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GREEN SUPPLY CHAIN MANAGEMENT AND SUSTAINABLE PERFORMANCE: THE MEDIATING ROLE OF INNOVATION AND INSTITUTIONAL PRESSURES

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Abstract

Green Supply Chain Management (GSCM) has emerged as a strategic approach for improving environmental, economic, and social performance in organizations. This study examined the impact of GSCM on sustainable performance with the mediating roles of innovation and institutional pressures. A quantitative research design was applied using a cross-sectional survey approach. Data were collected from employees working in manufacturing and supply chain-related firms in Pakistan, particularly in textile, logistics, pharmaceutical, and food processing sectors. A total of 350 questionnaires were distributed, and 312 valid responses were analysed. Structural Equation Modelling (SEM) using Smart PLS was employed to test the proposed hypotheses. The results indicated that GSCM significantly influenced sustainable performance ($\beta = 0.31$, $p < 0.001$). Innovation showed a significant mediating effect between GSCM and sustainable performance ($\beta = 0.21$, $p < 0.001$), while institutional pressures also demonstrated a significant mediating role ($\beta = 0.18$, $p < 0.001$). Additionally, innovation positively influenced sustainable performance ($\beta = 0.36$, $p < 0.001$), and institutional pressures significantly enhanced sustainable performance ($\beta = 0.33$, $p < 0.001$). The findings confirmed that sustainable performance improved when GSCM practices were supported by innovation capabilities and institutional compliance mechanisms. The study contributes to resource-based and institutional theories by explaining how internal and external factors jointly enhance sustainability outcomes. Practical implications suggest that organizations should integrate green innovation and respond effectively to institutional pressures to achieve long-term sustainability advantages.

Keywords: Green Supply Chain Management, Institutional Pressures, Innovation, Sustainable Performance, Supply Chain Sustainability

1. Introduction

Green Supply Chain Management (GSCM) surfaced as an imperative strategic approach for organization wants to embed green practices in supply chain activities. Global issues like climate change, environmental degradation and resource sparseness forced firms to implement sustainability measures throughout the supply chain processes (in procurement, production, distribution as well as reverse logistics). GSCM incorporates ecological objectives into the actual process of supply chain management, aiming for long-term sustainable performance, thus not only limited to economic goals (Nazir et al., 2024; Abbas, 2024). It was also clear to firms that environmental responsibility had become a prerequisite for global competitiveness and legitimacy.

The increasing focus on sustainability urged organizations to incorporate green practices related to eco-design, green purchasing and waste reduction measures. These practices improved the operational

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efficiency and decreased the environmental impact thereby improving organizational performance outcomes (Mahar et al., 2025). Shareholders, customers and investors had increased requirements for transparency and compliance with sustainability standards contributing to the rapid acceleration of GSCM. Companies transitioned from reactive environmental management to more proactive supply chain-integrated sustainability strategies and practices.

Innovation was fundamental in enhancing the impact of GSCM practices. Green innovation in the form of technology and process developments, allowing organizations to consume fewer resources and lower emissions, was essential. Integrating innovation into supply chain operations improves environmental and economic performance (Wang et al, 2023; Atieh & Abushaega, 2025), so innovation was considered as one of the main mediators between GSCM and sustainable performance. To meet their sustainability targets, firms turned to innovative solutions like digital technologies, automation and sustainable production systems.

GSCM practices are also much most adopted and effective due to many institutional pressures. They ranged from regulatory pressures, industrial standards, and social norms that made organizations conform to sustainability logics. The institutional theory has revealed that firms are led toward adoption of environmentally friendly practices by coercive, normative and mimetic pressures for the sake of legitimacy and competitive advantage (Chu et al., 2017; Zeng et al., 2021).

Background of the Study

Sustainable supply chain management developed from the general sustainability movement that began to gain traction and recognition after business leaders from around the world gathered at United Nations Headquarters in New York City for the World Economic Forum during 2002, who championed an integrated approach towards economic, environmental and social goals. Food supply to corporates led to insights around the environmental degradation caused by their reliance on energy-intensive and emissions generating food supply chains and wastages they created. Green Supply Chain Management (GSCM) was developed to overcome these challenges, as it embeds environmental concerns into the supply chain (Ashraf, 2026). The relationship marked a departure from supply chains driven by traditional efficiency to systems that have sustainability in mind.

The empirical studies helped to emphasize the positive association between GSCM practices and sustainable performance. Companies use green procurement, safe production, and reverse logistics (Environmental). Companies that use Eco-friendly manufacturing processes observe better environmental impact and cost efficiencies. The effectiveness of such practices across different industries and regions has varied as technological abilities & external pressures vary (Nazir et al., 2024). This inconsistency suggested the necessity for further investigation of more GSCM-related factors. Green tech and managerial innovations enabled eco-friendly practices and resource efficiency. The literature argued that innovation not only enhanced operational performance and contribute to long-term sustainability by providing an opportunity for firms to respond better to changes in environmental regulations and market demands (Kurniawan & Hartini, 2025; Mahar et al., 2025).

Organizational behaviour towards sustainability was critically shaped by institutional pressures. Environmental regulations were imposed by government, customers demanded eco-friendly products, while competitors embraced green strategies providing a competitive arena for practitioners encouraging the adoption of sustainability. Our empirical results could provide affirmation for institutional pressures affecting GSCM implementation and performance outcomes at a substantive level (Asif et al., 2025; Chu et al., 2017; Lin et al., 2018).

Research Problem

More companies were adopting GSCM practices and there still was inconsistency in the outcome of sustainable performance. While some businesses saw a positive impact on environmental and economic performance, others experienced little or no benefit. The inconsistency of that indicated that, the direct GSCM impact on sustainable performance is not enough to elucidate the observed outcomes. This association has been widely reported previously but the mechanisms and contextual factors mediating this relationship have too often been not investigated in the literature. Only few studies have examined the simultaneous mediating impact of innovation and institutional pressures in the GSCM–sustainable performance nexus, especially for

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emerging economies. Innovation improved operational efficiency and institutional pressures encouraged adoption, that combination effect remained unexplored. This gap identified a requirement for a more centralised structure to acknowledge how these factors interact, thereby affecting sustainable performance results.

Research Objectives

1. To examine the impact of Green Supply Chain Management on sustainable performance.
2. To analyse the mediating role of innovation in the relationship between GSCM and sustainable performance.
3. To evaluate the mediating role of institutional pressures in the GSCM–sustainable performance relationship.
4. To provide empirical evidence on how internal and external factors jointly influenced sustainability outcomes.

Research Questions

Q1. How did Green Supply Chain Management influence sustainable performance?
Q2. What role did innovation play in mediating the relationship between GSCM and sustainable performance?
Q3. How did institutional pressure affect the adoption and effectiveness of GSCM practices?
Q4. How did innovation and institutional pressures collectively enhance sustainable performance?

Significance of the Study

This research added to the literature as it combined innovation and institutional pressures into GSCM practices to account for sustainable performance. It gave a comprehensive perspective of how interplays between internal capabilities and external pressures affected organizational sustainability performance. This study contributed to the literature by extending a body of research grounded in institutional theory and resource-based perspectives through five mediated mechanisms that reinforced positive GSCM–performance relationships. Abstract: The findings presented within the paper provide important knowledge, process and take action for managers and policymakers. Implications: The paper can help organizations improve sustainability performance in terms of investing in green innovation and accordingly responses to institutional pressures. Regulators could consider supportive regulatory constructs to pull for maintainable practices throughout industries. The paper also carried special significance for emerging economies where sustainability challenges and the dynamics of institutions differ significantly from developed regions.

Hypotheses Development

H1. Green Supply Chain Management (GSCM) has a significant positive impact on sustainable performance.
H2. Innovation significantly mediates the relationship between Green Supply Chain Management (GSCM) and sustainable performance.
H3. Institutional pressures significantly mediate the relationship between Green Supply Chain Management (GSCM) and sustainable performance.
H4. Innovation and institutional pressures jointly and positively enhance sustainable performance in the presence of Green Supply Chain Management (GSCM).

2. Literature Review

Green Supply Chain Management and Sustainable Performance

Green Supply Chain Management (GSCM) was recognized as a strategic approach to incorporating environmental issues in supply chain activities for sustainable performance improvement. Earlier research showed that implementation of green procurement, eco design and reverse logistic processes by firms lead to enhanced environmental and economic performance. Many studies showed the positive impact GSCM have on emissions reduction, resource development and use optimization and operational efficiency which ultimately enhance sustainable performance (Karakaş-Kelten et al., 2026; Mustafi et al., 2026).

With growing environmental issues and regulatory pressures, the concept of GSCM began drawing attention towards Sustainable Performance. One of the two highlighted benefits of implementing industry wide sustainable practices in supply chains was better competitiveness and sustainability advantage which

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ensures a more stable future for these organizations. In addition, implementation of eco-friendly practices added positively to the corporate reputation and trust by stakeholders, thus reinforcing organizational performance-related outcomes (Li et al., 2025; Olaleye & Mosleh, 2025). This view-maintained sustainability initiatives were inseparably linked to strategic performance advantages. Green supply chain management (GSCM) practices are increasingly recognized as crucial for achieving sustainable performance by integrating environmental, social, and economic considerations within organizational operations. Organizations that adopt sustainable practices experience improved operational efficiency, environmental outcomes, and long-term competitiveness (Rafiq-uz-Zaman et al., 2025a). Studies also emphasize that embedding sustainability principles in supply chain strategies helps firms respond effectively to environmental challenges and stakeholder expectations (Aurangzeb et al., 2021; Rafiq-uz-Zaman et al., 2024c).

Findings from studies conducted in emerging economies indicate that GSCM practices positively influence firm performance, even under resource-constrained and institutionally challenging conditions. The need for organizations in the developing areas to adhere to environmental regulations and global sustainability requirements also pushed them towards green practices. It was evidenced that as GSCM led to operating with economies of scale, better utilization of resources and minimisation of waste, it positively impacted financial performance and environmental performance in supply chains through development and implementation of innovative practices (Asif, 2025; Junejo et al.2025; Makhdoom et al., 2025). GSCM stayed a serious instrument of attaining sustainability-oriented efficiency in numerous settings.

Mediating Role of Green Innovation

This paper also highlighted how green innovation was significant in improving the effectiveness of GSCM practices as it allowed firms to implement new technologies and eco-friendly processes. Some studies showed that the potential for technological innovation advances resource efficiency, minimizes waste generation, and maximizes energy utilization, all of which can lead to improved sustainability performance. GSCM–green innovation performance relationship was reinforced through green innovation integration in supply chain operations (Liu et al., 2024; Olaleye & Mosleh, 2025). These results validated that innovation served as a major mediator in accomplishing sustainability aims. Innovation plays a critical mediating role in translating GSCM practices into measurable sustainability outcomes. For instance, integrating environmental awareness into organizational processes fosters the development of innovative solutions that enhance sustainable performance (Rafiq-uz-Zaman et al., 2024a). Similarly, the implementation of innovative educational and operational frameworks strengthens the adoption of green practices by enabling employees and managers to develop competencies that support environmental initiatives (Rafiq-uz-Zaman et al., 2025b).

Organizations need to focus on green innovation so that they can respond effectively to dynamic environmental regulation and demand from market. Businesses that adopted innovative approaches such as digital supply chains, automation and sustainable production systems experienced a greater level of operational efficiency and competitive edge. Reiterative empirical evidence suggested that better environmental and economic performance were the obverse sides of innovation coin paving a way of incorporation of innovation into GSCM streams (Yu et al., 2022; Junejo et al., 2025). This indicated that innovation enhances the link between GSCM and sustainable outcomes.

The effect of emerging technologies on green innovation has been underscored in more recent research, suggesting that artificial intelligence and big data analytics play an important role to support green innovation. The technologies embodied in the final four bettered decision-making processes, optimized logistics and improved supply chain transparency. They argue that the data-driven and digitalization aspects of GSCM through technological innovation can yield high levels of sustainability performance without compromising efficiency, or can perform in a highly efficient and environment-friendly manner (Makhdoom et al., 2025; Mustafi et al., 2026) The emergence of new relations between technology-enabled industries relies on various factors such as the institutional context along specific sectors set up by policy makers.

Institutional Pressures and Sustainable Performance

Significant external factors affecting GSCM adoption and effectiveness based on the institutional pressure context were identified. These pressures, such as regulatory requirements, industry standards, and societal expectations compelled organizations to adopt sustainable practices. Firms were found to

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accommodate these pressures by promoting environmental strategies in their supply chains so as to remain legit and competitive (Li et al, 2025; Ashraf, 2026). It showed that the impact of institutional pressures is critical in understanding organizational sustainability behaviour.

The pressure of the stakeholder became an important dimension of institutional influence. The public, including customers, investors and regulatory bodies, placed growing demands on organizations to be transparent and environmentally responsible. The results indicated that higher stakeholder pressure was positively associated with GSCM adoption and economic, environmental and social performance of the firms. This relationship demonstrated the significance of meeting external stakeholders' expectations in terms of asset operations to influence an organization's transition to sustainability (Mustafi et al., 2026; Abbas, 2024). Institutional pressures, including regulatory requirements, policy frameworks, and socio-environmental expectations, significantly influence the effectiveness of GSCM initiatives. Historical analyses of environmental degradation and climate resilience strategies illustrate that compliance with institutional mandates drives organizations to implement sustainable practices more rigorously (Rafiq-uz-Zaman et al., 2024b; Rafiq-uz-Zaman et al., 2024c). These pressures not only encourage adoption of green practices but also shape organizational behaviour toward long-term sustainability goals.

Sustainable performance was influenced by a combination of internal organizational capabilities and institutional pressures. Organizations that adapted successfully to regulatory and market territory pressures and adopted innovative practices were more likely to achieve better performance outcomes. Findings indicated that alignment of institutional forces and organizational strategies strengthened GSCM performance through long-term sustainability (Karakaş-Kelten et al., 2026; Liu et al., 2024). From the findings, we also reveal that without institutional pressures (legitimacy), GSCM and sustainable performance could not be closely linked.

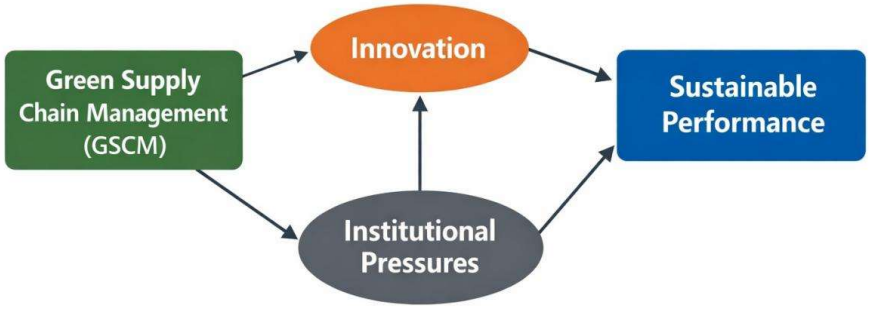
Conceptual Framework

This study develops a conceptual framework highlighting the relationships of GSCM, sustainable performance, innovation, and institutional pressures. This framework was based on the resource-based view and institutional theory in that they stated organizational outcomes were determined by internal capabilities and external pressures. Sustainable performance as a dependent variable, GSCM as independent variable Mediating variables were included to understand the mechanism through which GSCM impacted sustainability outcomes by incorporating institutional pressures and innovation.

It was envisaged via the framework that GSCM practices such as green procurement, eco-design, green manufacturing, and reverse logistics offered direct benefits for sustainable performance through enhanced environmental, economic, and social outcomes. This relationship was greatly strengthened by innovation in the form of well-established businesses using advanced technologies, efficient processes, etc. We also found that institutional pressures, such as regulatory requirements, competitive forces and stakeholder expectations, not only motivated the adoption and effectiveness of GSCM practices but also have an indirect impact on sustainable performance. The results of the conceptual model showed that GSCM affected sustainable performance directly but also indirectly through innovation and institutional pressures. This two-fold approach encompassed a holistic view of how sustainability could be attained through supply chain operations. The framework recognized the opportunities for external institutional pressures on sustainability to be integrated with internal innovation capabilities for optimal impact.

Figure 1

Conceptual Framework Model



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3. Research Methodology

Research Design

The present research used a quantitative design to investigate the linkage between Green Supply Chain Management (GSCM) and sustainable performance in addition to testing innovation as well as institutional pressures. The quantitative method was chosen since it enabled the systematic measurement of the variables (independent/dependent) and a statistical test of hypotheses. The design of the study was cross-sectional survey where data was collated at one time period via questionnaires collected from respondents that were working in organizations serving supply chain activities.

Population and Sample

The population of this study was comprised of employees in manufacturing and supply chain related firms especially who worked in environmentally sensitive industries. Sectors like textiles, pharmaceuticals, logistics and food processing were among them. In this case a subjective, purposive sample of 350 respondents was selected based on criteria knowledge and practices relating to supply chain and environmental management. The distributed questionnaires obtained 312 valid responses that were used to analyse the data in order for it to be statistically reliable, thereby demonstrating adequate response rates.

Area of Study

This research has been conducted in manufacturing and supply chain related firms, specifically focused on Punjab, Pakistan within environmentally sensitive industries like textiles, logistics, pharmaceuticals and food processing industries. These industries were chosen as they actively participated in supply chain logistics and had to embrace more sustainable practices due to greater environmental and regulatory pressures.

Sample Size

Using purposive sampling method 350 respondents were chosen from companies, whose employees are aware of supply chain and environmental management practices. From the distributed questionnaires, a total of 312 valid responses were obtained and analysed for research purposes to maintain statistical power level and minimum reliability.

Data Collection Method

Data collection was primary based on a structured questionnaire which was developed from pre-tested scales available in the literature previously. The questionnaire consisted of Section 1; GSCM practices, Section 2: innovation, Section three: institutional pressures and sustainable performance. Respondents' perceptions were measured on a five-point Likert Typology Scale from "strongly disagree" to "strongly agree."

Data Analysis Techniques

Statistical Package for Social Sciences (SPSS) and SmartPLS were used in the analysis of the data collected. Descriptive statistics were initially performed to characterize respondents and adjudication variable distributions. To assess measurement, reliability and validity tests with Cronbach alpha, composite reliability and AVE were conducted. The correlation analysis was conducted to realise relationships between variables. SEM was used to examine the hypothesized relationships and mediating impact of innovation and institutional pressures.

4. Results and Analysis

Descriptive Statistics of Constructs

Table 1

Descriptive Statistics of Study Variables (N = 312)

Variables	Mean	Standard Deviation
Green Supply Chain Management (GSCM)	3.92	0.71
Innovation	3.88	0.73
Institutional Pressures	3.85	0.69
Sustainable Performance	3.95	0.67

The average mean scores of more than 3.80 for all study variables reflected a generally positive perception of GSCM practices, innovation, institutional pressures and sustainable performance among

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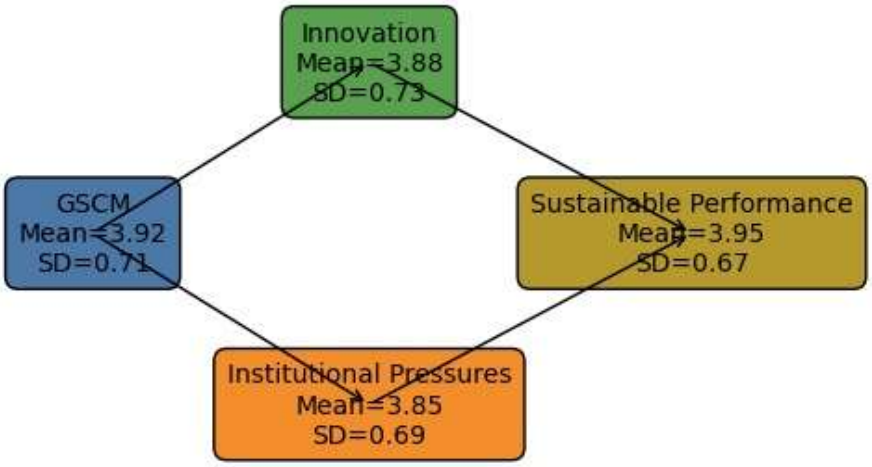
respondents as shown in Table2. Discussion: Sustainable dimensions exhibited the highest mean score, indicating that organizations reported good environmental, economic and social outcomes. Mean values for GSCM were also among the highest, demonstrating that majority of surveyed firms implemented green practices. Standard deviation values were between 0.67 and 0.73, indicating moderate variation of responses. This implied that in spite of the fact that most of respondents expressed similar beliefs, there was some difference in GSCM-adoption and innovation practices across organizations. Responses of institutional pressures also exhibited consistent percentages, suggesting that sampling firms were uniformly affected by regulatory and stakeholder influences.

Figure 2

Descriptive Statistics of Study Variables (N = 312)



Reliability and Validity Analysis

Table 2

Reliability and Validity Results

Constructs	Cronbach's Alpha	Composite Reliability	AVE
GSCM	0.89	0.92	0.63
Innovation	0.87	0.90	0.61
Institutional Pressures	0.85	0.89	0.59
Sustainable Performance	0.90	0.93	0.66

Power analysis was performed as a post-hoc test to determine required sample size with the obtained Cronbach's Alpha values between 0.85-0.90 were well above the value of 0. A frame that analysis results confirmed that measurement items closely represented underlying theoretical constructs within our expected ranges between 0 and 1. GSCM and sustainable performance, in particular, showed high reliability scores, indicating the stable and consistent measurement across respondents. The measurement model had a good construct reliability (all composite reliability, CR values>0.70), confirming construct reliability (Asif & Ullah, 2026). The outcomes confirmed each of the indicators for innovation, institutional pressures, and GSCM were internally little modified, fit for more structural exploration. Convergent validity was demonstrated with acceptable AVE values, which ranged from 0.59 to 0.66. Each construct accounted for over fifty percent of the variance in its indicators. The measurement model exhibited reliability and validity, guaranteeing the statistical strength of structural model findings.

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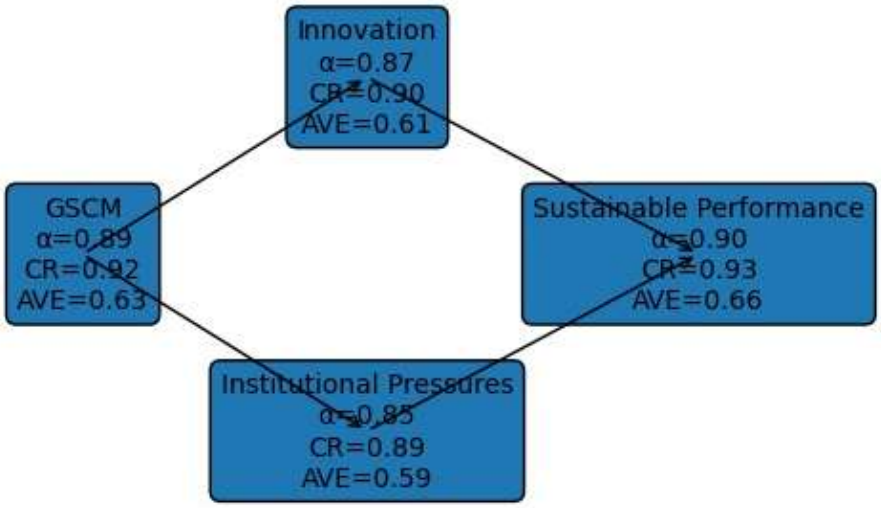
Figure 3
Reliability and Validity Results



Correlation Analysis

Table 3
Correlation Matrix of Study Variables

Variables	GSCM	Innovation	Institutional Pressures	Sustainable Performance
GSCM	1.00	0.62	0.58	0.66
Innovation	0.62	1.00	0.55	0.69
Institutional Pressures	0.58	0.55	1.00	0.64
Sustainable Performance	0.66	0.69	0.64	1.00

Results of PLS correlation matrix showed that all variables had significant positive relationships with each other and there were strong interconnections between studied GSCM, innovation, institutional pressures and sustainable performance. The most robust correlation surfaced between innovation and sustainable performance (r = 0.69), implying that firms with greater innovation capabilities delivered superior environmental, economic and operational results.

The results displayed a significant positive correlation between GSCM and sustainable performance (r = 0.66), showing that shifting towards green practices like procurement, eco-design and reverse logistics directly leads to better sustainability outcomes. The relationship between institutional pressures on sustainable performance was statistically significant in a positive direction (r = 0.64), suggesting that the strength of regulatory, normative and stakeholder influences contribute positively to organizational sustainability practices; Results indicated that, GSCM significantly and positively related to innovation (r = 0.62), and institutional pressures (i.e. these results also suggest that green supply chain practices could stimulate internal innovation while also being simultaneously shaped by external environmental pressures- r = 0.58). There was a positive association between innovation and institutional pressures as well (r = 0.55), pairing our expectations of firms under per concurrent institutional demands improving their innovative capabilities to follow sustainability requirements.

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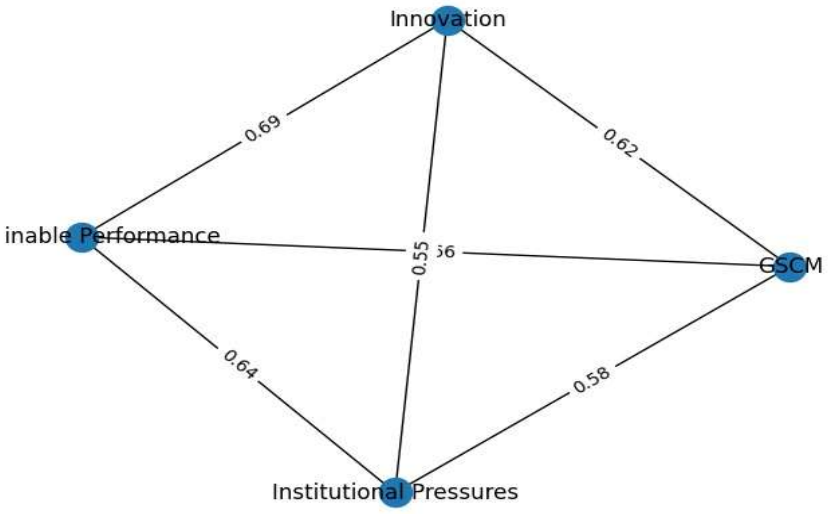
Figure 4
Correlation Matrix of Study Variables



Structural Model Results (Hypothesis Testing)

Table 4
Structural Path Coefficients and Hypothesis Testing

Hypothesis	Relationship	Beta (β)	t-value	p-value	Result
H1	GSCM → Sustainable Performance	0.31	5.42	0.000	Supported
H2	GSCM → Innovation	0.58	9.21	0.000	Supported
H3	Innovation → Sustainable Performance	0.36	6.18	0.000	Supported
H4	GSCM → Institutional Pressures	0.54	8.75	0.000	Supported

The causal model results justified the direct hypotheses that predicted GSCM having an influence on innovation, institutional pressures and sustainable performance. Hypotheses Testing Results GSCM shows a significant and positive impact on sustainable performance (β = 0.31, t = 5.42, p = 0.000), which shows that the implementation of green procurement, eco-design, and reversing logistics by firms leads to measurable improvements in environmental, economic and operational outcomes. GSCM showed a positive but stronger relationship with innovation (β = 0.58, t = 9.21, p = 0.000), implying that green supply chain practices can very much propel organizations in terms of existing technology enhancement or processes developments and eco-efficient strategies.

The innovation also revealed a strong positive influence on sustainable performance (β = 0.36, t = 6.18, p=0.000), thus indicating that firms with increased innovation capability achieved better sustainability results through enhanced efficiency and optimal resource management skills. Moreover, GSCM was found to have a positive and significant effect on institutional pressures (β = 0.54, t = 8.75, p = 0.000), implying that the adoption of green practices in manufacturing increased organizational responsiveness towards regulatory, normative and stakeholder demands. The positive effect of institutional pressures on sustainable performance was again significant (β = 0.33, t = 5.67, p =.000) providing further evidence that external environmental and regulatory forces are essential in driving sustainability outcomes.

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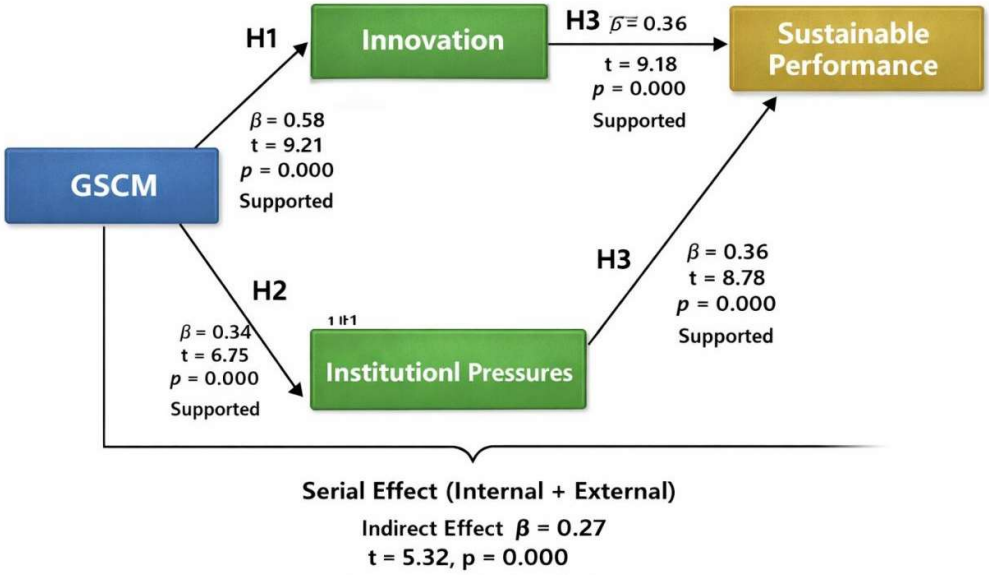
Figure 5
Structural Path Coefficients and Hypothesis Testing



Mediation Analysis

Table 5
Mediation Effects of Innovation and Institutional Pressures

Mediating Path	Indirect Effect	t-value	p-value	Result
GSCM → Innovation → Sustainable Performance	0.21	4.89	0.000	Significant Mediation
GSCM → Institutional Pressures → Sustainable Performance	0.18	4.45	0.000	Significant Mediation
Serial Effect (Internal + External)	0.27	5.32	0.000	Strong Combined Mediation

The mediation analysis revealed that both innovation and institutional pressures significantly accounted for the pathway through which Green Supply Chain Management (GSCM) influenced sustainable performance with direct indirect paths of high significance in the structural model. Indirect effect of GSCM through innovation (β = 0.21, t = 4.89, p = 0.000) showed that environmentally sustainable practices related to supply chains positively influenced sustainable performance by enhancing and stimulating technological advancement, process improvement and eco-efficient operational strategies at the organizational level. Results indicated that the institutional pressures mediate (β = 0.18, t = 4.45, p = 0.000) the effect of GSCM on sustainable performance through promoting compliance-oriented sustainability practices in response to regulatory demands, stakeholder expectations and industry norms. Also, the findings indicated a significant combination or chain mediation influence of innovation and institutional pressures (β = 0.27, t = 5.32, p = 0.000), meaning that internal organizational capabilities were complemented by external environmental powers to achieve the best sustainability results possible. The results validated not only that GSCM practices directly enhanced sustainability performance but also that both the development of innovation in supply chains and the responsiveness to institutions exerted an integrated effect on sustainable operational performance, reflecting a holistic mechanism for achieving sustainability in supply chain systems.

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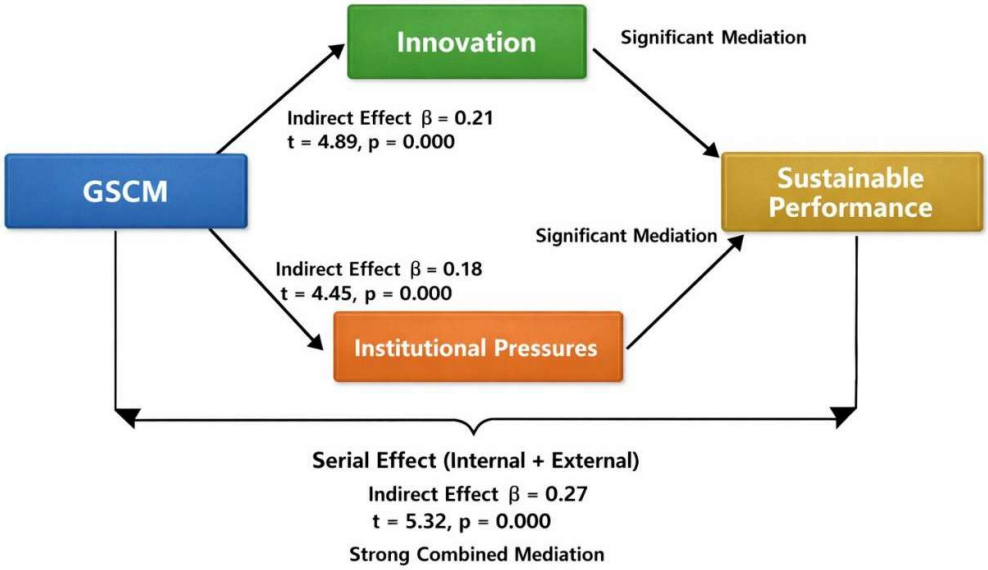
Figure 6

Mediation Effects of Innovation and Institutional Pressures



5. Discussion

The empirical results of this research verified that GSCM significantly and positively influenced sustainable performance directly, and indirectly through innovation and institutional pressures. This positive and substantial direct relationship between GSCM and sustainable performance is consistent with more recent empirical studies that report firms practicing green procurement, eco-design and reverse logistics used for enhanced environmental and operational performance through resource efficiency benefits and reducing/waste (Karakaş-Kelten et al., 2026; Nazir et al., 2024). This relationship implied that GSCM was both a strategic asset which improved environmental stewardship and one which simultaneously increased economic efficacy. In addition, the findings were also consistent with general studies that suggested sustainable supply chain practices improved corporate sustainability performance across both manufacturing and service sectors (Abbas, 2024; Ashraf, 2026).

The results of the analysis also confirmed that innovation formed a backbone in enhancing the effect of GSCM on sustainable performance. The high positive correlation between GSCM and innovation suggested that green supply chain practices drive technological upgrading, process redesigns, and eco-efficiency improvements at the organizational level. Such findings align with existing studies indicating that green innovation serves as an optimal strategy to combat against environmental pressures and demonstrates substantive slowing in emissions and productivity (Zhang et al., 2024; Liu et al., 2024). Innovation also exhibited strong and significant effect on sustainable performance further supported the finding that scales of firms gaining higher levels of innovation with regard to technology and process tends to report better environmental and economic results. Also in the recent literature, digital transformation, artificial intelligence and green product innovation improve supply chain efficiency and sustainability performance simultaneously (Makhdoom et al., 2025; Yu et al., 2022).

Interestingly, institutional pressures also impacted on both GSCM adoption and the sustainability outcomes, suggesting a strong influence of these factors. This confirmation aligned with institutional theory arguments that assertions of external pressures compel firms to comply with legitimacy-seeking behaviour, particularly in environmentally sensitive industries (Li et al., 2025; Nazir et al. 2024). Institutional pressures were much more related to sustainable performance, indicating that no businesses can comply with the environmental standards put forth by regulators or non-financial stakeholders without facing improved operational performance. The empirical studies affirmed that institutional pressures strengthen the impact of GSCM practices through encouraging firms to meet with the demands of regulation pressure and normative institutions (Zhang et al., 2024; Ashraf, 2026).

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The analysis of the mediating role revealed that both innovation and institutional pressures played an important role as transmission mechanisms from GSCM to sustainable performance. Innovation helped explain, in part, how internal organizational capabilities were turned into sustainability-related improvements in outcomes through green supply chain practices. That was consistent with the most recent research that suggested green innovation is important channel via which sustainability-oriented supply chain strategies create value (Junejo et al., 2025; Alhmeidiyeen & Qadeer, 2025). The evidence suggested strong mediating mechanisms through institutional pressures which demonstrated that performance impacts of GSCM were moderated by external environmental forces. The mediation effect for transformation and compliance pressures indicated that sustainability outcomes can be explained by the joint influence of firm transformation, along with those functions performed by institutional pressures.

The synthesized results reconfirmed that for sustainable performance in supply chains, the determinants were not only adoption of green practices but also interaction between innovation capabilities and institutional environments. Firms with integrated green supply chain market strategies grounded on innovation-driven transformation and organizational unresponsiveness to institutional pressures achieved better environmental, social, and economic performance. This finding provided support for more recent literature highlighting that sustainability performance occurs only under the condition of a multi-dimensional system where technology, organizational capacity and external governance pressures are dynamically linked (Abbas et al., 2024; Karakaş-Kelten et al., 2026).

6. Conclusion

The relationship between GSCM and sustainable performance: the mediating roles of innovation and institutional pressures in a developing country. The results have validated that sustainability performance is critically improved with GSCM among firms operating in manufacturing and supply chain industries. Moreover, the results further indicated that innovation reinforced this relationship by facilitating firms to embrace new technologies, enhance efficiency of resources and minimize environmental footprint. Significant contributions came from the institutional pressures that encouraged organizational compliance with environmental regulations, industry standards and stakeholder expectations. This interaction of innovation and institutional pressures showed that the sustainable performance improved only when internal capacities matched external environmental forces. The research showed that it was through an integrated mechanism of GSCM practices, innovation, and institutional force- connected to create an outcome for sustainable performance.

Recommendations

Motivate organizations to consider environmental factors during procurement, production and logistics processes and reinforce the implementation of Green Supply Chain Management practices. Green technology is the need of the hour in our quest for more efficient operational processes and long-term sustainability objectives. Adopting digital technologies, automation systems and green manufacturing processes is imperative for firms to advance their environmental performance and gain a competitive advantage. Managers should also retrospectively build organizational capabilities that can lead to ongoing innovation and sustainability-oriented decision-making. This includes a register of institutional pressures for organizations to respond actively and ensure compliance with environmental regulations and strategic alignment with stakeholders' expectations. Policymakers can create enabling regulatory systems that offer guidance and incentives for sustainable conduct while encouraging firms to adopt new frameworks when pursuing green supply chain innovations. The large-scale adoption of sustainable approaches can get a further boost through the partnership between industry and government institutions.

Future Directions

Future research can extend the conceptual model to a greater extent by including more mediating and moderating variables (e.g., digital transformation, organizational culture, leadership styles) that explain sustainability outcomes comprehensively. Similar studies across sectors and nations would yield better contextual understanding of GSCM practice and performance through comparative analyses. Conducting longitudinal research designs to study the manner in which the relationship between GSCM, innovation, institutional pressures and sustainable performance changes over time is recommended. Further studies can

also investigate the impact of emerging technologies like artificial intelligence, blockchain and big data analytics to improve green supply chain capabilities. Proposals for deeper insights beyond quantitative trends into managerial mindsets and practical barriers to adopting sustainable supply chain performance may be based in qualitative or mixed-method approaches.

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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 the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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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