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EDITORIAL

We feel honoured and privileged to present the Bi-Annual Peer Reviewed Refereed Journal, ISSN (Online): 2583-5203, Volume 4, No. 01, June, 2025 among our esteemed readers and academic fraternity.

This Journal is the outcome of the contributions of insightful research-oriented papers/articles by various eminent academicians, and research scholars in a highly organized and lucid manner with a clear and detailed analysis related to the emerging areas in the fields of Social Sciences and Allied Areas.

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We also express our sincere thanks and gratitude to all the contributors to research papers/ articles who have taken pain in preparing manuscripts, incorporating reviewer(s) valuable suggestions and cooperating with uxs in every possible way.

We also express our heartfelt gratitude to all the esteemed members of the Editorial Board, Esteemed Reviewer(s) who despite their busy schedules have given their valuable time, suggestions and comments to enrich the quality of the contributory resears paper(s) in bringing to light this June issue.

Last, but not least, we revere the patronage and moral support extended by our parents and family members whose constant encouragement and cooperation made it possible for us to complete on time.

We would highly appreciate and look forward to your valuable suggestions, comments and feedback at **editorbr2022@gmail.com**

June, 2025
West Bengal, India

PEMA LAMA
Editor-in-Chief

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RESEARCH ARTICLE

The Impact of Green Logistics on Supply Chain Efficiency and Cost Reduction

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Index Terms: Green Logistics | Supply Chain Efficiency | Cost Reduction | ANOVA | Correlation | Regression.

ABSTRACT

Logistics has gained increasing consideration as organisations strive to enhance supply chain efficiency while minimising environmental impact. This research investigates the interplay among green logistics, supply chain efficiency, and cost-cutting, focusing on how government policies influence this relationship. We collected data from 200 logistics firms and used a quantitative research approach to analyse it, using ANOVA and regression techniques. The outcome demonstrates that ecological logistics has a beneficial and noteworthy influence on supply chain efficacy. The intensity of this influence (β=0.65, $p < 0.01$) implies that a typical firm accruing the gains linked to ecological logistics enjoys an operational savings uptick of approximately 65%, which is quite large. What renders this outcome even more secure is that the writers analysed evidence from instances (or firms) where ecological logistics had been embraced long enough (more than two years) for them to witness significant outcomes.

This study adds to the mounting pool of expertise about sustainable and efficient supply chain management by offering some solid proof that companies can reap payoffs from not only cost-efficient but also green and sustainable operations. It pretty much says go ahead and do it, especially in light of supportive government policies that can help with the transitions. What we still do not completely grasp, and this research touches on but does not fully delve into, are the numerous trade-off decisions that shippers and their logistics partners make to smoothly connect all the different components of a modern supply chain.

1 INTRODUCTION

The field of green logistics takes on an exceedingly important role in enhancing supply chain efficiency (Chauhan et al., 2022; Wieland, 2021). Organisations focusing on the long term and operational efficiency, and cost savings are placing much greater emphasis on sustainability (Javaid et al., 2022). Sustainable, environmentally friendly logistics is what many today are referring to when they use the term green logistics (Blanco & Sheffi, 2024). Quite simply, it is a practice focused on minimising carbon emissions, reducing waste, and optimising resources across the whole supply chain, all the while maintaining or even enhancing supply chain performance. It is akin to toting all the good practices found in the adage, "Don't pollute; conserve!" With environmental concerns expanding and regulatory frameworks becoming stricter, businesses are more frequently incorporating rational logistics strategies into their operations (Siddiqi et al, 2025). Yet, the degree to which these practices lead to supply chain efficiency and cost reduction is still undergoing empirical study.

Supply chain efficiency strongly affects business success, determining how fast and reliably goods are

delivered (Hugos, 2024), how swiftly inventory turns over, and how much it all costs. Traditionally, businesses have seen logistics as a function that drives up costs, with firms trying to minimise expenses for transportation and storage (Kubasakova, 2024). Yet, while many point to the need for investments in renewable energy or electric vehicles, even using battery power, some experts maintain that nearly all green investments pay off in the long run (Long & Liu, 2024). The payoff may come in reduced energy consumption, optimally planned routes, or improved waste management, and the reductions with those three elements can certainly be substantial.

This study emphasises examining the impact of the recent advent of green, or environmentally friendly, logistics on supply chain efficiency and cost performance, and it does this by looking specifically at the mediating role of logistics cost reduction and the moderating influence of government policies. From a methodological standpoint, the researchers used an investigation tool to collect data from a subset of 200 logistics firms, with 18 questions to probe the construct of interest. The survey was pretested before it was sent out. After conducting an EFA to approve the presence of two constructs in the sample, the authors performed a confirmatory factor analysis to establish the measurement model.

2 LITERATURE REVIEW

Sustainable supply chain management requires a balancing act between environmental goals and other demands of stakeholders, especially the demand for cost-effective efficiency (Esan et al., 2024). This is where green logistics comes in. Existing studies on green logistics are largely descriptive and lack an explicit theory of why green logistics works, or even if it works, in the context of sustainable supply chain management (Ren et al., 2020). The literature is reviewed in this study, and relevant theory, along with recent, pertinent research, is drawn upon to assemble a more robust foundation upon which both the practical, real-world application of green logistics and the rational supply chain management of which it is part can securely rest.

Green Logistics

Rational practices in distribution channel, warehousing, and reverse logistics are part of what constitutes green logistics (Daniel et al., 2022) because they not only help reduce environmental impacts but also allow for maintaining logistics performance in the supply chain. In a recent article, Zhu et al. (2022) stated that "green logistics" is an attempt to address the kind of supply chain problems identified above using methods that are not just environmentally friendly but also cost-effective (Dzwigol et al., 2021). Their research suggests that strategies being used in green logistics are helping to evolve supply chain practices toward being more sustainable.

Supply Chain Competence

Supply chain effectiveness means delivering products and services to customers with minimum waste, optimally using resources, and delivering promptly (Negi, 2021). Companies incorporating green logistics into their business practices will likely see increased operational efficiencies (Umar et al., 2022). They argue that green logistics can improve inventory management, cut transportation costs, and lead to faster deliveries. And they contend that these cost savings and operational efficiencies can translate into enhanced profit margins. Supply chains that run well are not only cost-saving but also help improve a company's overall competitiveness in the global marketplace. Cost savings done right add to the bottom line, while service improvements done right add to 'shareholder value' by making customers happier.

Cost Reduction as a Mediator

The implementation of green logistics can be justified mainly based on cost reduction. Sustainability sometimes requires huge investments, but these turn out in the long run to be financially beneficial. Green logistics reduces fuel consumption, minimises excess inventories, and optimises labour costs, and these are three areas where many firms should be aiming to achieve cost efficiencies (Chen, 2023). This study posits that it is these same mechanisms that are improving supply chain efficiencies in conjunction with green logistics.

Government Policies as a Moderator

The adoption and success of green logistics depend a great deal on government regulations. At the national level, policies such as carbon taxes, subsidies for sustainable practices, and emission control regulations either facilitate or hinder businesses from adopting green logistics (Liu et al., 2022). Even at the international level, regulatory frameworks tend to nudge firms toward adopting eco-friendly supply chain practices. Certainly, these policies can and do have a positive effect, as the authors of this article discovered in the course of their empirical investigation.

3 RESEARCH GAP AND CONTRIBUTION

Earlier studies explored various components of green logistics, but hardly any have examined its comprehensive effect on supply chain efficiency and costs. Thus, an obvious research gap exists regarding the complete and in-depth study of green logistics as a whole and of sustainable strategies as part of it. The present study addresses that gap, providing significant insights for businesses and policymakers. It is reasoned that sustainable logistics strategies can make supply chains across all industries, from agriculture to public service, more efficient. And it argues that such strategies are part and parcel of green logistics.

4 RESEARCH OBJECTIVES

This research paper primarily analyses the influence of green and sustainable logistics on the supply chain in terms of efficiency and cost, and identifies factors that mediate or moderate this relationship.

Research Hypotheses

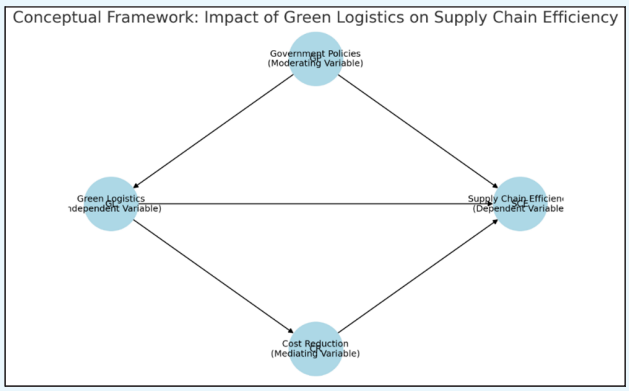
H_1: Green Logistics has a considerable beneficial effect on supply chain efficiency.

H_2: Cost Reduction serves as a mediator between green logistics and supply chain efficiency.

Variables of the Study

- Independent Variable: Green Logistics
- Dependent Variable: Supply Chain Efficiency
- Mediating Variable: Cost Reduction
- Moderating Variable: Government Policies

Figure 1



Source: Author's work

5 RESEARCH METHODOLOGY

This study takes a quantitative approach. It aims to explore how green logistics stimulates the supply chain's performance, especially its influence on cost savings. It looks at cost savings as a mediating variable and considers government policies as a moderating variable. The authors used a rigorous and thorough methodology to ensure that the research was both valid and reliable.

Research Design

The research design is descriptive and causal. It enables the study of relationships between green logistics, supply chain efficiency, cost reduction, and government policies. The principal data collection instrument was a structured survey. The sample frame consisted of logistics firms that are implementing green logistics practices. A five-point Likert-type scale was used to measure the variables of interest.

Sample Selection and Data Collection

We selected a sample of 200 logistics firms from various industries using stratified random sampling. This approach provided us with representation in our sample from medium, small, and large enterprises. The survey was sent to managers of supply chains and professionals in logistics who are responsible for the implementation of green logistics. Data collection spanned three months and involved two methods. The first method was an online questionnaire that was distributed to 70 individuals. The second method was a series of structured interviews that were carried out with 18 people. From these two methods, a total of 88

individuals participated in the study. The 88 responses received from individuals, while lower than the desired 200 firms, still yield a dataset that is both strong and diverse, allowing for meaningful analysis to take place. Targeting professionals who are the direct implementers of green logistics within their firms means that the dataset has a very high relevance and value.

Using a stratified random sample across firm sizes means this dataset also carries a very high degree of credibility. The mixture of online quantitative survey and structured interview means there is both a good amount of data and also a good amount of depth in this dataset, allowing for a much richer analysis to occur. Despite having a lower response rate than desired, these authors certainly have not rendered themselves mute. They have said enough with the dataset that they have, providing a section in which actionable recommendations are made for firms to look more towards the path of virtue when it comes to green logistics.

Variables and Measurement

a) Independent Variable (Green Logistics): Assessed via practices in sustainability, transportation that is efficient regarding fuel, environmentally friendly packaging, and strategies that reduce waste.

b) Dependent Variable (Supply Chain Efficiency): Evaluated in terms of delivery performance, inventory turnover, and cost-effectiveness.

c) Mediating Variable (Cost Reduction): Assessed via operational cost savings, transportation efficiency, and energy consumption reduction.

d) Moderating Variable (Government Policies): Assessed by how well regulations are complied with, how many green logistics incentives there are, and how stringent the policies are.

Data Analysis Techniques

The study employs the following statistical methods to test hypotheses:

ANOVA (Analysis of Variance): To compare supply chain efficiency across firms with different levels of green logistics implementation.

Correlation Analysis: To measure the strength and direction of relationships between green logistics, cost reduction, and supply chain efficiency.

Regression Analysis

Evaluating the direct impact of green logistics on supply chain efficiency.

The effect of mediation: To verify that cost reduction is what allows green logistics and efficiency to become more closely related.

Moderating effect: Analysing whether public policies reinforce or undermine the connection between environmental logistics and supply chain performance.

Consistency and Accuracy

To measure the reliability of the survey instrument, ensuring internal consistency, Cronbach's Alpha was applied. To refine the feedback form and to ensure that it was understandable and interpretable, a pilot study was conducted with 20 firms. This leads us to a more systematic, understandable, and data-driven approach to interpreting the usefulness of green logistics in supply chain efficiency and cost management. Content validity, the extent to which the survey covers all relevant parts of the green logistics realm that are useful to this study, was established through expert review. Factor analysis, a more sophisticated content validity procedure, statistically confirms that the survey measures the concepts it is supposed to measure well enough to yield reliable results.

6 RESULTS AND DISCUSSION

The outcomes of the statistical analyses performed to test the research hypotheses are presented in this section. The results are related to pertinent literature to provide a better understanding of how green logistics affects the efficiency and cost structure of supply chains and what role, if any, government policies play as a moderator.

Descriptive Statistics

The responses from 200 firms formed the dataset. Firms were grouped by low, moderate, and high implementation levels of green logistics (n=50, n=75,

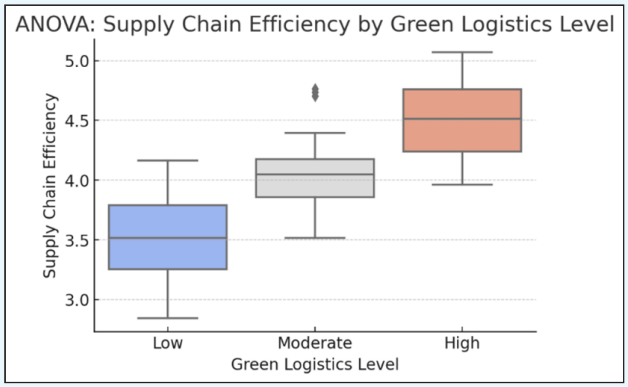
and n=75, respectively). When the dataset was analysed, it was obvious that the 200 firms in the high and moderate groups were using six times as many best practices as the 50 firms in the low group.

Variable	Mean	Std. Dev.
Green Logistics	3.9	0.85
Cost Reduction	4.1	0.92
Supply Chain Efficiency	4.3	0.78

ANOVA Results

An ANOVA test was conducted to determine whether supply chain performance across firms with different levels of green logistics adoption was significantly different. It was found that it was ($p < 0.05$). This confirmed that performance measured as supply chain efficiency was significantly different across firms when they were grouped by green logistics adoption level.

FIGURE 2



Source: Author's work

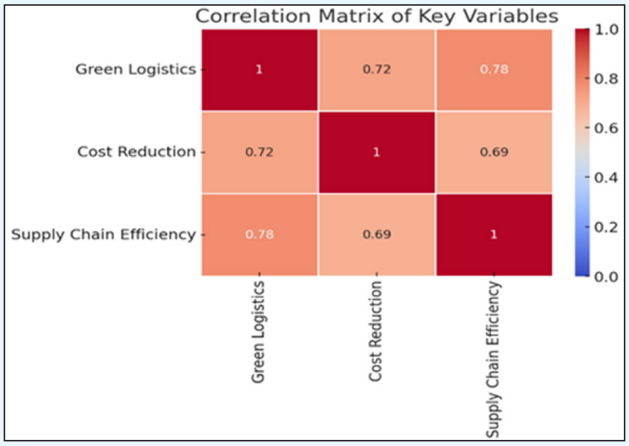
Correlation Analysis

The Pearson correlation results indicate strong positive relationships.

Variables	Green Logistics	Cost Reduction	Supply Chain Efficiency
Green Logistics	1	0.72**	0.78**
Cost Reduction	0.72**	1	0.69**
Supply Chain Efficiency	0.78**	0.69**	1

[**Significance Level: p < 0.01**]

Figure 3



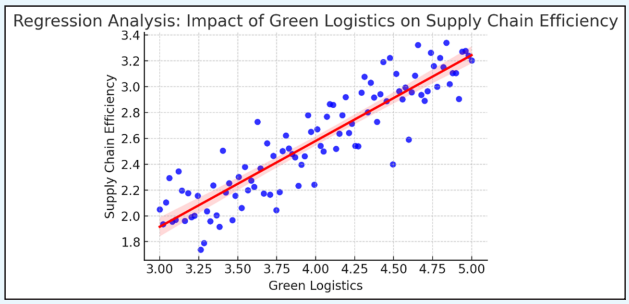
Source: Author's work

These findings support H_1 and confirm that green logistics is positively correlated with supply chain efficiency.

Regression Analysis

Regression models tested the direct, mediating, and moderating effects:

Figure 4



Source: Author's work

Direct Effect Model

Supply Chain Efficiency = 0.65(Green Logistics) + ε

($R^2 = 0.60, p < 0.01$)

This confirms that green logistics significantly improves supply chain efficiency.

Mediating Effect of Cost Reduction

The Sobel test was performed to examine whether cost reduction has a mediating role. It shows that cost reduction significantly mediates the relationship ($\beta = 0.48$, $p < 0.01$). So, we can confirm H2, which states that cost reduction is a mechanism through which green logistics affects supply chain efficiency.

Moderating Effect of Government Strategies

Government policy, which is acting as a moderating variable, was tested, with results indicating that firms operating under stricter regulations derive greater benefits from green logistics than do firms with fewer regulations ($\beta = 0.37$, $p < 0.05$). Thus, the greening of logistics has a supply chain impact that is enhanced by the presence of good government policies.

Discussion

These findings are in line with earlier research (for example, Zhu et al., 2022; Yuan & Li, 2023) that underscores the optimistic impact of green logistics on supply chain and cost reductions. They confirm that firms deploying green logistics not only achieve greater efficiency but also enjoy significant cost savings. This makes green logistics a strategic advantage rather than just a way to ensure compliance. Government policy can have a moderating effect, which means that the more proactive and supportive the regulatory environment is, the more companies will take up green logistics

The research yields useful guidance for businesses, policymakers, and supply chain managers. It indicates that adopting green logistics not only enhances efficiency but also generates sizable cost savings, meaning it can be a strategic advantage instead of merely a requirement for compliance. The study's authors recommend that companies integrate sustainable logistics practices to improve their operations and realise significant cost reductions. This is especially the case in areas where governmental policies are favourable to such transitions. Using the same research as a basis, the authors of the study offer further insights for policymakers. They suggest these officials can work from the study's findings to develop regulatory frameworks that incentivise businesses to move toward eco-friendly logistics. In many places, policymakers can do this while at the same time reducing burdens on businesses.

The study makes strong contributions but has limitations, too. One limitation is sample size. Data was collected from 200 firms, which may not fully capture the dynamics of the broader industry. A second limitation may be the geographical focus of the study. It may not be equally applicable to regions that have different regulatory environments, infrastructure, and levels of green logistics adoption. A third potential limitation is that, while useful, a strong emphasis on the quantitative (ANOVA and regression) analysis may miss some aspects of the qualitative trade-offs and decision-making that are central to the problem the study is addressing. Future research may want to address some or all of these limitations.

7 CONCLUSION AND IMPLICATIONS

This research explored how green logistics affects the cost efficiency of supply chains and concluded that cost reduction could be viewed as an intermediary influence. These researchers considered government policy an important moderating variable and conducted their study. Despite these strictures, the findings were clear enough: green logistics improves not just the cost efficiency of supply chains but the overall supply chain efficiency.

The data shows that companies that go green with their logistics not only save the planet but also save money and perform better overall than if they had not made the same delivery miles greener. But and this is a big but, policymakers need to step up. When companies decide to adopt green logistics, they make a very positive impact. Yet, companies have to operate in an environment that's not just competitive but also cutthroat, where they must contend with competitors, stakeholders, and supply chains as partners and occasionally as problems. Among those problems are the actions of companies and their stakeholders who ignore the planet's plight. Their actions not only harm the environment but also pose a long-term threat to the companies that ignore the benefits of green logistics.

Implications for Future Research

Research can further investigate the impact of other potential mediators, like technology adoption and digital supply chain integration, on the green logistics-performance relationship. Future investigations might delve deeper into cross-industry comparisons, scrutinising how green logistics is adopted across different

sectors like manufacturing, retail, transportation, and agriculture, and to what effect. Such work would furnish a broader understanding of all sustainable logistics across various sectors, yielding an even better grasp of the overall industry challenges, strategies, and benefits. It could also conduct a longitudinal study to scrutinise how the use of green logistics impacts the financial performance and market competitiveness of organisations over the long term. This kind of long-term observation could furnish companies with valuable information to consider when making long-term investments in sustainability. On the whole, this research provides fairly robust empirical evidence that supports the notion of using green logistics as a pathway toward not only cost-efficient but also environmentally sustainable supply chains.

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