between 900 and 1000	18	8.4	8.4	37.9
Over 1000	70	32.7	32.7	70.6
Under 200	63	29.4	29.4	100.0
Total	214	100.0	100.0	

Table 2. *Demographic Profile of Firms.*

Demographic Profile of Firms					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Airline	8	3.7	3.7	3.7
	Arms production	4	1.9	1.9	5.6
	Bank	2	.9	.9	6.5
	Building material	7	3.3	3.3	9.8
	Car and transport equipment	19	8.9	8.9	18.7
	Chemical, rubber and plastic products	14	6.5	6.5	25.2
	Clothing Manufacturing	8	3.7	3.7	29.0
	Computer and electric products and components	27	12.6	12.6	41.6
	Defense	4	1.9	1.9	43.5
	Electrical and Mechanical services	6	2.8	2.8	46.3
	Food products & beverages	47	22.0	22.0	68.2
	Freight forwarding company	7	3.3	3.3	71.5
	Health care	4	1.9	1.9	73.4
	Health Related	6	2.8	2.8	76.2
	Hospital	4	1.9	1.9	78.0
	IT services	4	1.9	1.9	79.9
	Medicines	4	1.9	1.9	81.8
	Pharmaceutical	7	3.3	3.3	85.0
	Service	9	4.2	4.2	89.3
	Services	7	3.3	3.3	92.5
	Solar, Energy, Testing lab Machines	6	2.8	2.8	95.3
	Switchgear	1	.5	.5	95.8
	Terminal operations	9	4.2	4.2	100.0
	Total	214	100.0	100.0	

4.2. Reliability of Measurement Model

The model includes a total of 22 items to assess the link between environmental performance, reverse logistics, eco-design, and green purchasing. To determine the questionnaire's reliability, Cronbach's Alpha for four latent components was computed. Table 3 lists the dependability indicators. The questionnaire has excellent reliability and consistency, as shown by a Cronbach's Alpha of more than 0.9 (0.9 Cronbach Alpha > 1.0). Table 3 displays the findings for all structures; the composite dependability scores are all greater than the recommended 0.7 cutoff. This means that the measurements of the structures are both externally and internally consistent at a very high level of precision.

Table 3. *Summary of Reliability Analyses.*

Construct / Variable	Cronbach's alpha	No. of Items
Eco Design	0.81	4
Reverse Logistics	0.78	4
Green Purchasing	0.76	5
Environmental Performance	0.88	6

4.3. SEM Estimation and Hypothesis Testing

After running the structural model on AMOS 21 to evaluate the assumptions, we found the following: $\chi 2 = 0.909$; df = 1.389; p =.000; CFI = 0.913; RMSEA = 0.043.

Table 4. *Model Fitness (CMIN).*

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	44	202.821	146	.001	1.389
Saturated model	190	.000	0		
Independence model	19	827.869	171	.000	4.841

CMIN/DF < 3 shows that the hypothetical model and the sample data are a good match.

Table 5. *Baseline Comparisons.*

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.755	.713	.917	.909	.913
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

The chi-squared test of model fit and the normed fit index may be negatively impacted by small sample sizes, whereas the comparative fit index (CFI) analyses model fit by comparing it to the hypothesised model. Higher numbers on the CFI scale (which ranges from 0 to 1) indicate a more satisfactory fit.

Table 6. RMSEA.

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.043	.027	.056	.801
Independence model	.134	.125	.144	.000

If the root mean square error of approximation (RMSEA) is less than .08, then the approximation is close enough. The result of .043 indicates a satisfactory match with the given model.

The results show that the first hypothesis, Eco-design has an impact on Environmental Performance, has been accepted (β = 0.416; p <.05). This shows that companies who have Eco-design practices would have a higher value of Environmental Performance. The results suggest that Eco-design can be used to influence Environmental Performance through green packaging, labeling, and practices to increase the lifecycle of the product. This positive impact of Eco-design is expected to create favorable intentions among companies to behave in an environmentally friendly manner.

The second hypothesis, Green Purchasing has an impact on Environmental Performance, has also been accepted (β = 0.563; p <.05). The results show that there is a positive correlation between GPUR and EP, implying that companies having a positive attitude towards Green Purchasing would have a higher concern for the environmental performance. Here two inferences can be made: Green Purchasing has enhanced the companies' concern towards the environmental performance, and ISO certifications can be used to enhance the environmental performance of the company.

The third hypothesis, Reverse Logistics has an impact on Environmental Performance, has also been accepted (β = 0.288; p <.005). It shows that those companies who have a high concern towards environmental performance would show a more positive attitude towards reverse logistics. These results imply that in order to make the company positive towards green reverse logistics, their environmental concerns should be raised. Companies should be convinced that environmental performance is as important to them as their personal performance. If the government and corporations are successful in increasing environmental concerns, the overall attitude of the companies towards reverse logistics will become favorable [38].

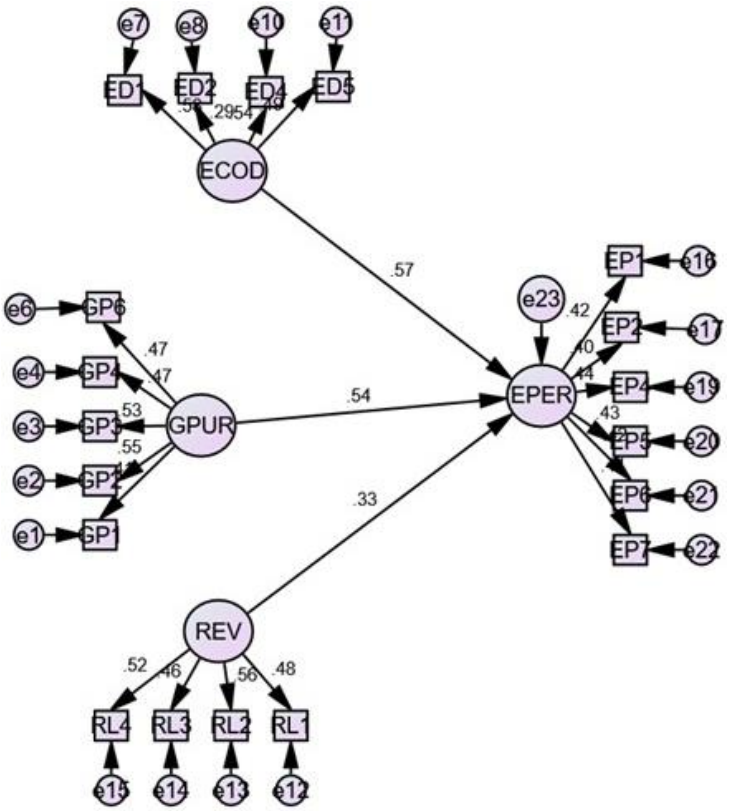

Figure 2. Confirmatory Factor Analysis.

Table 7. Hypothesis Testing.

			Estimate	S.E.	C.R.	P	Label
EPER	<---	ECOD	.416	.123	3.382	***	
EPER	<---	GPUR	.563	.181	3.104	.002	
EPER	<---	REV	.288	.116	2.483	.013	

Confirmatory Factor Analysis

SEM for a theoretical causal model consisting of a collection of expected covariances between variables; CMIN approach to identify minimal disagreement per degree of freedom; RMSEA for root mean squared error approximation; are all performed after all the components have been analyzed.

5. Discussion

This research adds to the growing body of knowledge about green supply chain practices by looking at the links between GSCM activities and environmental outcomes. The three GSCM aspects' influence on environmental performance was investigated. Managers will be able to select relevant GSCM strategies to enhance the performance areas that require improvement because of this. According to the results, external GSCM activities such as green purchasing, eco-design, and reverse logistics are key external GSCM practices that have a good or moderate impact on environmental performance. Most studies in this sector back up this claim.

Sroufe et al. [60] and Walker and Sisto [64] both found that environmental performance has a substantial impact on eco-design. Previous research backs up the concept that eco-design improves environmental performance. Green et al. [24] discovered that the eco-design and environmental performance dimensions had a positive connection, but that these dimensions were unrelated to financial performance. In their study of data from the Chinese industrial sector, Zhu and Sarkis [72] discovered substantial positive correlations between eco-design and environmental performance. Because eco-design is a company-wide green supply chain effort, the company focuses on improving the environmental characteristics of its goods and processes internally, with little collaboration or engagement with other businesses. As a result, the impact of such an upgrade is directly related to the firm's internal performance [51]. Dangelico, Pujari, and Pontrandolfo [13] highlight the positive influence of eco-design on environmental performance when considering the different GSCM methodologies. An ED strategy has the potential to give firms a leg up on the competition via the creation of long-lasting goods and the design of products or manufacturing processes that use less energy. To reduce environmental and economic risks across the product life cycle, as well as to create eco-designed products and processes, more and more businesses are forming partnerships with their customers and suppliers [62].

In the study, the researchers looked at a possible connection between eco-friendly spending and environmental impact. This might be because a company's own environmental performance is a driving factor in the development of its green purchasing strategy [17]. Green purchasing, according to Schoenherr et al. [57], is linked to better environmental performance and can be regarded a strategic resource. On the other side, despite the importance of consumers in promoting green principles in supply chains, there are few empirical studies that investigate whether similar assertions can be made regarding customer collaboration [39]. In general, how an organization responds to consumer pressures is dependent on activities connected to green purchasing, thus the level of Green Purchasing will capture customers' impact [65]. This study adds by shining light on a customer collaboration viewpoint to support GP efforts, particularly in the context of achieving EM. Green purchasing and supply management practices have also been proven to be beneficial in terms of improving environmental performance [24]. Green marketing strategies have been shown in the literature to improve a company's reputation and image, as well as boost sales, and so have a beneficial impact on the company's environmental and economic performance [68]. Sarkis et al. [54] also emphasize the importance of consumer collaboration and green buying as important corporate resources. In a GSCM framework, Junquera, del Bro, and Fernández [14] provide an innovative matrix approach for understanding the link between the responsibilities of green suppliers and customers in attaining greater environmental performance.

Reverse logistics has an important role in decreasing waste and lowering process costs, according to a few studies on the subject [31]. Many studies have shown that reverse logistics may help organizations improve their operations by detecting and analyzing disadvantages in the supply chain [39]. Reverse logistics, according to [11, 32], has a beneficial impact on environmental performance. Finally, reverse logistics techniques can lower consumer risk and improve customer value when purchasing a product [53, 50]. However, the successful deployment of reverse logistics necessitates the coordination of both forward and backward material and information movements [1]. Tibben-Lembke [61] highlights the relevance of product life cycle features and their interaction with reverse logistics in terms of environmental performance. In a case

study of refurbished PC displays, Vasudevan et al. [63] found that reverse logistics is a crucial component for recycling in businesses. Ahmad et al. [3] investigated the impact of the life cycle of post-consumer items on remanufacturing processes.

6. Conclusion Implications and Recommendations

The research showed that eco-friendly supply chain practices improved environmental efficiency. According to the results, all three factors positively affected Environmental Performance. The three factors were green purchasing, eco-design, and reverse logistics. One may thus draw the conclusion that these factors significantly affect the environmental performance of businesses. The variables that have the greatest impact on environmental performance are green buying and eco-design. Green buying and environmental performance were shown to have a substantial link in the study. This might be because green buying methods emphasize increasing environmental performance, which is primarily attributable to the company's own environmental performance. The use of efficient reverse logistics solutions may help businesses cut down on carbon emissions and improve air quality by eliminating wasteful trips caused by poor return processes [52]. Companies are embracing reverse logistics methods such as returns management and refurbishing, recycling of goods and materials, and efficient disposal of materials from undesired items to push the sustainable development needle while saving costs and reaping products with a longer shelf life. Consequently, the company is trying to include greener practices across the supply chain [59].

7. Theoretical and Practical Implications

This research has practical consequences for manufacturing practitioners as well as policymakers. In developing nations, most producers' top goals are to better their economic condition and minimize economic hazards. However, companies that prioritize short-term gains at the expense of the environment are doomed to fail in the long run. Economic aims are combined with not just profit maximization but also environmental advantages in this research to examine the significance of operating on a win-win paradigm. Managers will be able to weigh the costs and advantages of various eco-friendly initiatives according to this study's findings.

This research looked at how GSCM techniques are implemented in manufacturing companies. Other sorts of businesses, such as wholesalers and retailers, can be represented using the model. Disaggregating and exploring circumstances that promote consumer collaboration in an EM setting at the macro and micro levels may be beneficial in future studies. Inter-industry disparities, the impact of human resource practices and organizational structures, and the influence of managers' environmental views and attitudes, to name a few examples, may all be investigated. The study has used narrowed geographical areas where future research can be conducted in other geographical areas. Further, the basic GSCM practices were selected due to the inclusion of small and medium firms as they are already deficient in resources and GSCM practices are resource intensive. In the future, different GSCM practices can be used to enhance the GSCM understanding at the national level. Lastly, this research has used convenience sampling that compromised the generalization of results. In the future, probability sampling can be adopted after gaining the sampling frame.

Abbreviations

GSCM	Green Supply Chain Management
SCM	Supply Chain Management
NRBV	Natural Resource Based View
SEM	Structural Equation Modeling
AMOS	Analysis of Moment Structures
RMSEA	Root Mean Square Error of Approximation
CFI	Comparative Fit Index

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Abdullah, R., Mohamad, M. N., & Thurasamy, R. (2019). Towards sustainable performance: Promoting eco-design in green supply chain management practices. *International Journal of Supply Chain Management*, *8*(3).

[2] Adriana, B. (2009). Environmental supply chain management in tourism: The case of large tour operators. *Journal of Cleaner Production*, *17*(16). https://doi.org/10.1016/j.jclepro.2009.06.010

[3] Ahmad, A., Ikram, A., Rehan, M. F., & Ahmad, A. (2022). Going green: Impact of green supply chain management practices on sustainability performance. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.973676

[4] Azapagic, A. (2003). Systems Approach to Corporate Sustainability. *Process Safety and Environmental Protection*, *81*(5). https://doi.org/10.1205/095758203770224342

[5] Azevedo, S. G., Carvalho, H., & Cruz Machado, V. (2011). The influence of green practices on supply chain performance: A case study approach. *Transportation Research Part E: Logistics and Transportation Review*, *47*(6). https://doi.org/10.1016/j.tre.2011.05.017

[6] Bai, C., & Sarkis, J. (2010). Integrating sustainability into supplier selection with grey system and rough set methodologies. *International Journal of Production Economics*, *124*(1). https://doi.org/10.1016/j.ijpe.2009.11.023

[7] Bloom, N., Dorgan, S., & Dowdy, J. (2007). Management practice and productivity: Why they matter. *Centre for Economic Performance, September*.

[8] Bloom, N., Eifert, B., Mahajan, A., McKenzie, D., & Roberts, J. (2013). Does management matter? Evidence from india. *Quarterly Journal of Economics*, *128*(1). https://doi.org/10.1093/qje/qjs044

[9] Bowen, F. E., Cousins, P. D., Lamming, R. C., & Faruk, A. C. (2001). The role of supply management capabilities in green supply. *Production and Operations Management*, *10*(2). https://doi.org/10.1111/j.1937-5956.2001.tb00077.x

[10] Büyüközkan, G., & Ifi, G. (2012). A novel hybrid MCDM approach based on fuzzy DEMATEL, fuzzy ANP and fuzzy TOPSIS to evaluate green suppliers. *Expert Systems with Applications*, *39*(3). https://doi.org/10.1016/j.eswa.2011.08.162

[11] Christmann, P. (2000). Effects of "best practices" of environmental management on cost advantage: The role of complementary assets. *Academy of Management Journal*, *43*(4). https://doi.org/10.2307/1556360

[12] Clauson, K. A., Breeden, E. A., Davidson, C., & Mackey, T. K. (2018). Leveraging Blockchain Technology to Enhance Supply Chain Management in Healthcare:: An exploration of challenges and opportunities in the health supply chain. *Blockchain in Healthcare Today*.

[13] Dangelico, R. M., Pujari, D., & Pontrandolfo, P. (2017). Green Product Innovation in Manufacturing Firms: A Sustainability-Oriented Dynamic Capability Perspective. *Business Strategy and the Environment*, *26*(4). https://doi.org/10.1002/bse.1932

[14] del Brío, J. Á., Fernández, E., & Junquera, B. (2007). Management and employee involvement in achieving an environmental action-based competitive advanrage: An empirical study. *International Journal of Human Resource Management*, *18*(4). https://doi.org/10.1080/09585190601178687

[15] Dowlatshahi, S. (2000). Designer-buyer-supplier interface: Theory versus practice. *International Journal of Production Economics*, *63*(2). https://doi.org/10.1016/S0925-5273(99)00009-2

[16] Dzikriansyah, M. A., Masudin, I., Zulfikarijah, F., Jihadi, M., & Jatmiko, R. D. (2023). The role of green supply chain management practices on environmental performance: A case of Indonesian small and medium enterprises. *Cleaner Logistics and Supply Chain*, *6*. https://doi.org/10.1016/j.clscn.2023.100100

[17] Eltayeb, T. K., Zailani, S., & Ramayah, T. (2011). Green supply chain initiatives among certified companies in Malaysia and environmental sustainability: Investigating the outcomes. *Resources, Conservation and Recycling*, *55*(5). https://doi.org/10.1016/j.resconrec.2010.09.003

[18] Fidlerová, H., Makyšová, H., Sklenárová, L., & Bajdor, P. (2021). Streamlining packaging as part of sustainable reverse logistics processes. *Acta Logistica*, *8*(4). https://doi.org/10.22306/al.v8i4.249

[19] Fu, L., Yang, D., Liu, S., & Mei, Q. (2023). The impact of green supply chain management on enterprise environmental performance: a meta-analysis. *Chinese Management Studies*, *17*(2). https://doi.org/10.1108/CMS-02-2021-0048

[20] Geng, R., Mansouri, S. A., & Aktas, E. (2017). The relationship between green supply chain management and performance: A meta-analysis of empirical evidences in Asian emerging economies. *International Journal of Production Economics*, *183*. https://doi.org/10.1016/j.ijpe.2016.10.008

[21] Georgiadis, P., & Vlachos, D. (2004). Decision making in reverse logistics using system dynamics. *Yugoslav Journal of Operations Research*, *14*(2). https://doi.org/10.2298/YJOR0402259G

[22] González-Benito, J., & González-Benito, Ó. (2005). Environmental proactivity and business performance: An empirical analysis. *Omega*, *33*(1). https://doi.org/10.1016/j.omega.2004.03.002

[23] Govindan, K., Soleimani, H., & Kannan, D. (2015). Reverse logistics and closed-loop supply chain: A comprehensive review to explore the future. In *European Journal of Operational Research* (Vol. 240, Issue 3). https://doi.org/10.1016/j.ejor.2014.07.012

[24] Green, K., Morton, B., & New, S. (1996). Purchasing and environmental management: interactions, policies and opportunities. *Business Strategy and the Environment*, *5*(3). https://doi.org/10.1002/(SICI)1099-0836(199609)5:3<188::AID-BSE60>3.0.CO;2-P

[25] Hamner, B. (2006). Effects of green purchasing strategies on supplier behaviour. In *Greening the Supply Chain*. https://doi.org/10.1007/1-84628-299-3_2

[26] Hart, S. L., & Dowell, G. (2011). A natural-resource-based view of the firm: Fifteen years after. In *Journal of Management* (Vol. 37, Issue 5). https://doi.org/10.1177/0149206310390219

[27] Hejazi, M. T., al Batati, B., & Bahurmuz, A. (2023). The Influence of Green Supply Chain Management Practices on Corporate Sustainability Performance. *Sustainability (Switzerland)*, *15*(6). https://doi.org/10.3390/su15065459

[28] Hervani, A. A., Helms, M. M., & Sarkis, J. (2005). Performance measurement for green supply chain management. *Benchmarking*, *12*(4). https://doi.org/10.1108/14635770510609015

[29] Ho, W., Xu, X., & Dey, P. K. (2010). Multi-criteria decision making approaches for supplier evaluation and selection: A literature review. *European Journal of Operational Research*, *202*(1). https://doi.org/10.1016/j.ejor.2009.05.009

[30] Hoffmann, E. (2007). Consumer integration in sustainable product development. *Business Strategy and the Environment*, *16*(5). https://doi.org/10.1002/bse.577

[31] Hosseini, M. R., Chileshe, N., Rameezdeen, R., & Lehmann, S. (2014). Reverse Logistics for the Construction Industry: Lessons from the Manufacturing Context. *International Journal of Construction Engineering and Management*, *3*(3).

[32] Huang, Y. C., Rahman, S., Wu, Y. C. J., & Huang, C. J. (2015). Salient task environment, reverse logistics and performance. *International Journal of Physical Distribution and Logistics Management*, *45*(9-10). https://doi.org/10.1108/IJPDLM-08-2014-0182

[33] Huscroft, J. R., Hazen, B. T., Hall, D. J., Skipper, J. B., & Hanna, J. B. (2013). Reverse logistics: Past research, current management issues, and future directions. *The International Journal of Logistics Management*, *24*(3). https://doi.org/10.1108/IJLM-04-2012-0024

[34] Kalyar, M. N., Shoukat, A., & Shafique, I. (2020). Enhancing firms' environmental performance and financial performance through green supply chain management practices and institutional pressures. *Sustainability Accounting, Management and Policy Journal*, *11*(2). https://doi.org/10.1108/SAMPJ-02-2019-0047

[35] Khan, M. R., Billah, M. T., Mubashir Ali Khan, & Shakeel, M. (2022). Reinforcing Environmental Sustainability through Institutional Pressures, Green Supply Chain, and Customer Intention among Pakistani Manufacturing Firms A-Pilot Test. *IRASD Journal of Management*, *4*(2). https://doi.org/10.52131/jom.2022.0401.0073

[36] Khan, M. R., Khan, N. R., Tufail, M. M. B., & Ali, L. (2023). A PATH TOWARDS A GREENER FUTURE: FOSTERING GREEN SUPPLY CHAIN, GREEN MARKETING, AND ENVIRONMENTAL SUSTAINABILITY. *Logforum*, *19*(1). https://doi.org/10.17270/J.LOG.2023.815

[37] Khan, S. A. R., & Qianli, D. (2017). Impact of green supply chain management practices on firms' performance: an empirical study from the perspective of Pakistan. *Environmental Science and Pollution Research*, *24*(20). https://doi.org/10.1007/s11356-017-9172-5

[38] Kitsis, A. M., & Chen, I. J. (2023). Does environmental proactivity make a difference? The critical roles of green operations and collaboration in GSCM. *Supply Chain Management*, *28*(2). https://doi.org/10.1108/SCM-09-2020-0499

[39] Kumar, S., Luthra, S., & Haleem, A. (2014). Critical success factors of customer involvement in greening the supply chain: An empirical study. In *International Journal of Logistics Systems and Management* (Vol. 19, Issue 3). https://doi.org/10.1504/IJLSM.2014.065498

[40] Kung, F. H., Huang, C. L., & Cheng, C. L. (2012). Assessing the green value chain to improve environmental performance: Evidence from Taiwan's manufacturing industry. *International Journal of Development Issues*, *11*(2). https://doi.org/10.1108/14468951211241119

[41] Lee, K. (2009). Why and how to adopt green management into business organizations? *Management Decision*, *47*(7). https://doi.org/10.1108/00251740910978322

[42] Li, X., Liu, D., Zhang, Z., Cheng, T., Liu, L., & Yuan, J. (2022). The impact of internal and external green supply chain management activities on performance improvement: evidence from the automobile industry. *Heliyon*, *8*(11). https://doi.org/10.1016/j.heliyon.2022.e11486

[43] Mollenkopf, D., Closs, D., Twede, D., Lee, S., & Burgess, G. (2005). ASSESSING THE VIABILITY OF REUSABLE PACKAGING: A RELATIVE COST APPROACH. *Journal of Business Logistics*, *26*(1). https://doi.org/10.1002/j.2158-1592.2005.tb00198.x

[44] Noci, G., & Verganti, R. (1999). Managing "green" product innovation in small firms. *R and D Management*, *29*(1). https://doi.org/10.1111/1467-9310.00112

[45] Porter, M. E. (2000). Location, competition, and economic development: Local clusters in a global economy. *Economic Development Quarterly*, *14*(1). https://doi.org/10.1177/089124240001400105

[46] Porter, M. E., & van der Linde, C. (2017). Green and competitive: Ending the stalemate. In *Corporate Environmental Responsibility*. https://doi.org/10.4337/9781782543978.00010

[47] Ragatz, G. L., Handfield, R. B., & Petersen, K. J. (2002). Benefits associated with supplier integration into new product development under conditions of technology uncertainty. *Journal of Business Research*, *55*(5). https://doi.org/10.1016/S0148-2963(00)00158-2

[48] Rao, P., & Holt, D. (2005). Do green supply chains lead to competitiveness and economic performance? In *International Journal of Operations and Production Management* (Vol. 25, Issue 9). https://doi.org/10.1108/01443570510613956

[49] Reinhardt, F. L. (1998). Environmental product differentiation: Implications for corporate strategy. *California Management Review*, *4*. https://doi.org/10.2307/41165964

[50] Rogers, D. S., & Tibben-Lembke, R. (2001). AN EXAMINATION OF REVERSE LOGISTICS PRACTICES. *Journal of Business Logistics*, *22*(2). https://doi.org/10.1002/j.2158-1592.2001.tb00007.x

[51] ROSINI, F. A. (1990). Innovation: A Cross-Disciplinary Perspective. *R&D Management*, *20*(2). https://doi.org/10.1111/j.1467-9310.1990.tb00705.x

[52] Rupa, R. A., & Saif, A. N. M. (2022). Impact of Green Supply Chain Management (GSCM) on Business Performance and Environmental Sustainability: Case of a Developing Country. *Business Perspectives and Research*, *10*(1). https://doi.org/10.1177/2278533720983089

[53] Russo, I., & Cardinali, S. (2012). Product returns and customer value: A footware industry case. In *Contributions to Management Science*. https://doi.org/10.1007/978-3-7908-2747-7_5

[54] Sarkis, J., Zhu, Q., & Lai, K. H. (2011). An organizational theoretic review of green supply chain management literature. In *International Journal of Production Economics* (Vol. 130, Issue 1). https://doi.org/10.1016/j.ijpe.2010.11.010

[55] Saunders, M., Lewis, P., & Thornhill, a. (2009). Research Methods for Business Students. In *Business* (Vol. 5th).

[56] Schmidt, C. G., Foerstl, K., & Schaltenbrand, B. (2017). The Supply Chain Position Paradox: Green Practices and Firm Performance. *Journal of Supply Chain Management*, *53*(1). https://doi.org/10.1111/jscm.12113

[57] Schoenherr, T., Griffith, D. A., & Chandra, A. (2014). Knowledge management in supply chains: The role of explicit and tacit knowledge. *Journal of Business Logistics*, *35*(2). https://doi.org/10.1111/jbl.12042

[58] Shrivastava, P. (1995). The Role of Corporations in Achieving Ecological Sustainability. *Academy of Management Review*, *20*(4). https://doi.org/10.5465/amr.1995.9512280026

[59] Song, M., & di Benedetto, C. A. (2008). Supplier's involvement and success of radical new product development in new ventures. *Journal of Operations Management*, *26*(1). https://doi.org/10.1016/j.jom.2007.06.001

[60] Sroufe, R., Curkovic, S., Montabon, F., & Melnyk, S. A. (2000). The new product design process and design for environment "Crossing the chasm." *International Journal of Operations and Production Management*, *20*(2). https://doi.org/10.1108/01443570010304297

[61] Tibben-Lembke, R. S. (2002). Life after death: Reverse logistics and the product life cycle. *International Journal of Physical Distribution and Logistics Management*, *32*(3). https://doi.org/10.1108/09600030210426548

[62] Vachon, S., & Klassen, R. D. (2006). Extending green practices across the supply chain: The impact of upstream and downstream integration. *International Journal of Operations and Production Management*, *26*(7). https://doi.org/10.1108/01443570610672248

[63] Vasudevan, M. K., & Prakash, G. (2016). Linking grave to cradle: The next big reverse logistics business. *International Journal of Logistics Systems and Management*, *23*(4). https://doi.org/10.1504/IJLSM.2016.075208

[64] Walker, H., di Sisto, L., & McBain, D. (2008). Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors. *Journal of Purchasing and Supply Management*, *14*(1). https://doi.org/10.1016/j.pursup.2008.01.007

[65] Walker, H., & Jones, N. (2012). Sustainable supply chain management across the UK private sector. *Supply Chain Management*, *17*(1). https://doi.org/10.1108/13598541211212177

[66] Wu, X., & Zhao, S. (2024). Research on green development strategy of logistics packaging based on corporate social responsibility: an evolutionary game analysis. *Environment, Development and Sustainability*. https://doi.org/10.1007/s10668-023-04362-y

[67] Younis, H., Sundarakani, B., & Vel, P. (2016). The impact of implementing green supply chain management practices on corporate performance. *Competitiveness Review*, *26*(3). https://doi.org/10.1108/CR-04-2015-0024

[68] Yung, W. K. C., Chan, H. K., So, J. H. T., Wong, D. W. C., Choi, A. C. K., & Yue, T. M. (2011). A life-cycle assessment for eco-redesign of a consumer electronic product. *Journal of Engineering Design*, *22*(2). https://doi.org/10.1080/09544820902916597

[69] Yurdakul, M., & Kazan, H. (2020). Effects of eco-innovation on economic and environmental performance: Evidence from Turkey's manufacturing companies. *Sustainability (Switzerland)*, *12*(8). https://doi.org/10.3390/SU12083167

[70] Zaid, A. A., Jaaron, A. A. M., & Talib Bon, A. (2018). The impact of green human resource management and green supply chain management practices on sustainable performance: An empirical study. *Journal of Cleaner Production*, *204*. https://doi.org/10.1016/j.jclepro.2018.09.062

[71] Zailani, S., Jeyaraman, K., Vengadasan, G., & Premkumar, R. (2012). Sustainable supply chain management (SSCM) in Malaysia: A survey. *International Journal of Production Economics*, *140*(1). https://doi.org/10.1016/j.ijpe.2012.02.008

[72] Zhu, Q., & Sarkis, J. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *Journal of Operations Management*, *22*(3). https://doi.org/10.1016/j.jom.2004.01.005

[73] Zhu, Q., & Sarkis, J. (2007). The moderating effects of institutional pressures on emergent green supply chain practices and performance. *International Journal of Production Research*, *45*(18-19). https://doi.org/10.1080/00207540701440345

[74] Zhu, Q., Sarkis, J., & Geng, Y. (2005). Green supply chain management in China: Pressures, practices and performance. *International Journal of Operations and Production Management*, *25*(5). https://doi.org/10.1108/01443570510593148

[75] Zhu, Q., Sarkis, J., & Lai, K. hung. (2008). Green supply chain management implications for "closing the loop." *Transportation Research Part E: Logistics and Transportation Review*, *44*(1). https://doi.org/10.1016/j.tre.2006.06.003

[76] Zhu, Q., Sarkis, J., & Lai, K. hung. (2013). Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. *Journal of Purchasing and Supply Management*, *19*(2). https://doi.org/10.1016/j.pursup.2012.12.001

[77] Zirger, B. J., & Hartley, J. L. (1994). A conceptual model of product development cycle time. *Journal of Engineering and Technology Management*, *11*(3-4). https://doi.org/10.1016/0923-4748(94)90011-6