



GREEN SUPPLY CHAIN MANAGEMENT AND FIRM PERFORMANCE IN PAKISTAN'S TEXTILE INDUSTRY

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Abstract

Purpose: This study investigates the impact of four green supply chain management (GSCM) practices—eco-design, green procurement, green manufacturing, and green distribution—on firm performance, while examining the mediating role of sustainable supply chain management (SSCM) among manufacturing firms in Pakistan's textile industry.

Approach: Grounded in a positivist research philosophy, the study adopts a quantitative, cross-sectional survey design. Data were collected through a structured, five-point Likert-scale questionnaire administered to 150 managers, supervisors, and supply chain professionals working in textile manufacturing firms located in Faisalabad, Sheikhupura, and Multan, using a convenience sampling technique. Data were analysed using SPSS for descriptive statistics, reliability analysis, and Pearson correlation, and AMOS for confirmatory factor analysis, structural equation modelling (SEM), and bootstrapped mediation testing.

Findings: The measurement model demonstrated sound reliability (overall Cronbach's $\alpha = .913$) and adequate sampling adequacy ($KMO = .843$, Bartlett's test significant, $p < .001$). Eco-design ($\beta = .410$), green procurement ($\beta = .194$), green manufacturing ($\beta = .191$), and green distribution ($\beta = .165$) each exerted a significant positive effect on firm performance, and SSCM itself was a strong positive predictor of firm performance ($\beta = .678$). However, SSCM significantly mediated only the relationship between eco-design and firm performance ($\beta = .329$, $p < .001$); its mediating role in the relationships involving green procurement, green manufacturing, and green distribution was not statistically supported.

Contributions: The study extends the Resource-Based View by demonstrating that GSCM practices function as valuable, rare, and difficult-to-imitate resources that translate into performance gains, partly through sustainable supply chain capabilities. Textile manufacturers should prioritize eco-design initiatives and strengthen the sustainable supply chain infrastructure required to convert broader green practices into measurable performance outcomes.

Originality value: This is among the first studies to empirically test SSCM as a mediating mechanism between multiple GSCM dimensions and firm performance within Pakistan's textile sector, an emerging-economy context where such evidence remains scarce.

Keywords: Green Supply Chain Management, Sustainable Supply Chain Management, Firm Performance, Eco-Design, Mediation Analysis, Textile Industry, Pakistan



1. Introduction

Sustainability is no longer an optional add-on for businesses but a core part of their business strategy today, due to environmental degradation, resource scarcity, and the rising regulatory pressure. Increasingly, governments, investors, and environmentally conscious consumers demand that businesses grow the economy while doing their best to reduce the environmental impact of their operations. As a result, the sourcing, production and distribution processes are being re-designed by organisations in diverse sectors to minimise adverse ecological impacts and enhance long-term competitiveness. Sustainable business practices are increasingly considered as tools for good management, not just for environmental regulation (Akbari & McClelland, 2020). The United Nations Sustainable Development Goals and other global efforts have additionally strengthened the focus on environmental responsibility as a business strategy adopted by global manufacturing companies in developed and developing nations.

In this context, green supply chain management (GSCM) has come to the fore as one of the important approaches to include environmental issues throughout the supply chain. GSCM also embeds sustainability issues in the product design, supplier selection, manufacturing processes, logistics and distribution, which allows companies to minimize waste, energy use, and emissions while increasing operational efficiency (Azevedo et al., 2011; Afum et al., 2020). Environmental practices like eco-design, green procurement, green manufacturing, and green distribution are opportunities for manufacturing organizations, where their operations tend to be resource- and energy-heavy, to meet environmental goals without compromising profits or competitiveness. Multinational companies are increasingly integrating these practices into their corporate policies, and have been encouraging suppliers in developing nations like Pakistan to operate in an eco-friendly manner (Akbari & McClelland, 2020).

The textile industry, the largest manufacturing industry in Pakistan, one of the biggest exporters and a major provider of employment, is a case in point of the opportunities, as well as the challenges, for sustainable manufacturing. The textile industry uses a lot of water, chemicals and energy, and companies are under increasing pressure from international buyers, regulators and local communities to lower their environmental footprint. While a number of companies have implemented such schemes as ISO 14001 certification, cleaner production technologies, and eco-labelling, the uptake of green practices is not uniform in the sector. Few organizations see environmental investments as strategic investments that can create competitive advantage, and they still view them as extra expenses. Thus, there is a significant disparity in the application of sustainable practices in the textile supply chain amongst the textile manufacturers in Pakistan.

The findings of previous studies that have investigated the association between GSCM and firm performance are mixed. Various studies have documented that green practices have a positive impact on the company's environmental, operational and financial performance, as they help to reduce waste, improve resource efficiency, boost corporate reputation and customer satisfaction (Azevedo et al., 2011; Afum et al., 2020). However, other research suggests that the adoption of green technologies, employee training and environmental certifications can raise operational expenses and slow down the economic benefits, especially in resource-limited companies (Afum et al., 2020). The conflicting results highlight that the relationship between GSCM and firm performance is not direct and is likely to vary based on the capabilities of the firm to transform green initiatives into tangible business results.

Sustainable supply chain management (SSCM) is one of the capabilities. Although the scope of GSCM is limited to environmental practices in the supply chain activities, SSCM has a wider scope, covering environmental, social, and economic goals across the whole supply chain (Akbari & McClelland, 2020). This holistic strategy fosters collaboration among supply chain stakeholders, responsible use of resources, and long-term organizational resilience. Although the mediating mechanism of SSCM between individual GSCM practices and firm performance has been gaining attention from the academic community, empirical studies on this linkage are still scarce, especially in developing economies. Moreover, the study of this relationship in the textile manufacturing sector in Pakistan is still limited and thus, there is a significant lacuna in the literature.



In view of this, the present study investigates the effects of eco-design, green procurement, green manufacturing and green distribution on firm performance and examines the mediating role of sustainable supply chain management between textile manufacturing firms in Pakistan. The study advances the literature by examining four separate green supply chain practices, instead of the GSCM as a homogeneous construct, which will help to gain a more holistic understanding of the impact of individual environmental practices on organizational performance. In practice, the results provide important insights for textile manufacturers, supply chain managers, and policy makers aiming to enhance their sustainability capabilities and competitiveness through successful application of green supply chain practices.

2. Literature Review and Hypothesis Development

2.1 Green Supply Chain Management

Green supply chain management (GSCM) involves taking environmental factors into account throughout the entire chain, from the product design to the sourcing of materials, manufacturing, distribution and end-of-life reuse, remanufacturing and recycling (Azevedo et al., 2011; Akbari & McClelland, 2020). The increasing regulation, stakeholder demand, and competition have compelled companies to implement sustainable supply chain management strategies to reduce the environmental footprint and enhance operational efficiency. Previous research has been mostly concerned with pollution prevention and waste reduction within the confines of an individual organization, but recent studies highlight the need for collaboration between the different entities of the supply chain, as this collaboration can affect the environmental performance of the organization (Akbari & McClelland, 2020). This more comprehensive view brings to the fore the importance of information sharing, supplier partnership and environmental performance monitoring as cornerstone of sustainable supply chain management (SCM) (Carvalho et al., 2012). Thus, GSCM is currently seen as a capability which can be broken down into four major aspects—eco-design, green procurement, green manufacturing and green distribution. These practices help organizations to minimize environmental impacts while improving their operational efficiency and competitiveness in the long run (Afum et al., 2020). Each practice is discussed below and the linkages with firm performance.

2.2 Eco-design and Firm Performance

Eco design means embedding environmental concerns into the design of products and processes to decrease consumption of resources and waste and allow for reuse, repair and recycling of products over the product life cycle (Kong et al., 2020). Eco-design frequently involves using recyclable materials, modular design and life-cycle assessment to enhance the environmental performance of the products while maintaining quality. The Natural Resource Based View states that the skills that can be used to design in the environment can provide valuable and hard to imitate competitive business advantages (Hart, 1995). Based on empirical evidence, eco-design can have a positive impact on resource efficiency; it can reduce the production cost; it can boost green innovation; it can increase the organization's reputation; and it can enhance the organization's performance (Kong et al., 2020; Azevedo et al., 2011). However, the available evidence usually excludes South Asian manufacturers of textiles, and most of the studies conducted in the region have been in developed and East Asian economies. Given the resource-based expectation that unique, environmentally oriented design capabilities are difficult for competitors to replicate and therefore a plausible source of advantage, this study hypothesizes:

H1: Eco-design has a significant positive effect on firm performance.

2.3 Green Procurement and Firm Performance

According to Carter and Carter (1998), green procurement means purchasing products and services that reduce environmental impacts in the purchasing process in order to ensure that environmental considerations are taken into account in the selection of suppliers. It involves assessing suppliers' environmental performance, promoting eco-friendly production processes, minimizing waste at the sourcing level, and selecting certified suppliers. The benefits of green procurement as identified in previous studies include: better environmental performance, more positive supplier relationships, better organizational reputation, and reduced regulatory risk (Azevedo et al., 2011; Hamdy et al., 2018). The financial advantages of green procurement can, however, differ from organisation to organisation, based on the commitment of



supplier(s), the financial resources available and the capabilities of the organisation. Firms that have more positive relationships with their suppliers and are more integrated with their supply chain tend to have more performance improvements (Hamdy et al., 2018). Although there are findings from various countries around the globe, very little research has been conducted on this relationship in the textile manufacturing sector in Pakistan. Accordingly:

H2: Green procurement has a significant positive effect on firm performance.

2.4 Green Manufacturing and Firm Performance

Green manufacturing is a process of optimizing the manufacturing process with the aim of minimizing the amount of wastes generated, energy consumption, harmful emissions, and maximize the use of resources (Afum et al., 2020). Common programs involve, for example, cleaner production technologies, energy-efficient machinery, recycling manufacturing waste, and more use of eco-friendly materials. These activities help companies to cut production cost, enhance manufacturing efficiency, minimize environmental pollution, and increase competitiveness (Afum et al., 2020; Azevedo et al., 2011). The results of the studies to examine the relationship between green manufacturing and sustainable organizational performance have been positive in all of the manufacturing sectors that have been studied in the developing economies. Nevertheless, very little empirical data is available for Pakistan's textile sector in which production processes are still highly resource intensive. Hence, the study of this relationship is a contribution to the understanding of whether the advantage of green manufacturing can be obtained with similar effectiveness in this important industrial sector.

This study therefore proposes:

H3: Green manufacturing has a significant positive effect on firm performance.

2.5 Green Distribution and Firm Performance

Green distribution involves the implementation of environmentally responsible logistics, which helps to reduce environmental effects related to transport, warehousing, packaging and distribution (Azevedo et al., 2011). These are common examples: route optimization, using fuel efficient transport, green packaging materials and joint logistics planning with a view to emission reduction, energy saving and thus reduced operating costs. In addition, better logistics efficiency will also boost supply chain responsiveness and organizational agility, thus improving competitive performance (Al Humdan et al., 2020; Carvalho et al., 2012). In previous studies, it is shown that green distribution positively affects customers' satisfaction, operation efficiency, and environmental performance, but in some contexts, there is a possibility of delayed financial returns due to the large initial investments required for green distribution (Hamdy et al., 2018). There is limited empirical evidence on green distribution in the textile supply chains in Pakistan, and more is needed., this study hypothesizes:

H4: Green distribution has a significant positive effect on firm performance.

2.6 Sustainable Supply Chain Management as a Mediator

Sustainable supply chain management (SSCM) is a concept that takes SCS beyond shareholder-value maximization to explicitly include environmental, social and financial aspects in the chain spanning from point of origin to point of consumption. In theory, SSCM acts as a process to transform discrete green practices into performance outcomes: discrete green practices create environmental and informational assets (such as eco-design and green procurement respectively), but whether or not the assets are integrated by managing them across the supply chain (by introducing visibility, collaboration with suppliers, and coordinated environmental risk management) determines whether performance gains are outcome. Organizations that implement sustainable supply chain management are more likely to cut down on their carbon footprints by using greener raw materials, boost operating efficiencies by decreasing waste and energy consumption, and enhance their resilience to supply disruptions by diversifying and tracking their suppliers' environmental risk, which should lead to higher profit, market share, and return on investment.

There is some evidence for this reasoning in previous mediation research. According to Hamdy, Elsayed, and Elahmady (2018), Sustainable Supply Chain Management practices significantly mediate the relationship among environmental practices and company performance as examined by research study on



sustainable supply chain management in Egyptian Companies. Likewise, the study of agile and resilient supply chain practices ensures that flexible, environmentally coordinated supply chain practices reinforce the performance effect of green initiatives in the supply chain (Carvalho, Azevedo & Machado, 2012). The mediating role of SSCM seems however to have different levels of importance based on the context and the practice: the importance of SSCM is in between the practices where the impact on performance is more direct and where the impact is more indirect and depends on the extent to which the practice can be implemented with supply chain coordination. In an emerging economy like Pakistan where the SSCM infrastructure, environmental capacity of suppliers, and information sharing between firms are still in their infancy, the mediating power of SSCM is not to be presumed but needs to be tested separately for each GSCM dimension. The following mediation hypotheses are developed in this study:

- H5:** Sustainable supply chain management mediates the relationship between eco-design and firm performance.
- H6:** Sustainable supply chain management mediates the relationship between green procurement and firm performance.
- H7:** Sustainable supply chain management mediates the relationship between green manufacturing and firm performance.
- H8:** Sustainable supply chain management mediates the relationship between green distribution and firm performance.

2.7 Sustainable Supply Chain Management and Firm Performance

In addition to its hypothesized mediating role, SSCM is hypothesized to have a direct impact on firm performance. Theorized to deliver cost savings, better customer and supplier relationships, and environmental and regulatory resilience, regardless of any single green practice, firms that coordinate information, material, and environmental risk management across their supply chains. Potential KPIs for SSCM maturity range from reduction of reverse logistics costs, waste reduction, carbon footprint reduction rates, supplier environmental sustainability indices, to product recycling rates, which are all plausible drivers of financial and operational success of a firm, including profitability, market share, and return on investment. This is in line with the natural-resource-based view of the world, which suggests that the ability to deal with environmental uncertainty throughout the value chain is a competitive advantage in and of itself (Hart, 1995). Accordingly:

- H9:** Sustainable supply chain management has a significant positive effect on firm performance.

2.8 Theoretical Foundation

This study is based on the Resource Based View (RBV) theory, which states that firms are able to sustain competitive advantage by building resources and capabilities that are valuable, rare, inimitable, and non-substitutable (Hart, 1995). Eco design, green procurement, green manufacturing, and green distribution are examples of strategic environmental capabilities that help companies increase resource efficiency, minimize environmental impacts and improve their performance in the field of green supply chain management (GSCM) (Azevedo et al., 2011; Afum et al., 2020).

In addition, RBV proposes that competitive advantage does not come from single resources but from how the firm integrates and uses these resources effectively (Hart, 1995). Thus, sustainable supply chain management (SSCM) is defined as a higher-order organizational capability, which integrates the environmental, operational and informational resources of supply chain partners. Collaboration, information sharing and integration with the environment helps enhance the effectiveness of GSCM practices and helps translate them into better firm performance (Akbari & McClelland, 2020; Carvalho et al., 2012).

Rather than reacting to external pressures, as stakeholder and institutional theories do, RBV is chosen as the basis for this study because it is oriented toward the impact of environmental capabilities within the firm on superior performance. Thus, RBV gives a proper theoretical background to explain the direct impact of GSCM practices on the performance of the firms and the role of SSCM as a mediator. This theoretical framework is the basis for the relationships and hypotheses that are explored in the current research.

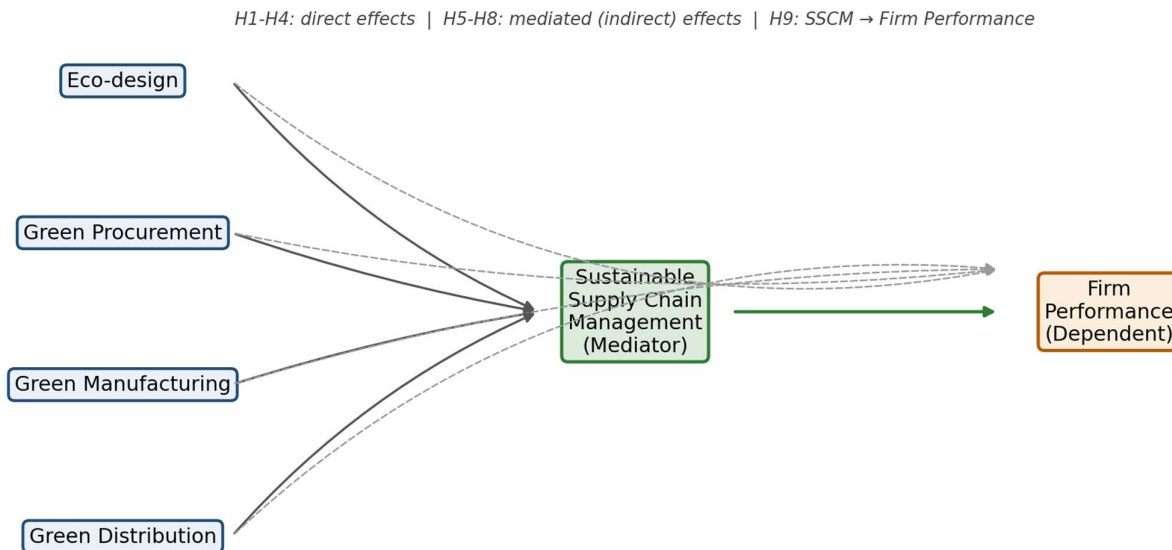


2.9 Conceptual Framework

Figure 1 presents the conceptual framework guiding this study. The four independent variables of eco-design, green procurement, green manufacturing, and green distribution are related directly to firm performance (H1–H4). The hypothesis of sustainable supply chain management as a mediating variable was hypothesized between each GSCM practice and firm performance (H5–H8) and also direct (H9).

Figure 1

Conceptual Framework of the Study



The framework in Figure 1 also explains the analytical approach used in this study: direct effects (H1–H4, H9) are estimated first by using structural equation modelling, and then indirect effects (H5–H8) are tested with bootstrapped mediation analysis, which enables the study to differentiate between GSCM practices whose performance benefits are mainly direct and those whose performance benefits are mainly indirect through sustainable supply chain coordination.

3. Research Methodology

3.1 Research Design

This study uses positivist philosophy of research and quantitative research design with cross-sectional design, which is used to test the hypotheses that have been predetermined in this study about the relationship between measurable variables. A positivist approach was deemed suitable as the research questions are related to the objective relationships between GSCP and firm performance measures, and not the subjective interpretation of managerial experience. Data were gathered through a structured survey instrument at one time only and the relationship among GSCM practices, SSCM and firm performance were analysed by means of the available statistical and structural equation modelling techniques. The cross-sectional approach was selected because of time and resource limitations associated with the study of one researcher, but it also allows for the rigorous hypothesis testing that is possible when using covariance-based structural equation modelling.

3.2 Population and Sample

The target population included managers, supervisors and supply chain professionals from textile manufacturing companies in Faisalabad, Sheikhpura and Multan, three of the main textile manufacturing cities of Pakistan, where the majority of textile manufacturing is export oriented, consequently leading to higher pressure from overseas buyers to be environmentally responsible. In this context it was impracticable to obtain a complete sampling frame of textile manufacturing employees and thus a convenience sampling method was used to distribute the questionnaire across these firms. The questionnaires circulated yielded 150 completed and usable responses, which is comparable to the minimum number of responses suggested for



exploratory factor analysis and structural equation modelling in survey research in organizations (Hair et al., 2010). The respondents were carefully selected from various levels of the organization and functional departments, so that the data obtained would not just be the opinion of a single level in management but would also reflect the opinions of various levels of the organization and functional departments.

3.3 Data Collection Procedure

The data was collected by means of a self-administered closed-ended questionnaire which was sent to executives and staff in the above-described departments. All constructs were measured on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) using items from the previously used scales for GSCM, SSCM and firm performance in the various empirical studies and modified to match the terminology and operational context of Pakistan textile industry. The questionnaire consisted of two parts: the first part was the demographic profile section (gender, industry type, designation and years of experience), and the second part was the measurement section that contained the six study constructs. The instrument was pretested for face validity and clarity of item wording before full distribution and minor changes to the wording of items were made as a result of this pretest. Participants' responses were made anonymous and confidential and were only used for academic purposes; no personally identifying data was stored in the analysis dataset. The return rate was adequate for obtaining 150 complete questionnaires, a rate common for organizational surveys of this type and based on a convenience sample. To ensure data quality, incomplete responses and responses that failed basic attention checks were removed before analysis.

3.4 Measurement of Variables

Table 1

Measurement of Variables

Variable	Number of Items	Source / Basis
Eco-design	3	Adapted from established GSCM scales
Green Procurement	5	Adapted from established GSCM scales
Green Manufacturing	4	Adapted from established GSCM scales
Green Distribution	6	Adapted from established GSCM scales
Sustainable Supply Chain Management	9	Adapted from established SSCM/KPI scales
Firm Performance	8	Adapted from established firm performance scales

Table 1 presents the constructs in this study and the number of items that were used to measure each construct. All items were scored using a 5-point Likert scale described above and construct scores were calculated as the average of the items. This item structure was used in the reliability and correlation analyses, as well as the structural equation modelling analysis, described in the next sections.

3.5 Data Analysis Techniques

Data were analysed in two stages: The data screening, descriptive statistics, reliability analysis (Cronbach's alpha) and Pearson correlation analysis among the six variables of the study were conducted using SPSS. Before substantive analysis, data screening was conducted to identify missing and extreme values and normality, which was evaluated by skewness and kurtosis statistics. Second, confirmatory factor analysis (CFA) was used to test the measurement model, and structural equation modelling (SEM) tested hypothesized direct paths (H1–H4, H9), while bootstrapped mediation analysis (5,000 resamples, bias corrected 95% confidence intervals) tested the hypothesized indirect paths (H5–H8) of SSCM. The two-step approach, first establishing measurement validity by CFA, then testing structural relationships by SEM, is standard practice in survey-based structural equation modelling, and is also designed to guarantee that hypothesis tests are performed on a psychometrically sound measurement model. The selection of bootstrapping for the mediation tests is particularly made because bootstrapping does not require the assumption of normally distributed sampling distribution for the indirect effect, which is frequently not met in mediation analysis and can otherwise lead to erroneous significance tests when more traditional methods (Sobel test) are used. Reliability was judged against the conventional criterion of Cronbach's alpha with values ranging from 0.60 to 0.70



considered acceptable in the methods literature (Bernstein, 1994; Field, 2009; Hair et al., 2010) for exploratory and newly adapted scales.

4. Results

4.1 Respondent Profile

Of the 150 respondents, 119 (79.3%) were male and 31 (20.7%) were female. All respondents (100%) were drawn from textile manufacturing firms. In terms of work experience, 53.3% had between one and five years of experience, 18.0% had six to ten years, 12.7% had eleven to fifteen years, and 16.0% had more than fifteen years. By designation, respondents were distributed across marketing (29.3%), operations and production (24.7%), procurement (22.0%), supply chain (13.3%), and sales/executive (10.7%) functions, reflecting reasonably broad representation across the departments most directly involved in green supply chain decision-making. This distribution suggests that the study's findings reflect the perspectives of respondents with substantial hands-on exposure to green practices at the point of implementation, rather than solely senior-management perceptions removed from day-to-day supply chain operations.

4.2 Descriptive Statistics

Table 2

Descriptive Statistics

Variable	N	Mean	SD	Skewness	Kurtosis
Green Procurement	150	3.68	0.61	-0.98	1.31
Green Manufacturing	150	3.28	0.69	-0.23	-0.25
Green Distribution	150	3.45	0.72	-0.68	0.11
Eco-design	150	3.80	0.78	-0.49	0.02
Sustainable Supply Chain Mgmt.	150	3.68	0.78	0.22	2.55
Firm Performance	150	3.71	0.69	-0.92	0.44

Note. All variables measured on a 5-point Likert scale. Skewness and kurtosis values fall within the acceptable ± 2 range, indicating approximately normal distribution (Hair et al., 2010).

Mean scores for all six variables cluster between 3.28 and 3.80, indicating that respondents, on average, mildly to moderately agreed that their firms engage in green supply chain practices and perceive positive firm performance outcomes. Eco-design recorded the highest mean (3.80), suggesting it is the most visibly adopted GSCM practice among sampled firms, while green manufacturing recorded the lowest (3.28), consistent with the capital intensity typically required to fully green production processes. Firm performance (mean = 3.71) and sustainable supply chain management (mean = 3.68) recorded similarly high average scores, suggesting that respondents who perceive stronger sustainable supply chain coordination within their firms also tend to report stronger firm performance outcomes—a pattern consistent with the correlation and structural results reported below. The relatively low dispersion of standard deviations (0.61 to 0.78) across all six constructs further indicates that responses were reasonably consistent across the sample, rather than being driven by a small number of extreme respondents.

4.3 Reliability and Validity

Table 3

Reliability Analysis

Construct	Items	Cronbach's α
Green Procurement	5	0.598
Green Manufacturing	4	0.637
Green Distribution	6	0.804
Eco-design	3	0.741
Sustainable Supply Chain Mgmt.	9	0.696
Firm Performance	8	0.854
Overall Scale (35 items)	35	0.913



Note. $\alpha \geq 0.70$ is considered reliable; values between 0.60–0.70 are treated as acceptable for exploratory research (Bernstein, 1994; Hair et al., 2010).

The overall 35-item instrument achieved excellent internal consistency ($\alpha = .913$). Individual constructs also achieved acceptable-to-good reliability, with green distribution, eco-design, and firm performance exceeding the conventional 0.70 threshold; green procurement, green manufacturing, and sustainable supply chain management fell marginally below this threshold but remained within the range considered acceptable for newly adapted, exploratory-stage scales. Sampling adequacy for factor analysis was confirmed by a Kaiser-Meyer-Olkin (KMO) value of 0.843 and a statistically significant Bartlett's Test of Sphericity ($\chi^2 = 4416.47$, $df = 703$, $p < .001$), together indicating that the correlation matrix was suitable for factor extraction. Confirmatory factor analysis in AMOS supported a six-factor measurement model, with standardized factor loadings ranging from approximately 0.50 to 0.90, exceeding the minimum acceptable threshold of 0.50 and, for the majority of items, the more stringent 0.70 benchmark. Communalities for all retained items exceeded 0.50, and no cross-loadings above the accepted threshold were observed, supporting the discriminant validity of the six constructs. Taken together, the reliability, sampling-adequacy, and factor-loading results indicate that the measurement model provides a psychometrically sound basis for the subsequent structural and mediation analyses.

4.3.1 Measurement Model Assessment. The confirmatory factor analysis model was estimated in AMOS software by maximum likelihood estimation, and the model consists of the 6 latent constructs (green procurement, green manufacturing, green distribution, eco-design, sustainable supply chain management, and firm performance) and their 20 observed items. All items loaded significantly and substantially onto the intended factors, and there was very little cross loading onto the unintended factors, which was consistent with the hypothesized six factor structure in the conceptual framework. The results of the above measurement model were judged adequate for proceeding to the structural path estimation, based on the combined evidence obtained from the reliability test, the KMO/bartlett test, and the standardized loading test.

4.4 Correlation Analysis

Table 4

Pearson Correlation Matrix

	GM	GD	ECOD	SSCM	FP	GP
GM	1					
GD	.490**	1				
ECOD	.471**	.676**	1			
SSCM	.461**	.594**	.715**	1		
FP	.546**	.602**	.658**	.678**	1	
GP	.417**	.342**	.243*	.275**	.430**	1

*Note. $N = 150$. * $p < .05$, ** $p < .01$ (2-tailed).*

All study variables were significantly and positively correlated with one another. Firm performance showed its strongest association with sustainable supply chain management ($r = .678$, $p < .01$), followed by eco-design ($r = .658$, $p < .01$), green distribution ($r = .602$, $p < .01$), green manufacturing ($r = .546$, $p < .01$), and green procurement ($r = .430$, $p < .01$). Eco-design was also strongly correlated with sustainable supply chain management ($r = .715$, $p < .01$), foreshadowing the mediation result reported below.

4.5 Structural Model and Hypothesis Testing

Structural equation modelling in AMOS was used to test the hypothesized direct effects of the four GSCM practices and of SSCM on firm performance.



Table 5

Structural Model Results (Direct Effects)

Hypothesis	Path	β	p-value	Decision
H1	Eco-design $\rightarrow$ Firm Performance	.410	.001	Supported
H2	Green Procurement $\rightarrow$ Firm Performance	.194	.001	Supported
H3	Green Manufacturing $\rightarrow$ Firm Performance	.191	.005	Supported
H4	Green Distribution $\rightarrow$ Firm Performance	.165	.035	Supported
H9	SSCM $\rightarrow$ Firm Performance	.678	.001	Supported

All four GSCM practices exerted a statistically significant positive effect on firm performance, with eco-design showing the strongest direct effect ($\beta = .410$, $p = .001$), followed by green procurement ($\beta = .194$, $p = .001$), green manufacturing ($\beta = .191$, $p = .005$), and green distribution ($\beta = .165$, $p = .035$). Sustainable supply chain management also exerted a strong, statistically significant direct effect on firm performance ($\beta = .678$, $p = .001$), supporting H9.

4.6 Mediation Analysis

Bootstrapped indirect-effect testing (5,000 resamples, bias-corrected 95% confidence intervals) was used to test whether SSCM mediates the relationship between each GSCM practice and firm performance.

Table 6

Mediation (Indirect Effect) Results

Hyp.	Indirect Path	β	95% CI	P-value	Decision
H5	Eco-design $\rightarrow$ SSCM $\rightarrow$ Firm Performance	.329	[.216, .455]	.001	Supported
H6	Green Procurement $\rightarrow$ SSCM $\rightarrow$ Firm Performance	.033	[-.052, .121]	.432	Not Supported
H7	Green Manufacturing $\rightarrow$ SSCM $\rightarrow$ Firm Performance	.074	[-.008, .161]	.071	Not Supported
H8	Green Distribution $\rightarrow$ SSCM $\rightarrow$ Firm Performance	.100	[-.008, .287]	.074	Not Supported

Note. Indirect effect considered significant when the 95% bootstrapped confidence interval excludes zero. $N = 150$.

The mediation results indicate that sustainable supply chain management significantly mediates the relationship between eco-design and firm performance ($\beta = .329$, 95% CI [.216, .455], $p = .001$), supporting H5. The confidence intervals for the indirect paths from green procurement, green manufacturing, and green distribution through SSCM to firm performance all include zero, and the associated p-values exceed the .05 threshold, indicating that H6, H7, and H8 are not supported. Taken together, the direct-effect and mediation results indicate a pattern of partial, practice-specific mediation: SSCM meaningfully channels the performance benefits of eco-design, but green procurement, green manufacturing, and green distribution appear to affect firm performance primarily through direct rather than SSCM-mediated pathways in this sample.

5. Discussion

5.1 Eco-design and Firm Performance

The finding that eco-design exerts the strongest direct effect on firm performance among the four GSCM practices ($\beta = .410$) is consistent with prior evidence that environmentally conscious design choices generate first-mover advantages, reduce material and lifecycle costs, and strengthen brand image among increasingly environmentally aware customers (Kong et al., 2020; Zimon et al., 2020). Within Pakistan's textile sector, this result likely reflects the relatively low capital barrier to eco-design compared with, for instance, retrofitting entire manufacturing lines: firms can begin incorporating recyclable materials, energy-conscious specifications, and design-for-disassembly principles without the scale of investment required for green manufacturing infrastructure. The strength of this effect, combined with eco-design's high correlation with SSCM ($r = .715$), suggests that eco-design decisions may also be the practice most tightly interwoven with firms' broader sustainable supply chain orientation, which helps explain why it is also the only practice for which SSCM mediation was confirmed. From a customer-facing perspective, eco-design changes are also the most visible of the four GSCM practices to end buyers and international clients, which may further



reinforce its comparatively strong link to perceived firm performance in a sector heavily dependent on export orders.

5.2 Green Procurement and Firm Performance

The impact of green procurement was more modest and significant and positive on firm performance ($\beta = .194$). This is in line with the general perception of sourcing environmentally certified inputs and reduced-waste materials as an increase in reputation and decrease in regulatory risk, and also indicates the relatively weak reliability found for this construct ($\alpha = .598$), as well as the remaining reliance on price-sensitive, price-driven supplier relationships in the textile sector. Performance outcomes of green procurement might be less than those reported within larger firms in more developed supply markets, in a context in which many textile companies are facing constrained margins and limited leverage on upstream suppliers. It is also possible that the relationship is implemented somewhat unevenly in the sample, with some firms being more committed to the green procurement than others, and this could reduce the overall strength of the average relationship, even if it were strong in the majority of cases.

5.3 Green Manufacturing and Firm Performance

The contribution of green manufacturing was significant and had a positive effect on firm performance ($\beta = .191$), which is consistent with findings from other manufacturing environments that process-level improvements in environmental performance (such as reduced energy use, waste minimisation and cleaner production technology) have a positive impact on firm performance (Afum et al., 2020). The relatively low mean score (3.28) for this construct, coupled with its significant performance impact, indicates that the current level of partial green manufacturing adoption by the textile companies in Pakistan is already having tangible impact on their performance, which implies that increased investment in this area would lead to proportionately greater benefits as more companies adopt green manufacturing practices. The fact that green manufacturing, although it can be the most capital-intensive of the four practices studied, still had a strong impact on firms, even though it is only just beginning to be widely adopted, is a positive note for firms thinking about investing in it.

5.4 Green Distribution and Firm Performance

Of the four direct effects, the weakest was green distribution ($\beta = .165$), but it was still significant. This is possible because logistics and distribution in the textile clusters in Pakistan are in many instances outsourced to third party transporters and shared regional infrastructure that individual manufacturing companies have little direct control over, which may reduce the effectiveness of the firm-level green distribution efforts, e.g., green packaging or selection of fuel-efficient transportation. However, the strong positive relationship is clear, meaning that even small steps towards green distribution are noticeable in the firm's performance in this context and that the green relationship between the firm and the third-party logistics provider may require more than just the firm's efforts.

5.5 Mediating Role of Sustainable Supply Chain Management

The most central and theoretically important result of this study is the partial mediating effect of sustainable supply chain management. While the eco-design–firm performance relationship was significantly mediated by SSCM, the relationships between green procurement, green manufacturing, and green distribution were not significantly mediated. This is somewhat different from the results of the studies carried out in more developed SSCM contexts, such as the Egyptian evidence reported by Hamdy et al. (2018), which revealed that SSCM practices (the combination of green and socially responsible supply chain practices) mediated more broadly between the variables of green supply chain conduct and firm performance. The contrast is informative: while the Egyptian case was based on companies in a sector that is part of a national sustainability strategy that is clearly linked to the UN Sustainable Development Goals, textile firms in Pakistan do not currently have a sector-level sustainability mandate like this, which may partly account for the apparent broader reach of the mediating effect of the SSCs in the Egyptian sample.

There are several possible context explanations for this difference. The relatively small sample size ($N = 150$) might reduce statistical power to detect smaller indirect effects for green procurement, green manufacturing, and green distribution. Although the sample size was sufficient for the analyses performed, it



may limit the statistical power to detect smaller indirect effects for green procurement, green manufacturing, and green distribution. Second, Pakistan's textile industry is still at an early stage of SSCM maturity, namely sustainable supply chain infrastructure (supplier environmental information sharing, cross-firm sustainability KPIs and integrated reverse-logistics systems), and firms lack the coordination mechanisms necessary to ensure that the sustainable supply chain practices of procurement, manufacturing and distribution are translated into sustainable supply chain outcomes through SSCM.

Third, eco-design choices are likely to be made early and centrally during the product development process, and thus more easily integrated into, and consequently more easily amplified by, a firm's sustainable supply chain orientation than other eco-design activities like procurement or distribution tasks, which are more likely to be multi-party and fragmented in the firm's coordination with external suppliers and logistics providers. These findings do not contradict the theoretical arguments for SSCM as a mediating process, but rather indicate that the mediating role of SSCM is dependent on the level of integration of the specific green practice into the coordination of the supply chain as a whole, a dimension that is not always addressed in earlier mediation studies that consider GSCM as a unified construct.

It is noteworthy that the direct effects of green procurement, green manufacturing and green distribution on the firm performance remained statistically significant in the absence of mediation by SSCM. This does not imply that sustainable supply chain capabilities measured in this study are not relevant to the performance of these practices; rather, there is evidence that the benefits of these practices, in terms of sustainable supply chain capabilities, are realised through other pathways, such as direct cost savings, regulatory compliance or customer relationship impacts which do not necessitate broader supply-chain coordination to be realised. The distinction is of practical importance for investment priorities for the textile industry and policy makers, which will be discussed below in relation to the four GSCM practices.

Another contextual factor that needs to be taken into account is the relative infancy of SSCM institutionalization in the textile sector, compared to other sectors and countries where formal sustainability reporting, third-party auditing and environmental certification of supply chains are more mature. Even though these practices are individually beneficial, informational flows that are theorized to enable by SSCM, such as visibility into supplier practices, coordinated tracking of waste and emissions, and shared environmental risk management, may not yet be sufficiently dense at the firm level to drive the performance benefits of procurement, manufacturing, and distribution greening in the absence of robust institutional infrastructure. This interpretation is in line with the relatively low reliability that was observed for the construct itself SSCM ($\alpha = .696$), which can be interpreted as the respondents in different firms may have different and not fully converged meanings of what really is meant by sustainable supply chain management in their respective organizations.

6. Implications

6.1 Theoretical Implications

In contrast to the previous studies, which considered GSCM as a composite construct, the present study breaks down GSCM into four dimensions and examines the different direct and indirect effects of these dimensions on firm performance through the mediation of GSCM. It extends the sustainable supply chain management literature by showing that the mediating role of SSCM is not the same for all the green practices; the results are clear for eco-design and not for the other green practices, green procurement, green manufacturing or green distribution, indicating that future models of mediation in SSCM should test the mediating pathways of the practices and not assume a single and undifferentiated effect. The study also extends the RBV by suggesting that the relationships between the GSCM resources and the performance outcomes are partially indirect, mediated by the higher-order SSCM capability, and partially direct, without the requirement of complete integration into supply-chain-wide coordination, since some green practices may bring about resource-based advantage more directly. This extends the standard RBV view of environmental strategy that assumes that the key mechanism through which green-practice value is realized is the ability of the value chain, demonstrating empirically that this conduit is not universal but selective.



Last but not least, the study brings rare emerging-economy data to the GSCM–SSCM literature, which is dominated by developed and East Asian manufacturing contexts, and provides a methodological template that can be easily replicated in other manufacturing contexts in developing countries, specifically those in Pakistan in which the textile industry is the main focus. A more general implication of the study is that it calls for future theorization of the conditions under which SSCM can be considered to be a true mediator, as opposed to contexts where GSCM practices can still be said to have a relatively direct link to firm performance, which goes beyond the textile industry explored in this study.

6.2 Managerial Implications

The results indicate that for textile producers, eco-design is a high priority for investment, not only in terms of the direct impact on firm performance, but also because of the added value that can be gained from sustainable supply chain coordination, which is also likely to lead to compounding returns as the capability of SSCM increases. Even though the benefits of green procurement, green manufacturing and green distribution are not yet channelled via SSCM, managers of the supply chain should still be investing in these areas because each area individually has a significant positive impact on firm performance. For procurement managers, it means that green sourcing can be done on its own merits, without the need for more comprehensive SSCM infrastructure to prove value, and that investment in green procurement does not need to be dependent on the maturity of the sector-wide SSCM. The impact of green manufacturing, despite relatively small share of adoption, is evident for the operations and production managers, and this indicates that there is likely to be a significant benefit to using energy efficient and waste minimising production technology even at an early stage of implementation. The findings indicate that policies to increase the infrastructure of SSCM (e.g., supplier environmental data-sharing platforms, sector-wide sustainability KPIs, and reverse-logistics systems) may help to broaden the mediating role of SSCM beyond eco-design to the other GSCM practices, thereby enhancing the overall performance benefits of green investment in the textile industry. The implications of these considerations suggest two paths for management: focus on eco-design as a short-term priority, leveraged by SSCM, and maintain incremental investments in procurement, manufacturing and distribution greening as stand-alone projects that are separately compelling.

7. Conclusion

The aim of this research was to identify the impact of eco-design, green procurement, green manufacturing and green distribution on firm performance of textile manufacturing companies in Pakistan and to test the mediating role of sustainable supply chain management in the relationships between these variables. The study was based on survey data from 150 managers, supervisors and actors in the supply chain, which were analysed using reliability, correlation, confirmatory factor analysis and structural equation modelling, and concluded that all four GSCM practices, as well as sustainable supply chain management itself, have significant positive direct effects on the performance of the firm. While sustainable supply chain management was found to significantly mediate only between eco-design and firm performance, the mediation between green procurement, green manufacturing and green distribution was not detected.

The results add to the literature by showing that the relationship between green SCM and firm performance is not linear and is not fully captured by a single mediating mechanism, and challenges theories that assume that the relationship between green SCM and its benefit is a one-way straight path. They further expand the RBV by demonstrating how the practices of GSCM can create performance advantage directly and also via higher-order sustainable supply chain capability (in the specific case of eco-design). On the practical level, the study provides textile manufacturers, supply chain managers and policy makers with a more solid foundation for prioritizing investments in sustainability: eco-design is the practice which achieves the highest performance return, and is amplified by the SSCM, whereas green procurement, green manufacturing and green distribution are practices that remain worthwhile even in the absence of a sustainable supply chain infrastructure. Overall, the study highlights that continued investments in green supply chain practices offer measurable performance benefits to textile manufacturers in Pakistan, and that green supply chain infrastructure can be a stepping stone towards the overall sustainability of the sector in the future, benefitting not only the individual companies but also the competitiveness of these companies.



8. Limitations and Future Research

Limitations

The current study has some limitations. First, the cross-sectional design is only able to reveal relationships at one particular point in time and does not allow for the determination of causality with confidence. Secondly, the sample was limited to the textile industry, and more specifically to textile firms in Faisalabad, Sheikhpura, and Multan, which might restrict the findings to other industries in Pakistan or other parts of the country. Third, the data were self-reported by managers, supervisors and staff, perhaps causing common method or social-desirability bias, especially with perceptual assessments of firm performance.

Future Research

The findings might be applied to other manufacturing sectors (e.g. chemical processing, plastics, automotive parts), or to other contexts in the emerging economies, to investigate the generalizability of the practice-specific mediation pattern identified here. Longitudinal designs would allow for better understanding of the causal ordering of GSCM adoption, SSCM maturity and firm performance over time. Considering the increasing importance of sustainable manufacturing strategy, future studies could also include circular economy indicators, integration of environmental, social, and governance (ESG) aspects, and digital supply chain technologies as other practices or mediating mechanisms.

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Contribution of Authors

All the authors participated in the ideation, development, and final approval of the manuscript, making significant contributions to the work reported.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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Informed Consent

Informed consent was obtained from all individual participants included in the study.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of 1964 Helsinki declaration and its later amendments.

Data Availability

The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

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