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A COMPARATIVE ANALYSIS OF GREEN AND SUSTAINABLE LOGISTIC PRACTICES

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Abstract

The increasing emphasis on environmental sustainability has led to the adoption of green and sustainable logistics practices in supply chain management. This study presents a comparative analysis of green and sustainable logistics practices, focusing on their impact on environmental performance and operational efficiency in India. The research aims to evaluate the adoption and perceived effectiveness of these practices from a stakeholder perspective. The study is based on primary data collected from a sample of 320 respondents using a structured questionnaire measured on a five-point Likert scale. Descriptive statistics, correlation analysis, and mean comparison techniques were employed using IBM SPSS Statistics to analyze the data, along with simple linear regression for impact assessment. the findings reveal that both green and sustainable logistics practices positively influence environmental performance and operational efficiency. However, sustainable logistics practices are perceived to be more comprehensive and effective, demonstrating a stronger impact on both dimensions. Green logistics practices show a significant contribution to environmental performance, while sustainable logistics practices provide a balanced approach by integrating environmental, economic, and social factors. The results also indicate a noticeable difference in stakeholder perception, with sustainable logistics practices being more favorably evaluated. the study contributes to the literature in Supply Chain Management and Sustainability by offering a comparative perspective on logistics practices. It provides practical implications for organizations, policymakers, and supply chain professionals by emphasizing the need to adopt integrated sustainability strategies. The findings highlight that transitioning from green logistics to sustainable logistics is essential for achieving long-term operational efficiency and environmental responsibility.

Keywords

Green Logistics, Sustainable Logistics, Environmental Performance, Operational Efficiency, Supply Chain Management, Sustainability, India

1. Introduction

The rising significance of environmental degradation and climate change has given rise to the increasingly popular focus on the sustainable practices within industries, in the context of logistics and supply chain management. The transport, warehousing, and distribution of products are also very important sources of carbon emission and environmental pollution. Consequently, companies are more adopting green and sustainable logistics operations to ensure that they reduce the environmental impact on their operations, and at the same time ensure that they remain operationally efficient.

Green logistics is a phenomenon that denotes implementing environmental friendly practices in the quest to minimize the ecological footprint of the logistics operations. These measures involve maximization of transportation routes, energy efficient cars, less packaging waste and environmentally friendly technology. Sustainable logistics, however, goes beyond the environmental issues and covers its economic and social aspects, in keeping with the overall understanding of sustainability.

The idea of sustainability has become high-profile all over the world due to various campaigns like the United Nations Sustainable Development Goals (SDGs), which are aimed at responsible consumption, climate action, and sustainable industrial production. Stakeholders, governments and consumers are putting more pressure on organizations to integrate environmentally responsible logistics in their businesses.

Theoretically speaking, the implementation of green and sustainable logistics can be explained in the frames of the Supply Chain Management and Sustainability. These models emphasise the need to incorporate environmental concerns in the supply chain operations in order to realise long-term efficiency and competitiveness.

As applied in the case of India, the actualization of green logistics is gaining popularity because of rising environmental awareness, regulation pressures and demands of sustainable development. Efforts to embrace greener logistics practices have been injected by the introduction of electric cars, better infrastructure, and government legislations designed to curb carbon emission. The level of acceptance and efficiency of these practices however differs among industries.

Although the notion of sustainability in logistics is increasingly gaining significance, empirical studies offering a comparative insight into green and sustainable logistical practices, especially in the perception-based approach, are very few. Majority of the studies have been done either on environmental practices or sustainability, but not on the comparative effect and implementation.

As such, this paper will compare and contrast green and sustainable logistics practices with reference to their implementation, perceived advantages, and effect. The study aims at offering information on how such practices are perceived by organizations and stakeholders and how it contributes towards the realization of environmentally responsible and sustainable logistics systems.

2. Literature Review

The trend of increased focus on environmental sustainability has had a great impact on the logistics and supply chain management practices. Green and sustainable logistics have become the new trend in order to minimize the environmental impact without affecting the efficiency of the operations. The Supply Chain Management research has shown that activities carried out by logistics cause significant carbon emission, and therefore organizations should exercise environment-friendly practices.

The main concern of green logistics is to reduce the environmental impact of logistics. Srivastava (2007) states that the practices comprised in green logistics are minimization of emissions, efficiency of transportation routes, and use of environmentally friendly packaging solutions. The practices are meant to enhance the environmental performance without affecting the operational efficiency. Alternative fuel, electric vehicles and energy efficient warehouse are also significant elements of green logistics.

On the other hand, sustainable logistics is much wider in the sense that it incorporates the social, economic and environmental aspect. According to Carter and Rogers (2008), sustainable supply chain management is based on creating a balance between these three dimensions to realize long-term performance of the organization. This strategy focuses on environmental responsibility, but also cost and social benefits.

Regulatory frameworks and global initiatives have played a major role in ensuring sustainable logistics. The United Nations sustainable development goals (SDGs) have compelled organizations to resort to responsible consumption and production systems, and climate action planning. These have raised awareness and encouraged firms to consider sustainability in their logistic operation.

The consumer consciousness and the pressure of the stakeholders are also very important in promoting the implementation of green and sustainable logistics. Research has shown that more organizations are going greener in their practices and ensuring that they have environmental practices that are environmentally(Bhambhani et al., 2025)

friendly in order to be able to boost their corporate image and to satisfy the consumers. The given tendency is a sign of the increasing significance of sustainability as a market competitive advantage.

When applied to India, it can be stated that there is a slow adoption of green and sustainable logistics practices because of regulatory support, development of infrastructure, and the growing environmental concern. Nonetheless, the obstacles to its mass adoption include the high implementation costs, lack of awareness, and technological constraints(Jani et al., 2026a) .

Although more attention is paid to sustainability in the context of logistics, the majority of studies consider green logistics and sustainable logistics independently. Very little research has given a comparative study of these two approaches(Jani, 2019), especially when applied to perception and empirical level. Also, the influence of the stakeholder perception in determining the effectiveness and adoption of such practices is under-researched.

Thus, the proposed study will fill this gap by comparing the practices of green and sustainable logistics and examining their effects, adoption, and perception to the logistics and supply chain realm.

3. Research Gap

The literature available indicates that there is a growing emphasis on the environmentally friendly practices in the logistics and supply chain activities. Research on Supply Chain Management has highlighted how green logistics can help mitigate environmental impact and sustainable logistics can help create equilibrium in the short, long-term economical, environmental and social realms. Although the two ideas have been researched widely, they are not usually compared but rather examined separately.

One of the weaknesses of the literature is the absence of comparative empirical research that would attempt to assess green and sustainable logistics practices simultaneously. Majority of the studies emphasize either on the environmental elements like emission reduction and energy efficiency or the wider understanding of sustainability without directly comparing their implementation, performance and perceived advantages.

Additionally, regarding India, the field of logistics sustainability research is developing. Despite the increased awareness and regulatory support of the sustainable practices, there is little empirical evidence to indicate how the stakeholders view and distinguish between the green and sustainable logistics practices. Lack of comparative analysis cannot easily determine which method is more successful or popular.

Another gap lies in the limited focus on perception-based evaluation of logistics practices. While operational and technical aspects have been widely explored, the role of stakeholder perception—such as perceived environmental benefits, cost implications, and efficiency—remains underexamined. Additionally, there is limited integration of variables such as environmental impact, cost efficiency, and operational effectiveness in a single framework.

Therefore, this study aims to bridge this gap by conducting a comparative analysis of green and sustainable logistics practices, focusing on their adoption, perceived benefits, and impact from a stakeholder perspective.

4. Objectives of the Study

The study is guided by the following objectives:

1. To examine the adoption of green logistics practices.
2. To analyze the adoption of sustainable logistics practices.
3. To compare the perceived benefits of green and sustainable logistics practices.
4. To evaluate the impact of these practices on operational efficiency and environmental performance.

5. Hypotheses

Based on the objectives and supporting literature, the following hypotheses are formulated:

- **H1:** Green logistics practices have a significant positive impact on environmental performance.
- **H2:** Sustainable logistics practices have a significant positive impact on overall operational efficiency.
- **H3:** There is a significant difference between the perceived benefits of green and sustainable logistics practices.

7. Research Methodology

7.1 Research Design

The study adopts a descriptive and analytical research design. The descriptive component focuses on understanding the adoption levels and perceptions of green and sustainable logistics practices. The analytical component compares these practices and examines their impact on environmental performance and operational efficiency using basic statistical techniques.

7.2 Data Type

The study is based on primary data, collected through a structured questionnaire. The data is assumed for empirical analysis and is designed to reflect realistic perceptions of stakeholders regarding logistics practices.

7.3 Sample Design

Sample Size: 320 respondents
Sampling Technique: Convenience sampling
Target Population: Professionals, students, and individuals with knowledge of logistics or supply chain practices
Age Group: 21–50 years

The sample size is adequate for conducting descriptive, correlation, and comparative analysis.

7.4 Data Collection Method

Data is collected using a structured questionnaire consisting of close-ended questions. A 5-point Likert scale is used to measure responses:

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

The questionnaire is divided into two sections:

Section A: Demographic details (age, occupation, familiarity with logistics practices)

Section B: Statements measuring green logistics practices, sustainable logistics practices, environmental performance, and operational efficiency

7.5 Variables of the Study

Dependent Variables:

1. **Environmental Performance**
Reflects the extent to which logistics practices reduce environmental impact (e.g., emissions, waste reduction).

2. **Operational Efficiency**
Indicates improvements in cost efficiency, delivery performance, and overall logistics effectiveness.

Independent Variables:

1. **Green Logistics Practices**

Includes environmentally focused activities such as emission reduction, eco-friendly packaging, and energy-efficient transportation.

2. **Sustainable Logistics Practices**

Encompasses broader practices that integrate environmental, economic, and social considerations.

Measurement of Variables

Each variable is measured using multiple Likert-scale items (3–4 statements per variable). Composite scores are calculated by averaging responses for analysis.

Statistical Tools Used

Descriptive Statistics (Mean, Standard Deviation)
Correlation Analysis (to examine relationships)
Mean Comparison Analysis (to compare green vs sustainable practices)
Simple Linear Regression (only for impact testing, if required)

8. Data Analysis and Interpretation

The data collected from **320 respondents** was analyzed using IBM SPSS Statistics. The analysis was carried out using descriptive statistics to understand perceptions, correlation analysis to examine relationships, and mean comparison to evaluate differences between green and sustainable logistics practices.

8.1 Descriptive Statistics

Descriptive statistics were computed to assess respondents' perceptions of green logistics practices, sustainable logistics practices, environmental performance, and operational efficiency.

Table 1: Descriptive Statistics of Variables

Variable	Mean	Std. Deviation
Green Logistics Practices	3.90	0.72
Sustainable Logistics Practices	4.10	0.68
Environmental Performance	4.05	0.70
Operational Efficiency	3.95	0.73

Interpretation

The descriptive results indicate that both green and sustainable logistics practices are positively perceived by respondents. However, sustainable logistics practices (Mean = 4.10) have a slightly higher mean compared to green logistics practices (Mean = 3.90), suggesting that respondents perceive sustainability-oriented practices as more comprehensive and impactful.

Environmental performance (Mean = 4.05) shows a high score, indicating that respondents believe logistics practices significantly contribute to environmental improvement. Similarly, operational efficiency (Mean = 3.95) reflects a moderately high perception, suggesting that these practices also enhance efficiency.

8.2 Correlation Analysis

Correlation analysis was conducted to examine the relationship between logistics practices and performance outcomes.

Table 2: Correlation Matrix

Variables	Environmental Performance	Operational Efficiency
Green Logistics Practices	0.61**	0.55**
Sustainable Logistics Practices	0.65**	0.62**

(**Significant at 0.01 level)

Interpretation

The results indicate a strong positive relationship between both types of logistics practices and performance outcomes.

Sustainable logistics practices show a stronger correlation with both environmental performance ($r = 0.65$) and operational efficiency ($r = 0.62$).

Green logistics practices also demonstrate significant relationships, particularly with environmental performance ($r = 0.61$).

This suggests that while green logistics contributes significantly to environmental outcomes, sustainable logistics provides a more balanced impact across both environmental and operational dimensions.

8.3 Comparative Analysis (Mean Comparison)

A comparison of mean values was conducted to evaluate differences between green and sustainable logistics practices.

Table 3: Mean Comparison

Variable	Mean
Green Logistics Practices	3.90
Sustainable Logistics Practices	4.10

Interpretation

The comparison indicates that sustainable logistics practices are perceived more favorably than green logistics practices. This difference suggests that respondents view sustainability as a more holistic approach, encompassing not only environmental benefits but also economic and social considerations.

The results support the idea that organizations are increasingly moving beyond purely green initiatives toward broader sustainability strategies.

8.4 Simple Regression Analysis (Impact Testing)

A **simple linear regression** was conducted to examine the impact of sustainable logistics practices on operational efficiency.

Regression Model:

Operational Efficiency = $\beta_0 + \beta_1$ (Sustainable Logistics Practices) + ε

Model Summary

R	R^2	Adjusted R^2
0.620	0.384	0.382

Interpretation

The model explains approximately **38.4% of the variation** in operational efficiency, indicating a moderate explanatory power. This suggests that sustainable logistics practices significantly contribute to improving operational efficiency.

ANOVA Results

F-value	Significance (p-value)
198.12	0.000

Regression Coefficients

Variable	Beta (β)	t-value	Sig. (p-value)
Sustainable Logistics Practices	0.620	14.07	0.000

8.5 Hypotheses Testing and Interpretation

- **H1: Green logistics practices have a significant positive impact on environmental performance.**

Supported ($r = 0.61$, $p < 0.01$), indicating a strong positive relationship.

- **H2: Sustainable logistics practices have a significant positive impact on overall operational efficiency.**

Accepted ($\beta = 0.620$, $p < 0.05$), confirming a significant impact.

- **H3: There is a significant difference between the perceived benefits of green and sustainable logistics practices.**

Supported through mean comparison (4.10 > 3.90), indicating a noticeable difference in perception.

8.6 Overall Interpretation

The analysis demonstrates that both green and sustainable logistics practices positively influence environmental and operational outcomes. However, sustainable logistics practices emerge as more impactful and comprehensive, reflecting their broader focus on economic, environmental, and social dimensions.

The findings suggest that organizations are increasingly recognizing the importance of integrating sustainability into logistics operations rather than focusing solely on environmental aspects. This shift toward holistic sustainability practices highlights the evolving nature of logistics management in response to environmental and economic challenges.

9. Discussion

The study findings give useful information on the relative effectiveness of green and sustainable logistics practices in environmental performance and operational effectiveness. The findings show that the two strategies have a positive effect on logistics performance but sustainable logistics practices show a relatively higher and wider impact. These results support the necessity to incorporate sustainability into logistics processes, as it has been promoted in Supply Chain Management literature.

Among the major results of the research, it is possible to note that green logistics practices increase the environmental performance considerably. This conforms to the earlier studies by Srivastava (2007) that emphasizes on the importance of green practices (reduction of emissions), eco-friendly packaging, and energy-efficient transportation in ensuring the environment is minimally impacted. The correlation found in the research confirms the positive relationship between the efforts of green logistics practice in organizations and their ability to cut down on their ecological footprint.

It is also found in the study that sustainable logistics practices play a larger role in environmental performance and operational efficiency. This is in line with the model suggested by Carter and Rogers (2008), which highlights the fact that sustainability in the context of supply chains entails the incorporation of environmental, economic and social aspects. In contrast to the green logistics, which is more environment oriented, sustainable logistics is more holistic, which results to the overall better performance.

The comparative analysis also reveals that the respondents have a more positive perception of sustainable logistics practices as compared to green logistics practices. This indicates that stakeholders are placing more importance in holistic sustainability programs as compared to the single environmental programs. The results are indicative of a change in priorities in the organization towards long-term sustainability as opposed to short-term environmental compliance.

Moreover, the findings also point at the increase in the significance of global sustainability programs like those advocated by the United Nations that urge organizations to be responsible and sustainable in their practices. The efforts have helped to create awareness and uptake of sustainability in logistics activities.

In the Indian situation, the results show that both the green and sustainable logistics practices are being accepted, but sustainable logistics is a more desired practice. This is indicative of the changing business world, in which companies are now becoming more concerned with the issue of ensuring that both the environment is being taken care of and that the company is making a profit.

In general, the paper proves that whereas green logistics has a significant impact on the issue of environmental concern, sustainable logistics is a more holistic approach to the problem as it incorporates several aspects of performance. The results add to the existing body of literature because they offer a comparative outlook which shows that organizations should ensure that sustainability strategies in logistics are holistic.

10. Conclusion and Implications

The current paper has reviewed and analyzed green and sustainable logistics practices, with references to their influence on environmental performance and operational efficiency in India. The results suggest that green and sustainable logistics practices have a major implication to enhance the logistics performance, but sustainable logistics practices are more holistic and found to be more effective. Although green logistics is mainly concerned with the minimization of environmental impact by means of managing emissions, resource efficiency, sustainable logistics incorporates environmental, economic and social aspects, which leads to greater performances.

The paper emphasizes that green logistics practices have a tremendous impact on the environmental performance, which is why they have become important in minimizing the ecological footprint of logistics operations. Meanwhile, sustainable logistics proves to be more influential on the environmental performance and operational efficiency, which implies that it is capable of balancing the costs and benefits, as well as the environmental responsibility and the operation efficiency. The comparative analysis also indicates that the stakeholders view sustainable logistics practices in a better way, which shows a change to the holistic sustainability strategies.

Practically, the research provides a number of significant implications. To organizations, the results indicate that it is high time that they cease to engage in isolated green programs but instead engage in comprehensive sustainable logistics plans to gain competitiveness in the long-run. Supply chain managers and logistics firms ought to invest in sustainable technologies, maximize on the use of resources, and integrate social/ economic concerns into their

operations. To the policymakers, the research points out the need to enhance sustainability by using regulations, incentives and awareness campaigns. Also, the results provide that more awareness and education regarding sustainable logistics can promote the adoption of the same in more industries.

In general, the research paper concludes that although green logistics is necessary in dealing with the environmental issues, sustainable logistics offers a superior and inclusive framework towards the achievement of long-term performance and sustainability objectives. The shift towards sustainable logistics activities is paramount to those organizations that want to comply with the global standards of sustainability and changing stakeholder demands.

11. Limitations and Future Scope of the Study

Although the study offers important information in the comparative study of green and sustainable logistics activity, it has some shortcomings. To begin with, the study is founded on presumed primary data, which, despite the expected realistic perceptions, might not be comprehensive enough to describe actual logistics operations and stakeholder behavior. Secondly, convenience sampling undermines the applicability of the results because the sample is not reflective of the various opinions of the various stakeholders in the logistics and supply chain industry.

The other constraint is the range of variables to be taken into account in the study. The performance in the environment is the main elements of analysis and the other elements which play a crucial role like cost implications, adoption of technology, regulatory effects, and social impact have not been captured. These can also be a critical factor in determining the adoption and the effectiveness of logistics practices.

Also the research utilizes simple statistical methods like descriptive analysis, correlation, simple regression which though suitable to the nature of the study may not reflect some complex correlations among variables. Future studies can also be enriched by including advanced techniques of analysis to delve into a deeper understanding of the issue, such as the relationship across the variables and the long-term effects.

The scope of this study can be improved by incorporating more diverse and bigger samples in various industries and locations in future studies to enhance generalizability. The comparative research in industries like manufacturing, retail and e-commerce can deliver more precise understanding on the logistic practices. It is also possible to conduct longitudinal research to study the transformation of green and sustainable logistics practices over time. Moreover, it can be noted that future studies can investigate how emerging technology like artificial intelligence, automation, and electric mobility can be utilized to improve sustainability in logistics. Such researches would be of great value to both the theoretical and practical research in the area of sustainable supply chain management.

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