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ARTICLE

Green Logistics Management Effect on Sustainable Logistics Performance

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ABSTRACT

This study explores the influence of Green Logistics Management (GLM) on Sustainable Logistics Performance (SLP), emphasizing the pivotal role of Green Innovation (GI) in promoting sustainability and enhancing logistics efficiency (LE). As organizations increasingly seek to align operational efficiency with environmental goals, GLM has emerged as a strategic approach to achieving this balance. The research evaluates the impact of GLM on SLP, examines GI's contribution to improving LE, and validates the relationship between green logistics practices and SLP. Survey-based data analysis employing reliable scales (AVE and Cronbach's alpha > 0.70) reveals that GI significantly advances LE. Firms demonstrate a strong commitment to sustainability, with high scores for eco-friendly packaging (5.35) and clean technologies (5.14). Despite this, variability in adoption rates highlights differences in implementation across organizations. The findings confirm that GLM positively influences SLP, underscoring the importance of integrating green practices into logistics operations. This study provides actionable insights for organizations and policymakers by addressing inconsistencies in green logistics practices and proposing strategies to enhance sustainability and operational efficiency. It presents a practical framework for improving environmental and business performance, offering valuable guidance for firms striving to achieve sustainable growth while meeting environmental objectives. The research contributes to advancing the logistics sector's sustainability and innovation-driven performance.

Keywords: Green Innovation; Sustainable Practices; Logistics Efficiency; Resource Optimization; Eco-Friendly Initiatives

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1. Introduction

The significance of Green Logistics Management (GLM) in today's business landscape is undeniable, as organizations strive to balance operational efficiency with environmental sustainability. GLM involves integrating eco-friendly practices into logistics activities such as transportation, warehousing, and distribution, aiming to minimize their ecological footprint. By adopting these sustainable practices, companies not only meet regulatory requirements but also gain a competitive advantage in a market increasingly driven by environmental consciousness [1]. A key impact of GLM on sustainable logistics performance is the enhancement of resource efficiency. Resource consumption and operating expenses are greatly decreased by tactics including streamlining transportation routes, cutting down on packaging waste, and using energy-efficient technologies [2]. Furthermore, GLM fosters innovation by encouraging the adoption of environmentally friendly technologies, such as electric vehicles and renewable energy sources, which contribute to reducing carbon emissions and mitigating pollution [3]. The strategic adoption of GLM also positively influences supply chain sustainability by aligning with the broader objectives of circular economy practices, thereby creating value across the logistics network [4]. Additionally, as consumers who care about the environment increasingly choose to support firms that are dedicated to sustainability, businesses that use GLM improve their brand reputation and foster customer loyalty [5]. In this context, GLM serves as a vital framework for businesses seeking to achieve long-term operational and environmental success, reinforcing their role as responsible corporate citizens in a rapidly evolving marketplace [6].

Figure 1 illustrates the concept of Green Logistics Management (GLM) as a framework to promote sustainable logistics and distribution systems. At its core, it emphasizes the importance of resource efficiency, circular economy, and environmental preservation. The figure depicts various elements of green logistics, such as innovation, sustainable packaging, and the integration of IoT (Internet of Things) technologies to optimize logistics operations. The recycling symbol at the center connects different aspects, highlighting the goal of sustainability through reuse, reduction, and recycling in logistics. Concepts like green distribution, energy efficiency, and reduced environmental footprints are depicted with trucks, factories, and green initiatives. The diagram also emphasizes the role of innovation, renewable energy, and circular economy practices in fostering sustainable operations.

Figure 1. Green logistics management on sustainable logistics performance.

1.1. Reducing Resource Consumption and Waste

Reducing resource consumption and waste is a critical component of sustainable logistics practices, as it directly influences environmental and operational performance. By optimizing supply chain processes, companies can significantly minimize their reliance on materials, energy, and water, contributing to resource conservation and waste reduction [7]. Lean inventory management, for instance, reduces excess stock and associated waste, while efficient transportation routes lower fuel consumption and emissions [8]. Eco-friendly packaging further reduces waste by utilizing biodegradable or recyclable materials, aligning logistics operations with sustainability goals [9]. Implementing recycling programs and material reuse initiatives transforms waste into valuable resources, promoting a circular economy approach that enhances resource efficiency [10]. Moreover, investments in advanced technologies, such as energy-efficient logistics systems and renewable energy solutions, significantly reduce carbon emissions and operational costs [11]. These efforts not only address environmental concerns but also meet increasing consumer demands for eco-conscious practices, thereby strengthening brand reputation and customer loyalty [12]. Ultimately, reducing resource consumption and waste supports long-term sustainability objectives by enhancing operational efficiency, improving environmental performance, and fostering a competitive advantage within the framework of Green Logistics Management[13].

1.2. Fostering Innovation through Technology

Achieving Sustainable Logistics Performance and improving Green Logistics Management (GLM) depend heavily on fostering innovation through technology. Businesses may increase resource efficiency, cut waste, and streamline supply chain operations with the help of emerging technologies like blockchain, artificial intelligence, and the Internet of Things[14]. More informed and data-driven decision-making is made possible by these technologies, which also streamline logistics procedures, improve transparency, and enable real-time tracking[15]. Companies can drastically lower the environmental impact of logistics operations by implementing eco-friendly practices including energy-efficient transportation routes and sustainable packaging options made possible by the integration of smart logistics technologies[16]. For example, blockchain technology guarantees accountability and transparency in sustainable supply chain processes, while IoT-enabled sensors and AI-based predictive analytics can optimize fuel use and lower emissions[17]. Additionally, digital innovations promote cooperation between stakeholders, which in turn promotes a sustainable culture and ongoing logistics management improvement[18]. By implementing these technical innovations, businesses can increase their competitiveness, fulfill the increasing demands of consumers for sustainable practices, and improve their environmental performance[19]. Ultimately, fostering innovation through technology is a strategic imperative for achieving long-term sustainability in logistics, contributing to both economic growth and environmental stewardship[20].

Figure 2 represents a circular model emphasizing the role of technology in fostering innovation within green and sustainable logistics management. At the center is the theme of "Fostering Innovation Through Technology," with interconnected branches radiating outwards that highlight various technological solutions and their contributions to sustainable logistics practices. Key technologies such as blockchain, AI (artificial intelligence), and IoT (Internet of Things) are prominently displayed, showcasing their ability to improve efficiency, transparency, and traceability in logistics systems. For instance, blockchain ensures secure and transparent supply chains, while AI enables real-time tracking, predictive analytics, and optimization of routes and resources. IoT is presented as a crucial tool for monitoring and managing logistics processes in real time, enhancing energy efficiency and reducing redundancies. The figure further connects these technological advancements to specific outcomes, such as green logistics management (GLM), sustainable packaging, eco-friendly transportation, and energy-efficient supply chains. The emphasis is on integrating these innovations into a cohesive strategy to achieve environmentally and economically sustainable logistics operations.

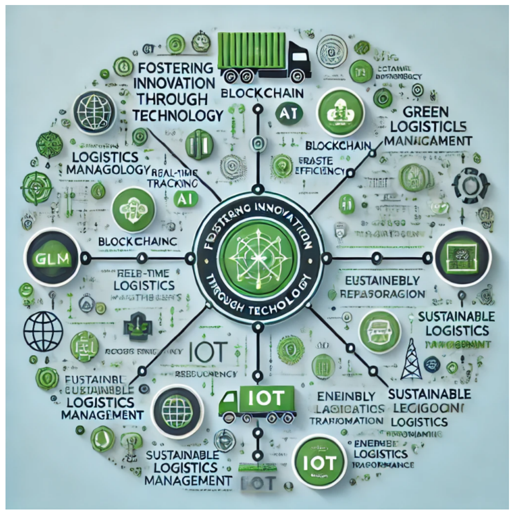

Figure 2. Innovation in technology for green logistics.

1.3. Green Technologies' Contribution to Improving Logistics Sustainability

With several studies emphasizing the significance of implementing eco-friendly practices within the logistics and supply chain sectors, the role of green technology in improving logistics sustainability has attracted a lot of attention recently. Green technologies are inventions and methods designed to improve operational efficiency while lowering negative effects on the environment, such as waste, carbon emissions, and resource usage. Several studies emphasize how these technologies contribute to achieving sustainability goals within logistics operations. For instance,[21] investigate how green logistics affects manufacturing companies' environmental performance. They propose that integrating green technologies, like electric vehicles (EVs) and energy-efficient warehouse management systems, can greatly lower carbon footprints and enhance sustainability in general. These technologies are essential for sustainable logistics since they not only reduce emissions but also save money by using less fuel and energy. Similarly,[3] focus on the role of circular practices driven by green logistics in the Industry 4.0 era, where technological advancements like automation, data analytics, and sustainable supply chain flexibility contribute to reducing waste and improving the reuse and recycling of materials.

Furthermore, green supply chain management (GSCM) systems, eco-friendly packaging, and the use of renewable energy in warehouses have all been shown to be successful tactics for improving sustainability[4], for instance, talk about how businesses can boost their competitiveness and environmental performance by embracing green supply chain methods. Green logistics helps businesses stand out in the marketplace by meeting the growing demand from customers for eco-friendly goods and services. Furthermore, implementing green technologies is essential for fulfilling legal obligations and addressing institutional demands. According to[22], evaluating circularity in logistics operations improves environmental performance and ensures adherence to global environmental standards like ISO 14001. The integration of green technologies into logistics operations helps businesses reduce environmental risks and align their practices with global sustainability trends.

2. Literature Review

Green logistics management has become a critical strategy for enhancing sustainable logistics performance amidst increasing environmental concerns. Organizations can improve operational efficiency and drastically lower their carbon footprint by implementing eco-friendly practices into supply chain operations[10, 18]. Important projects include integrating reverse logistics, switching to low-carbon means of transportation, and streamlining transportation routes that support both economic and environmental sustainability. Moreover, green logistics fosters the development of sustainability-oriented capabilities that enable organizations to meet regulatory, technological, and market demands[23]. These practices not only improve environmental performance but also enhance competitiveness by aligning with evolving consumer preferences for sustainable products and services[19, 24]. Ultimately, green logistics serves as a vital tool for achieving economic and ecological objectives, positioning the logistics industry as a key contributor to sustainable development[14].

The **Table 1** summarizes a comprehensive literature survey highlighting various studies on sustainable logistics, green supply chain management, and their implications for economic and environmental performance. It provides insights into the role of green logistics in improving operational efficiency, fostering innovation, and achieving sustainability in diverse contexts such as trade enterprises, manufacturing, and supply chain management. Key findings include the positive impact of environmental responsibility, smart logistics, and circular logistics on sustainability, as well as the influence of business strategies and collaboration mechanisms in enhancing supply chain performance.

Table 1. Summary of literature survey.

Author's	Work Done	Findings
[24]	Investigated how environmental responsibility constraints influence the green performance of logistics enterprises.	Highlighted that adopting environmental responsibility improves the green performance of logistics enterprises.
[25]	Explored smart logistics' role in sustainable enterprise development with a focus on economic and environmental performance.	Demonstrated that smart logistics contributes significantly to both economic and environmental sustainability.
[26]	Examined the impact of green logistics on the sustainable development of commercial and trade enterprises.	Concluded that green logistics practices enhance long-term sustainability and operational efficiency in trade enterprises.
[27]	Analyzed the development of smart logistics in a green environment.	Found that integrating green practices with smart logistics fosters sustainability and innovation in logistics operations.

Table 1. *Cont.*

Author's	Work Done	Findings
[28]	Investigated how Europe's trade openness is affected by the logistics performance index.	Logistics performance positively impacts trade openness in Europe, highlighting its role in economic integration.
[21]	Examined how China's manufacturing companies' environmental performance was affected by green logistics.	Green logistics practices improve environmental performance by reducing emissions and waste.
[29]	Investigated cooperation mechanisms and triads in sustainable supply-chain management.	Collaboration mechanisms are crucial for enhancing sustainability within supply chains.
[22]	Evaluated logistics operations' circularity for green business performance management.	Circular logistics activities contribute to green business performance by promoting resource efficiency.
[30]	Examined a car manufacturer's inbound logistics supply chain.	Identified key challenges and optimization opportunities within inbound logistics for enhanced efficiency.
[31]	Conducted a bibliographic study on sustainability research in supply chain management.	Sustainability in supply chains is multidimensional, requiring diverse approaches for effective implementation.
[32]	Examined how the strategy tripod affected the sustainability of the supply chain.	Business strategies significantly impact sustainability orientation, facilitating long-term supply chain success.
[33]	Investigated how supply chain performance is affected by defensive pessimism.	Defensive pessimism negatively impacts supply chain performance, reducing operational effectiveness.
[1]	Investigated environmentally friendly logistics techniques for a circular economy.	Sustainable logistics practices enhance value creation in a circular economy by promoting reuse and resource efficiency.
[3]	Examined the effects of Industry 4.0's circular practices powered by green logistics.	Institutional pressure and supply chain flexibility are crucial factors influencing circular practices in green logistics.
[4]	Investigated business innovation and green supply chain management.	Green supply chain practices drive business innovation, enhancing environmental and economic performance.
[34]	Examined ways to separate CO_2 emissions from economic growth in the main emitting nations.	Mechanisms like energy efficiency and renewable energy are key to decoupling economic growth from CO_2 emissions.
[5]	Investigated environmentally friendly purchasing methods and green capacities for long-term operations.	Green purchasing and capabilities are essential strategies for achieving sustainable operations in businesses.
[2]	Reviewed the research on green logistics performance and practices.	Better environmental and operational effectiveness is favorably correlated with green logistics techniques.

3. Research Methodology

This study employs a quantitative research approach to examine the impact of Green Logistics Management (GLM) on Sustainable Logistics Performance (SLP). Data is collected using a systematic questionnaire, with SLP constructs clearly defined to ensure accurate measurement. Building on recent research, the measurement scale is enhanced to strengthen the robustness of the existing framework [22]. The study utilizes Structural Partial Least Squares Modeling (PLSM), a powerful method for analyzing complex predictive relationships between variables, to explore the link between GLM practices and SLP. The study focuses on organizations and experts within the supply chain, logistics, and transportation sectors, with a random sample of 200 respondents chosen to ensure generalizability across the industry.

A standardized Likert-scale questionnaire is used for data collection, and Cronbach's Alpha is employed to assess reliability [30]. This methodology not only ensures the validity and consistency of the study but also contributes to the advancement of sustainable logistics by providing new insights into the impact of green logistics practices on long-term sustainability outcomes. The findings of this research have practical applications for organizations aiming to enhance their logistics performance while integrating environmental sustainability. Furthermore, it offers a valuable framework for policymakers and industry leaders to develop strategies that promote the adoption of green logistics practices, fostering a more sustainable logistics sector overall.

Objectives

1. To evaluate how Green Logistics Management impacts Sustainable Logistics Performance.
2. To examine how Green Innovation contributes to improving logistics efficiency in the context of GL Management.
3. To validate the positive correlation between GL practices and SL Performance.

4. Result and Discussion

Table 2 and **Figure 3** presents the summary statistics of key variables analyzed in the study. The data includes 200 observations each for Green Innovation (GI) and Logistics Efficiency (LE). GI has a mean value of 5.085 with a standard deviation of 0.9437, indicating moderate variability, while LE has a slightly lower mean of 4.982 and a higher standard deviation of 1.05, reflecting greater dispersion. The variance values further highlight the differences in the spread of these variables, providing insights into their distribution and consistency.

Table 2. Summary statistics of variables.

Variable	N	Mean	Std. Deviation	Variance
Green Innovation (GI)	200	5.085	0.9437	0.891
Logistics Efficiency (LE)	200	4.982	1.05	1.103

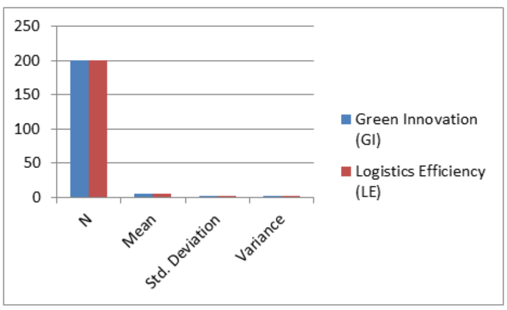

Figure 3. Statistics of variables.

The mean score of 5.085 for Green Innovation (GI) reflects a relatively high adoption of environmentally friendly practices in logistics operations, indicating that many firms are actively integrating sustainability into their processes. This aligns with findings by [4], emphasizing the role of green supply chain management in driving sustainable innovation. However, the standard deviation of 0.9437 and variance of 0.891 highlight moderate variability in adoption levels. This variability can be attributed to several factors. Regional differences play a role, as stricter environmental regulations and government incentives in certain areas encourage higher adoption compared to less regulated regions. Industry-specific factors also matter; sectors with significant environmental impacts, like manufacturing, face greater pressure to adopt green practices than less resource-intensive industries such as software or services [25]. Resource availability further influences adoption, with larger firms possessing the financial and technological means to lead in green innovation, while smaller firms may struggle due to cost constraints. Finally, organizational priorities shape adoption levels, as firms committed to sustainability often implement green practices more comprehensively than those focused on cost-cutting or immediate operational efficiency.

The mean score for logistics efficiency (LE) is 4.982, indicating a relatively high level of efficiency in logistics operations, though slightly lower than the adoption level of green innovation. This reflects progress in optimizing logistics systems, aligning with findings by [2], who associate green practices with improved logistics performance. However, the standard deviation of 1.05 and variance of 1.103

reveal greater variability in logistics efficiency compared to green innovation. This variation stems from several factors. The quality and availability of infrastructure, such as transportation networks and warehousing facilities, play a crucial role, with firms in regions boasting advanced infrastructure achieving higher efficiency than those in less developed areas. Technology integration also influences performance; firms leveraging automated systems, predictive analytics, and real-time tracking often outperform those relying on traditional methods. Additionally, operational complexity poses challenges, as firms with intricate supply chains and cross-border operations face greater hurdles in achieving efficiency compared to those with simplified processes. Finally, workforce skills and management practices significantly impact logistics efficiency, with firms employing skilled teams and strong leadership better positioned to optimize their operations.

To reduce the variability in green innovation and logistics efficiency across firms, policymakers and industry leaders can implement a range of targeted measures. Promoting green policies and incentives, such as subsidies, tax benefits, and government support, can encourage the adoption of green practices, particularly in regions or industries with lower levels of implementation. Enhancing infrastructure by investing in transportation networks, warehousing, and digital systems can help level the playing field for firms operating in areas with less-developed logistics systems. Industry-wide collaborations and knowledge-sharing initiatives can also play a key role by enabling smaller firms to learn from leaders in the field and adopt proven green and efficient logistics strategies. Additionally, providing financial support, such as grants and low-interest loans, along with workforce training programs, can assist resource-constrained firms in adopting both green innovations and efficiency improvements.

Descriptive statistics on Green Innovation (GI) goods offer important information about how eco-friendly methods are being used in logistics operations. With a mode of 6, indicating that many respondents gave this practice high ratings, the mean for G11, which gauges the usage of ecologically friendly materials like packaging, is 5.35, indicating a strong dedication to using eco-friendly materials. There are some variations in how businesses implement these principles, as evidenced by the moderate variety in the replies, as indicated by the standard deviation of 1.697. Similarly, for G12, which looks at the use of reusable or recyclable packaging, the mean is 5.14 with a mode of 6, suggesting a consistent emphasis on sustainable packaging practices. The standard deviation of 1.931 indicates a higher variation compared to G11, which is consistent with findings by [10], who observed diverse approaches to green logistics practices. For G13 (reducing resource consumption), the mean is 5.04, showing solid adoption of resource-saving initiatives. G14 (clean technology use) and G15 (optimized transportation practices) both have means of 5.03 and 4.89, respectively, with moderate standard deviations of 1.625 and 1.906, reflecting variability in practice adoption, in line with studies by [8, 11]. These results suggest that while there is a general commitment to green innovation, variations exist in the extent of its implementation.

Table 3 and **Figure 4** provides descriptive statistics for items measuring green innovation practices. It includes data from 200 valid responses with no missing values. The items cover environmentally friendly materials, reusable packaging, resource conservation, clean technology, and optimized transportation. Mean values range from 4.89 to 5.35, with modes consistently at 5 or 6, indicating generally positive practices across the items. Standard deviations, ranging from 1.621 to 1.931, suggest varying levels of consistency in responses for different green innovation practices.

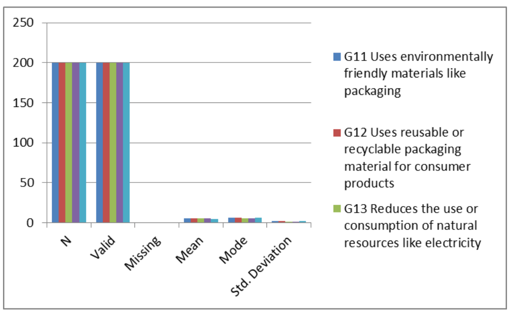

Figure 4. Descriptive statistics for green innovation items.

The descriptive statistics for logistics efficiency (LE) items offer insights into the performance of logistics operations and their alignment with green supply chain goals. LE1, which measures the percentage of orders shipped on time, has a mean of 4.97, with a mode of 7, indicating that most respondents report consistently high levels of on-time shipments. The standard deviation of 1.8 reflects moderate variation in responses, which aligns with the findings of[15], who discussed the challenges of maintaining consistent lo-

Table 3. Descriptive statistics for green innovation items.

Acronym	Description	N	Valid	Missing	Mean	Mode	Std. Deviation
G11	Uses environmentally friendly materials like packaging	200	200	0	5.35	6	1.697
G12	Uses reusable or recyclable packaging material for consumer products	200	200	0	5.14	6	1.931
G13	Reduces the use or consumption of natural resources like electricity	200	200	0	5.04	5	1.621
G14	Uses clean technology to reduce/prevent pollution	200	200	0	5.03	5	1.625
G15	Optimizes transportation practices to reduce pollution	200	200	0	4.89	6	1.906

gistics performance in diverse environments. Similarly, for LE2, which assesses the percentage of shipments requiring expediting, the mean is 4.94, with a mode of 7, suggesting that many companies experience minimal delays or disruptions, thus indicating effective logistics management. The standard deviation of 1.789 highlights some variation in the expediting needs, a trend also noted in the work of[13] regarding green logistics implementation and its challenges in practice. For LE3, which measures average order cycle time, the mean is 5.04 with a mode of 5, showing that most organizations achieve an average order cycle time within a reasonable range. The standard deviation of 1.537 indicates lower variability, suggesting that organizations tend to have more consistent cycle times. These findings are in line with[35], who highlighted the importance of logistics efficiency in the context of green supply chain management and the need for continuous improvement in performance. Overall, the statistics reflect a solid commitment to efficient logistics operations, though variations exist, emphasizing areas for potential improvement.

Table 4 and **Figure 5** presents descriptive statistics for items measuring logistics efficiency, based on 500 valid responses with no missing values. The items assess key logistics performance indicators, including on-time order shipments, expedited shipments, and average order cycle time. Mean values range from 4.94 to 5.04, with modes primarily at 5 or 7, indicating overall positive performance. The standard deviations, ranging from 1.537 to 1.8, reflect moderate variability in responses across the logistics efficiency metrics.

Table 4. Descriptive statistics for logistics efficiency items.

Acronym	Description	N	Valid	Missing	Mean	Mode	Std. Deviation
LE1	Percentage of orders shipped on time	500	500	0	4.97	7	1.8
LE2	Percentage of shipments requiring expediting	500	500	0	4.94	7	1.789
LE3	Average order cycle time (time)	500	500	0	5.04	5	1.537

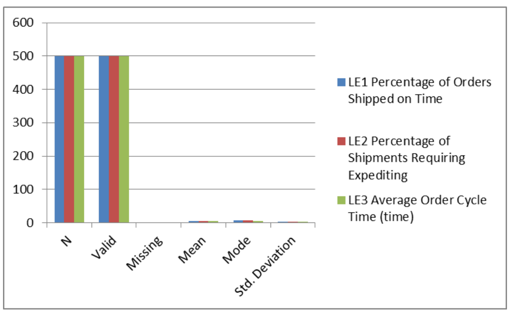

Figure 5. Descriptive statistics for logistics efficiency items.

The reliability and validity statistics for the study variables—Green Innovation (GI), logistics efficiency (LE), and Sustainable Logistics Performance (SLP)—provide strong evidence of their robustness in measuring the constructs. Since values above 0.70 are often regarded as suggestive of trustworthy scales, Cronbach's alpha values fall between 0.745 and 0.769, indicating strong internal consistency[33]. This is further supported by the composite reliability ratings, where both rho_a and rho_c values exceed 0.70, confirming that the constructs maintain strong reliability across items [3]. Additionally, the Average Variance Extracted values are well within acceptable limits, suggesting good convergent validity. The AVE for GI is 0.894, which is notably high, confirming that the Green Innovation construct effectively captures its intended dimensions [4]. Similarly, LE and SLP exhibit AVEs of 0.776 and 0.839, respectively, which are also above the recommended threshold of 0.50, affirming that these constructs adequately represent their underlying factors. These outcomes are consistent with other research findings, such as those of [5], which highlight the significance of reliable measurement methods in sustainable supply chain and green logistics strategies. The high reliability and validity of these variables ensure that the study's constructs are both accurate and consistent in capturing key aspects of sustainability in logistics.

The **Table 5** and **Figure 6** reports reliability and validity statistics for study variables. Cronbach's Alpha values (0.745–0.769) indicate good internal consistency. Composite Reliability (ρa and ρc) scores confirm robust reliability across variables. Average Variance Extracted (AVE) values range from 0.776 to 0.894, demonstrating acceptable convergent validity for green innovation (GI), logistics efficiency (LE), and sustainable logistics practices (SLP).

Table 5. Reliability and validity statistics for study variables.

Variable	Cronbach's Alpha	Composite Reliability (ρa)	Composite Reliability (ρc)	Average Variance Extracted (AVE)
GI	0.766	0.799	0.745	0.894
LE	0.769	0.817	0.744	0.776
SLP	0.745	0.708	0.703	0.839

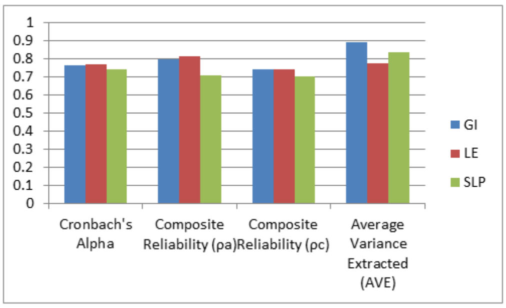

Figure 6. Reliability and validity statistics.

5. Need of This Study

The need for this study arises from the growing emphasis on sustainability in logistics and supply chain management. Organizations are feeling more and more pressure to implement green practices that not only lessen their environmental impact but also increase operational effectiveness as environmental concerns grow. Although Green Logistics Management (GLM) has become a vital tactic to tackle these issues, little is known about how it affects Sustainable Logistics Performance (SLP). By assessing how GLM approaches, such green innovation and eco-friendly technologies, affect SLP, this study seeks to close this gap. Understanding the relationship between GLM and SLP is essential for organizations seeking to optimize their logistics operations while achieving sustainability goals. The insights provided by this study can help businesses adopt effective green logistics strategies, improve their performance, and contribute to broader environmental and economic sustainability objectives.

6. Conclusions

The analysis of Green Innovation (GI) and Logistics Efficiency (LE) highlights a significant commitment to sustainable logistics practices, with encouraging levels of adoption across firms. A mean GI score of 5.085 indicates widespread implementation of green practices, albeit with moderate variability influenced by regional regulations, industry-specific pressures, resource availability, and organizational priorities. Similarly, the mean LE score of 4.982 reflects high logistics efficiency, though slightly lower than GI, with variability driven by infrastructure, technological integration, operational complexity, and workforce capabilities. Descriptive statistics underline the adoption of eco-friendly practices such as sustainable materials, reusable packaging, and optimized transportation. However, variability in implementation suggests room for improvement, particularly for smaller firms and those in regions with limited infrastructure. The findings emphasize the importance of targeted policy measures, industry collaborations, and financial support to reduce disparities in adoption levels and foster broader integration of green practices. Reliability and validity assessments confirm the robustness of the study's constructs, with Cronbach's Alpha values (0.745–0.769) and AVE scores exceeding recommended thresholds, ensuring accurate and consistent measurement of sustainability dimensions. These insights align with existing literature and provide a solid foundation for advancing sustainable logistics strategies. In conclusion, while firms are making notable strides in integrating sustainability and efficiency into logistics operations, targeted interventions, including policy incentives, infrastructure development, and capacity-building initiatives, are essential to bridge gaps and achieve more uniform adoption. This study reinforces the importance of collaborative efforts to enhance both green innovation and logistics efficiency, paving the way for sustainable supply chain practices in the long term.

7. Research of Future Scope

1. Investigate the long-term impacts of GL Management practices on Sustainable Logistics Performance to assess sustainability over time and track changes in organizational behaviour.
2. Conduct studies across different industries (e.g., manufacturing, retail, healthcare) to determine how sector-specific factors influence the effectiveness of Green Logistics Management initiatives.
3. Employ mixed-methods research designs that incorporate both quantitative and qualitative data to gain deeper insights into the motivations, barriers, and successes associated with implementing Green Logistics practices.

8. Suggestions

1. Firms should invest in green innovations like eco-friendly packaging and clean technologies to further improve logistics efficiency and sustainability.
2. While green logistics practices are widely adopted, variability across organizations should be addressed. Standardized approaches and knowledge-sharing programs can help ensure consistent implementation.
3. Firms should explore technologies such as AI and IoT to optimize operations, reduce costs, and enhance sustainability outcomes.
4. Companies should collaborate with supply chain partners to integrate sustainable practices across the entire supply chain, driving innovation and best practices.
5. Regular tracking and evaluation of green logistics initiatives will help identify areas for improvement, justify sustainability investments, and ensure long-term success.

Author Contributions

Conceptualization, A.G., and S.V.; methodology, S.V.; software, A.G.; validation, A.G., S.V.; formal analysis, A.G.; investigation, A.G.; resources, A.G.; data curation, A.G.; writing—original draft preparation, A.G.; writing—review and editing, A.G.; visualization, A.G.; supervision, S.V.; project administration, S.V.; All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

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Conflicts of Interest

The authors declare no conflict of interest.

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