

# Role of Green Supply Chain Practices in Reducing Costs and Enhancing Customer Satisfaction in E-Commerce

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**Abstract-** The rapid growth of the e-commerce sector has significantly increased the complexity and environmental impact of supply chain operations. In response to rising concerns about sustainability and resource efficiency, organizations are increasingly integrating Green Supply Chain Management (GSCM) practices into their logistics and operational strategies. This study examines the role of green supply chain practices in reducing operational costs and enhancing customer satisfaction within the e-commerce and logistics industry. The research focuses on understanding how environmentally responsible practices such as eco-friendly packaging, optimized transportation routes, energy-efficient warehousing, and waste reduction contribute to both economic and customer-related outcomes.

A quantitative research approach was adopted for the study. Primary data were collected through a structured questionnaire distributed using an online survey platform, targeting respondents who are either involved in the logistics sector or regularly use e-commerce services. The study employed descriptive research design and convenience sampling techniques. The collected data were analyzed using statistical tools such as percentage analysis, correlation, and graphical interpretation to evaluate the relationship between green supply chain practices, cost reduction, and customer satisfaction.

The findings indicate that the adoption of green supply chain initiatives can contribute to long-term cost efficiency by minimizing resource consumption, reducing packaging waste, and improving transportation efficiency. Furthermore, the results suggest that customers increasingly value environmentally responsible delivery practices, which positively influence their perception of service quality and overall satisfaction. Sustainable practices such as recyclable packaging and transparent environmental commitments strengthen customer trust and brand loyalty in the competitive e-commerce marketplace.

The study concludes that green supply chain management not only supports environmental sustainability but also provides strategic benefits in terms of operational efficiency and customer relationship management. Integrating sustainability into supply chain operations can therefore serve as an effective approach for achieving both economic and environmental performance in the rapidly evolving e-commerce industry.

**Keywords:** Green Supply Chain Management, Sustainable Logistics, Cost Efficiency, Customer Satisfaction, E-commerce Operations

## I.INTRODUCTION

Over the past decade, the rapid expansion of electronic commerce has fundamentally reshaped global retail and logistics systems. Digital platforms now connect millions of consumers and sellers across geographical boundaries, creating highly dynamic and data-driven supply networks. Companies such as Amazon, Flipkart, and Alibaba operate complex logistics infrastructures designed to deliver products faster and more efficiently than traditional retail systems ever could. Yet this growth has also generated a new set of challenges. The surge in online transactions has led to increased packaging waste, higher transportation emissions, and rising energy consumption in warehouses and fulfillment centers. As the scale of e-commerce expands, so does the environmental footprint associated with last-mile delivery, reverse logistics, and inventory management. In response to these concerns, firms have begun integrating environmental considerations into supply chain decision-making, giving rise to the concept of Green Supply Chain Management (GSCM), a framework that incorporates sustainability principles into

procurement, manufacturing, distribution, and product lifecycle management (Srivastava, 2007; Sarkis, Zhu, & Lai, 2011).

The appeal of green supply chain practices lies not only in their environmental benefits but also in their potential economic and relational value. Sustainable logistics initiatives, such as eco-friendly packaging, energy-efficient warehousing, electric delivery fleets, and optimized transportation routes, can reduce operational waste and improve resource utilization. These changes often translate into measurable cost savings over time. At the same time, consumer expectations are shifting. Online shoppers increasingly pay attention to the environmental behavior of the companies they buy from, rewarding brands that demonstrate responsibility and transparency in their operations. A delivery box made from recyclable materials or a carbon-neutral shipping option may appear minor at first glance, yet these signals shape how customers perceive the brand behind the transaction. In other words, sustainability practices can influence both operational efficiency and customer satisfaction, two outcomes that traditionally sit at the core of supply chain performance.

Ideally, a modern e-commerce supply chain would achieve a balance between efficiency, environmental stewardship, and customer experience. Firms would minimize resource consumption, maintain competitive operating costs, and simultaneously deliver high levels of service quality. In practice, however, this balance remains difficult to achieve. Many organizations still view sustainability initiatives as costly investments that may slow operational processes or increase logistics expenses in the short term. At the same time, fragmented logistics infrastructures, particularly in emerging markets, complicate the implementation of environmentally responsible practices. As a result, companies often face a dilemma: whether adopting green supply chain strategies truly enhances operational efficiency and customer value, or whether it simply introduces additional complexity into already demanding logistics systems.

This tension has generated growing academic interest in the relationship between GSCM practices and organizational performance. Earlier research has examined the environmental and operational implications of green supply chains in various

industrial contexts. For instance, Yu, Chavez, Feng, and Wiengarten (2018) found that customer pressure and cost drivers are key motivators for adopting sustainable supply chain practices, particularly within manufacturing sectors. Similarly, Li et al. (2023) demonstrated that green procurement and environmentally responsible logistics can improve firm performance through enhanced operational efficiency. Other scholars have explored sustainability in digital commerce environments. Prasertwit, Kanchanasuntorn, and Vongmanee (2023) used a life-cycle assessment approach to show that reducing packaging materials and optimizing delivery routes significantly lowers carbon emissions in e-commerce logistics. Research focusing on customer perception also suggests that sustainable practices can strengthen brand trust and loyalty. Kumar and Dokhoria (2023) argued that environmentally responsible supply chains contribute positively to customer satisfaction by aligning corporate behavior with consumer values.

Despite these contributions, several unresolved questions remain. Much of the existing literature concentrates either on environmental outcomes or financial performance, rarely examining both simultaneously. In addition, a substantial portion of empirical studies have focused on manufacturing industries rather than the logistics-intensive environment of e-commerce, where packaging waste, last-mile delivery, and high product return rates create unique sustainability challenges. Furthermore, while some research has acknowledged the role of customer perception, the connection between green logistics initiatives and customer satisfaction in digital retail contexts remains underexplored. This gap becomes particularly visible in emerging markets such as India, where e-commerce growth has been extraordinarily rapid, but supply chain systems are still evolving. In such contexts, understanding whether sustainable logistics practices can simultaneously reduce operational costs and enhance customer satisfaction is both a theoretical and managerial necessity.

The consequences of this knowledge gap extend beyond academic debate. If companies underestimate the economic potential of green supply chains, they may hesitate to adopt sustainability initiatives that could ultimately improve efficiency and competitive advantage. Conversely, if firms implement

environmental strategies without understanding their operational implications, they risk increasing costs or disrupting service quality. For policymakers, the issue carries broader implications. Governments promoting sustainable logistics policies, such as carbon reduction targets or extended producer responsibility regulations, must ensure that environmental objectives align with business realities and consumer expectations. Without empirical evidence linking sustainability to operational and customer outcomes, both corporate strategy and public policy remain guided largely by assumptions rather than systematic analysis.

Against this background, the present study investigates the role of green supply chain practices in reducing operational costs and enhancing customer satisfaction in the e-commerce sector. The research builds on the conceptual foundations of sustainable supply chain management and service quality theory. From a theoretical perspective, the study draws on the resource-based view (RBV) and stakeholder theory, which suggest that firms can achieve competitive advantage by developing capabilities that respond simultaneously to efficiency requirements and stakeholder expectations (Barney, 1991; Freeman, 1984). Within this framework, green supply chain practices are considered strategic resources that may generate both cost efficiencies and reputational value. By examining the operational and perceptual outcomes of these practices within an e-commerce context, the study seeks to provide a more integrated understanding of how sustainability influences supply chain performance.

#### Objectives of the study

1. To examine the extent to which green supply chain management practices are adopted within the e-commerce logistics sector.
2. To analyze the impact of green supply chain practices on operational cost reduction in e-commerce companies.
3. To evaluate the influence of green supply chain practices on customer satisfaction in the e-commerce industry.

Through these objectives, the research aims to test whether sustainable logistics initiatives create

measurable benefits in both operational efficiency and customer perception.

From an academic standpoint, the study contributes to the literature by integrating environmental sustainability, supply chain performance, and customer satisfaction within a single analytical framework. For practitioners, the findings offer insights into how sustainability initiatives can be strategically implemented without compromising service efficiency. Policymakers may also benefit from a clearer understanding of how environmental regulations and green logistics programs affect both business performance and consumer behavior in rapidly growing digital markets.

#### Road map

This study first establishes the importance of sustainable supply chain practices within the rapidly expanding e-commerce ecosystem. It then identifies a critical gap in existing research: the limited empirical examination of how green logistics simultaneously affects cost efficiency and customer satisfaction, particularly in emerging e-commerce markets. To address this gap, the present study investigates the relationship between green supply chain practices, operational cost reduction, and customer satisfaction using empirical data from e-commerce users and stakeholders. The remainder of the paper is organized as follows. The next section reviews relevant literature on green supply chain management and its performance implications. This is followed by the research methodology and data analysis. The findings are then discussed in relation to existing theoretical and practical insights, and the paper concludes with implications, limitations, and directions for future research.

## II.LITERATURE REVIEW

Online retail's explosive growth has made its logistics both a boon and a burden. While e-commerce platforms shorten supply chains, cutting out intermediaries and compressing inventory needs, they also generate vast packaging waste, higher delivery emissions, and energy-intensive warehousing (Prasertwit et al., 2024). In response, many firms have begun integrating GSCM, embedding environmental measures into procurement, packaging, and distribution (Srivastava, 2007; Sarkis et al., 2011). The

promise of GSCM is twofold. On one hand, sustainable practices (like electric delivery fleets, recyclable packaging, and optimized routing) can *reduce waste and energy use*, implying cost savings over time. On the other, as consumer environmental awareness grows, “green” logistics can bolster a brand’s image and meet customer expectations (Yu et al., 2018; Jalil et al., 2024). In theory, then, e-commerce firms could achieve a win-win: lower operational costs *and* higher customer satisfaction.

However, reality is mixed. Adoption of GSCM in e-commerce logistics remains uneven, especially in emerging markets. Studies in developing economies show that regulatory pressure, customer demand, and supplier performance are the main drivers for firms to go green[1]. Yet a recent review of B2C e-commerce noted that while companies see value in green procurement, eco-packaging, and clean operations, they face serious financial, organizational and technological barriers[2]. For example, Ranga Bhatta et al. (2024) observe that despite the environmental benefits of practices like recyclable packaging and warehouse energy efficiency, many e-tailers lack the capital or infrastructure to implement them comprehensively[2]. Likewise, industry reports suggest only a fraction of online sellers have formal sustainability roadmaps. In short, although green logistics is increasingly seen as a priority, actual adoption lags behind intent. Consumer surveys indicate rising interest in sustainability, and some e-commerce leaders (e.g. Alibaba, JD.com) are piloting green initiatives. But most companies are still at the pilot or incremental stage, investing piecemeal rather than transforming their supply chains entirely. This matches broader findings from GSCM literature that adoption is strongest in sectors where regulations or consumer pressure are highest[1], and weakest where short-term cost concerns dominate. In the e-commerce context, where delivery speed and price competition are intense, the transition to green logistics can seem risky.

**GSCM and Cost Reduction.** A core argument for sustainability is that it can *cut costs*. Cleaner processes often mean less waste and greater efficiency. Empirical and case studies illustrate this potential. Minashkina and Happonen (2024) note that e-commerce’s direct-sales model itself reduces supply-

chain complexity: fewer intermediaries, shorter lead-times, and leaner inventories all lower costs, even before “green” measures are added[3]. Adding sustainable practices can amplify these gains. For instance, Prasertwit et al. (2024) use a life-cycle model of e-commerce operations and show that trimming delivery distances and cutting out unnecessary packaging reduced emissions by about 3% per order, which translated into concrete cost savings. In their Thai case study, eliminating disposable plastic bags, sleeves, and redundant print materials saved the company 18 million Thai Baht in one year[4][5]. These savings came from both avoided material costs and carbon credits. Similarly, other researchers find that investment in green warehousing (like LED lighting, smart HVAC, and automation) can cut energy bills substantially. In short, where supply chains are digital and data-rich, analytics-driven optimizations (a green strategy in themselves) tend to lower operating expenses.

Several reviews echo this: “Organizations may benefit from reduced operational costs through increased energy efficiency [and] waste reduction” under GSCM (Khanra et al., 2022). Even if initial capital outlays rise, phased upgrades and process optimizations often pay off within a few years[5][4]. It is important, however, to note limitations: most cost studies focus on manufacturing or broad logistics settings, not exclusively e-commerce. Still, the pattern is clear that green practices, eco-packaging, route optimization, renewable energy, tend to align with lean operations. They reduce rework, returns, and fines for non-compliance, all of which cut costs. What is less clear is *how consistently* these cost benefits emerge in real-world e-commerce firms. For example, Prasertwit et al. achieved significant savings, but others caution that small retailers may not see payoffs until volumes scale up. Moreover, sometimes green investments can increase short-term expenses (new vehicles, retraining staff) before long-term gains. Thus, the literature suggests a conditional benefit: cost reduction is likely but depends on firm scale, region (energy prices, regulations), and the maturity of the green initiatives.

**GSCM and Customer Satisfaction.** Another hypothesized benefit is enhanced customer satisfaction and loyalty. Environmentally conscious consumers are believed to reward brands that “walk

the talk.” Several studies indirectly support this. Jalil et al. (2024) develop an integrated model linking e-commerce platform trust, green practices, and online shopping satisfaction. They find that GSCM practices significantly drive online shopping satisfaction, mediating the effect of consumer trust[6]. In other words, customers who trust an e-retailer’s platform are more likely to perceive its green supply chain as part of a superior shopping experience. Likewise, Arab researchers found that Jordanian industrial buyers reported higher satisfaction when suppliers implemented sustainable logistics (waste reduction, eco-labels, etc.)[7]. These empirical findings align with marketing theory: transparency about green initiatives, or visible eco-actions (like a “carbon neutral shipping” option), can strengthen customer commitment (Shareef, 2019; Charalampidis et al., 2023).

Yet the picture is not unanimous. Soykoth et al. (2022) examined perceptions of both customers and employees in a retail context. They report no direct effect of GSCM on customer satisfaction. Instead, green practices influenced satisfaction *indirectly* by improving product quality, service quality, and perceived cost fairness[8]. In their view, simply being “green” wasn’t enough to make customers happier unless it translated into higher quality or lower cost. Similarly, some studies note that uncritical environmental claims can backfire if customers perceive a trade-off with speed or price (the so-called “green gap” issue). Thus, while customers may appreciate sustainable packaging or the brand image it conveys, they primarily reward improvements in traditional service dimensions.

In summary, the literature identifies two ways GSCM could affect satisfaction: directly (through eco-image and trust-building) and indirectly (through operational improvements). Some research emphasizes the direct value of green credentials (Jalil et al., 2024; Mohammad et al., 2025), whereas others suggest a mediating chain (Soykoth et al., 2022). There is broad agreement that *perceived* environmental responsibility contributes to customer trust and loyalty (e.g. Malekian et al., 2023), but empirical results vary by context. Notably, most studies on satisfaction are outside pure e-commerce: retail settings in Asia or interviews with manufacturers, for example. Few have

explicitly tested these links for online shopping or last-mile logistics, leaving a gap in our understanding.

Patterns, Contradictions, and Gaps. Bringing these threads together, we see that research on GSCM suggests multiple performance payoffs, but with caveats. On the cost side, virtually all analyses indicate potential efficiency gains from green logistics, fewer delays, less waste, optimized routes, leading to *some* level of savings[3][4]. On the satisfaction side, evidence tilts positive: sustainable supply chains generally raise perceived value and satisfaction[6][7], especially where consumers are environmentally sensitive. Yet the strength of these effects depends on industry, region, and implementation depth. The inconsistencies are most apparent in *consumer-facing contexts*. For example, Soykoth’s retail study (Bangladesh) and Jalil’s e-commerce model (China) both highlight mediators (quality, trust) rather than a straight green-satisfaction link. By contrast, Mohammad’s survey of Jordanian clients found a straightforward positive association.

Crucially, few studies have examined both cost and satisfaction outcomes together in one framework. Most papers focus on environmental impact or operational metrics alone. Exceptions like Prasertwit et al. (2024) demonstrate cost and carbon benefits, while others like Jalil (2024) show linkages to satisfaction, but integrated analyses are scarce. Moreover, much of the existing literature is either theoretical (e.g. models of green sourcing) or tied to traditional manufacturing/supply contexts. The e-commerce setting, with its unique challenges (rapid growth, high returns, fragmented logistics) is underrepresented. For instance, few studies empirically explore whether Indian or Southeast Asian e-tailers that adopt green packaging or vehicles actually see measurable cost declines and happier customers.

In effect, the literature on GSCM in e-commerce is still in its early stages. It establishes the importance of the topic (territory) by linking sustainability to performance and customer trends[1][9], but it fails to fully occupy the niche of our specific research questions. There is a clear niche: We know green practices have individual benefits, but we lack a holistic view of *how those practices jointly affect costs and customers in e-commerce*. This gap is amplified in

emerging markets, where data are sparse, yet the e-commerce boom is most dramatic.

**Conclusion and Research Direction.** In light of this review, our study will aim to fill the identified gap by empirically examining the *simultaneous* effects of GSCM practices on operational cost reduction and customer satisfaction within the e-commerce logistics sector. We will build on stakeholder, and resource-based theories to test whether adopting green logistics (our key independent variable) indeed yields the dual outcomes suggested by earlier work (our objectives). Academically, this connects two often-separate literatures (sustainability management and service quality in e-commerce). Practically, it informs managers and policymakers whether investing in eco-friendly supply chains can serve efficiency and marketing goals at the same time. Our approach extends the literature by focusing on a fast-growing, under-studied context and by linking both cost and customer metrics. The next sections detail our empirical methods and findings, which together aim to “occupy the niche” outlined above, confirming if and how green supply chain practices drive cost savings and customer satisfaction in e-commerce.

### III.METHODOLOGY

This study employed a quantitative, survey-based research design to examine the role of Green Supply Chain Management (GSCM) practices in reducing operational costs and enhancing customer satisfaction in the e-commerce sector. The research design was selected to systematically investigate the relationships between green logistics practices, cost efficiency, and customer perceptions using measurable data. Quantitative survey designs are widely recommended in supply chain and operations management research when the aim is to capture perceptions, behaviors, and patterns across a relatively large group of respondents and to test relationships between variables through statistical analysis.

The research was conducted within the context of the Indian e-commerce and logistics environment, where sustainability initiatives such as eco-friendly packaging, route optimization, and energy-efficient delivery systems are increasingly being implemented by major companies including Amazon India and Flipkart. The study was carried out over a period of

approximately two months during the academic year 2025-2026 as part of the MBA comprehensive research project. This time frame allowed sufficient duration for questionnaire development, pilot testing, distribution, and data collection. The survey-based design was particularly suitable because it enabled the researcher to gather standardized responses from individuals who interact with e-commerce logistics systems either as customers or professionals. In line with methodological guidelines for quantitative social research, the design allowed objective measurement of perceptions regarding green practices and their potential influence on cost reduction and customer satisfaction outcomes.

Ethical considerations were addressed throughout the research process to ensure compliance with accepted academic research standards. Ethical approval for the study was obtained from the Faculty of Management Studies at Parul University, which oversees postgraduate research projects conducted within the MBA program. Participation in the survey was entirely voluntary. All respondents were provided with a brief explanation of the research purpose prior to completing the questionnaire, and they were informed that their responses would be used solely for academic purposes. Informed consent was obtained digitally through the online survey platform before participants proceeded to answer the questions. The anonymity and confidentiality of respondents were maintained, and no personally identifiable information was collected. These measures ensured that the research adhered to standard ethical principles of voluntary participation, confidentiality, and responsible data usage.

The study population consisted of individuals who interact with or are familiar with e-commerce and logistics services, including online consumers, logistics professionals, business employees involved in supply chain operations, and students with knowledge of logistics or sustainability practices. This broad population was selected because the research sought to capture perceptions about green supply chain practices from both users and individuals who may have operational awareness of logistics activities. Such diversity helped provide a more comprehensive understanding of how sustainable practices influence cost efficiency and customer satisfaction in the e-commerce sector.

Due to practical limitations related to time and accessibility, the study adopted a non-probability convenience sampling technique. Convenience sampling allowed the researcher to collect responses from participants who were readily available and willing to participate in the online survey. Although this method does not guarantee full representativeness of the entire population, it is commonly used in exploratory and descriptive research where the objective is to identify trends and relationships between variables rather than to generalize findings to an entire national population. Respondents were selected based on their familiarity with online shopping platforms or supply chain operations, ensuring that participants possessed at least a basic understanding of the subject under investigation.

The sampling frame consisted of individuals reachable through academic networks, professional contacts, and online platforms. Approximately 180 questionnaires were distributed, and 104 valid responses were received and included in the final analysis. The respondents represented a mixture of demographic groups, including students, working professionals, and regular online shoppers between the ages of 18 and 45. This diversity helped capture varying perspectives on sustainability practices within e-commerce logistics operations.

The primary data collection instrument used in this study was a structured questionnaire designed using Google Forms, which enabled efficient online distribution and automatic recording of responses. The questionnaire was developed based on constructs identified in the literature review related to green supply chain practices, cost efficiency, and customer satisfaction. It contained approximately twenty questions organized into several thematic sections. The first section collected demographic information such as age, gender, and frequency of online shopping. The second section focused on respondents' awareness of green supply chain initiatives, including eco-friendly packaging and sustainable delivery practices. The third section assessed perceptions regarding the impact of green logistics practices on operational cost reduction, while the fourth section examined how these practices influence customer satisfaction and trust toward e-commerce companies. The final section included open-ended or opinion-based questions that

allowed respondents to suggest additional sustainability measures that e-commerce firms could adopt.

Most of the questionnaire items were measured using a five-point Likert scale, ranging from "Strongly Agree" to "Strongly Disagree." This scale was selected because it allows respondents to express varying levels of agreement and provides quantitative data suitable for statistical analysis. Prior to full deployment, the questionnaire underwent a pilot test with a small group of respondents to ensure clarity and relevance of the questions. Feedback from this pilot stage helped refine wording, eliminate ambiguity, and improve the logical sequence of items.

The study procedure followed a systematic chronological process. First, an extensive literature review was conducted to identify key dimensions of Green Supply Chain Management relevant to the e-commerce industry. Based on this review, research objectives and hypotheses were formulated to examine the relationship between green practices, cost reduction, and customer satisfaction. Next, the survey instrument was designed and pretested through the pilot study. After final revisions, the questionnaire was distributed electronically through Google Forms using social media platforms, academic networks, and professional contacts in logistics and e-commerce sectors.

Participants accessed the survey through a shared link and completed the questionnaire at their convenience. Responses were automatically recorded in a digital spreadsheet format, which facilitated organization and preliminary screening of the data. After the data collection period concluded, incomplete responses were removed and the remaining valid responses were prepared for analysis. The data were then analyzed using basic statistical techniques such as percentages, frequency distributions, and correlation analysis to examine patterns and relationships among the variables. These analytical methods allowed the study to assess whether the adoption of green supply chain practices is associated with perceived operational cost reduction and improved customer satisfaction in the e-commerce sector.

Through this structured methodological approach, the study ensured that the collected data were reliable,

ethically obtained, and directly aligned with the research objectives concerning sustainability, operational efficiency, and customer experience in modern e-commerce supply chains.

#### IV.RESULTS

This section presents the empirical findings obtained from the regression analysis conducted using Microsoft Excel. The analysis aimed to examine whether green supply chain practices, represented by green logistics initiatives, significantly influence operational cost reduction and customer satisfaction in the e-commerce sector. Two hypotheses were tested using simple linear regression with 104 valid observations collected through the survey questionnaire. The independent variable in both models was respondents' perception of green logistics practices, while the dependent variables represented perceptions of operational cost reduction and customer satisfaction, respectively.

Adoption of green supply chain practices in the e-commerce logistics sector

The first objective of the study was to examine the adoption and perception of green supply chain practices within the e-commerce logistics environment. The independent variable used in the regression models captured respondents' agreement with the statement that green logistics practices, such as electric delivery vehicles and paperless billing, help protect the environment. The responses to this item provide an indication of the perceived relevance and acceptance of sustainable logistics initiatives within the broader e-commerce ecosystem.

The relatively strong correlation observed between the independent variable and the dependent variables in the subsequent regression models suggests that respondents widely recognize the potential value of green logistics practices. In particular, the regression analysis indicates that perceptions of environmentally responsible logistics are not merely symbolic; rather, they appear to influence both operational performance expectations and consumer preferences. This finding highlights the increasing visibility of sustainability practices within e-commerce supply chains and suggests that customers are aware of and responsive to such initiatives.

From a managerial perspective, this result implies that the adoption of green supply chain practices is becoming a strategic expectation rather than a peripheral activity. As e-commerce companies continue to expand their logistics networks, sustainable transportation and packaging solutions may play a crucial role in shaping both operational efficiency and customer perceptions of corporate responsibility.

Impact of green supply chain practices on operational cost reduction

The second objective of the study was to analyze whether green supply chain practices contribute to operational cost reduction in the e-commerce sector. Hypothesis 1 tested the relationship between perceptions of green logistics practices (independent variable) and respondents' belief that adopting green practices can reduce a company's long-term operational costs (dependent variable).

The regression analysis indicates a moderately strong relationship between the variables, with a Multiple R value of 0.594 and an  $R^2$  value of 0.353. This suggests that approximately 35.3% of the variation in perceived operational cost reduction can be explained by green logistics practices. The adjusted  $R^2$  value of 0.346 further confirms the explanatory power of the model, indicating a meaningful association between the variables.

The ANOVA results show that the regression model is statistically significant ( $F = 55.64$ ,  $p < 0.001$ ), demonstrating that the model provides a significantly better prediction than a model with no predictors. This statistical significance supports the validity of the relationship between green logistics practices and perceived cost reduction.

The regression coefficient for the independent variable is  $\beta = 0.599$  ( $p < 0.001$ ), indicating a positive and statistically significant relationship. This means that an increase in respondents' perception of green logistics practices is associated with a corresponding increase in the belief that such practices contribute to cost reduction. The positive coefficient implies that sustainable logistics initiatives, such as energy-efficient transportation systems, reduced paper usage, and optimized delivery routes, may improve resource efficiency and reduce long-term operational expenses.

These findings support Hypothesis 1, suggesting that green supply chain practices are perceived as economically beneficial within the e-commerce sector. This result aligns with sustainability literature that argues environmental initiatives often generate cost savings through improved resource utilization, waste reduction, and operational efficiency.

From a managerial standpoint, these findings challenge the common perception that environmental sustainability necessarily increases operational costs. Instead, the results suggest that green logistics initiatives can function as a strategic cost management tool, particularly in industries such as e-commerce where transportation and packaging represent significant operational expenditures.

Influence of green supply chain practices on customer satisfaction

The third objective of the study was to evaluate whether green supply chain practices influence customer satisfaction and purchasing preferences in the e-commerce industry. Hypothesis 2 tested the relationship between perceptions of green logistics practices and respondents' preference to purchase from companies that use eco-friendly and sustainable packaging.

The regression analysis indicates a moderate positive relationship between the variables, with a Multiple R value of 0.393. The  $R^2$  value of 0.154 suggests that approximately 15.4% of the variation in customer satisfaction and purchase preference can be explained by green logistics practices. Although the explanatory power of this model is lower than that of the cost reduction model, the results still demonstrate a meaningful relationship between sustainability practices and consumer attitudes.

The ANOVA results confirm that the model is statistically significant ( $F = 18.61$ ,  $p < 0.001$ ), indicating that green logistics practices significantly predict customer satisfaction and purchasing preference. The regression coefficient for the independent variable is  $\beta = 0.363$  ( $p < 0.001$ ), showing a positive and statistically significant effect. This means that stronger perceptions of environmentally responsible logistics practices are associated with higher levels of customer preference for companies adopting sustainable packaging and delivery solutions.

These findings provide empirical support for Hypothesis 2, indicating that green supply chain initiatives influence consumer behavior within the e-commerce sector. In practical terms, customers appear more inclined to support companies that demonstrate environmental responsibility in their logistics operations.

This result highlights the growing importance of sustainability as a competitive differentiator in digital retail markets. As environmental awareness increases among consumers, eco-friendly logistics practices may contribute not only to corporate reputation but also to customer loyalty and brand trust.

Summary of findings

Overall, the regression analysis demonstrates that green supply chain practices play a significant role in shaping both operational and customer-related outcomes in the e-commerce sector. The results indicate that sustainable logistics initiatives are positively associated with perceptions of operational cost reduction and customer satisfaction. However, the strength of these relationships varies. Green practices appear to have a stronger association with cost efficiency than with customer satisfaction, suggesting that operational benefits may be more immediately observable than consumer behavioral changes.

Taken together, these findings suggest that green supply chain management is not only an environmental strategy but also an operational and marketing tool that can support long-term competitiveness in the e-commerce industry.

## V.DISCUSSION

This study examined the influence of green supply chain practices, specifically green logistics initiatives, on operational cost reduction and customer satisfaction within the e-commerce sector. The regression analysis demonstrated that green logistics practices have a statistically significant and positive relationship with both perceived operational cost reduction and customer satisfaction, although the strength of the relationship differs between the two outcomes. In particular, the results indicate a stronger explanatory power for operational cost reduction than for customer satisfaction. These findings contribute to the growing body of research on sustainable supply

chain management and provide empirical evidence regarding the operational and market implications of environmental practices in e-commerce logistics.

The finding that green logistics practices are positively associated with operational cost reduction is consistent with much of the existing literature on sustainable supply chain management. Previous studies have argued that environmental initiatives often improve operational efficiency by reducing resource consumption, waste, and energy usage. For example, research on green logistics and environmental management has highlighted that practices such as optimized delivery routes, fuel-efficient transportation, and digital documentation can significantly reduce operational expenses over time. Studies by scholars such as Sarkis, Zhu, and Lai have also emphasized that environmentally responsible supply chain practices can generate both ecological and economic benefits, supporting the concept of the “win-win” relationship between sustainability and operational performance. The present study reinforces this perspective by demonstrating that respondents perceive green logistics practices as a viable mechanism for reducing long-term costs within e-commerce operations.

From a theoretical standpoint, these findings can be interpreted through the lens of the natural resource-based view (NRBV) of the firm. NRBV suggests that firms can develop competitive advantage by integrating environmental considerations into their core operations and capabilities. According to this theory, organizations that adopt environmentally sustainable practices are able to achieve greater efficiency and innovation, which can ultimately translate into improved performance outcomes. The strong positive relationship observed between green logistics practices and operational cost reduction in this study provides empirical support for this theoretical argument. By reducing waste, improving energy efficiency, and optimizing logistics operations, companies may enhance both environmental sustainability and economic performance simultaneously.

However, while the positive relationship between green supply chain practices and operational efficiency aligns with previous research, the findings related to customer satisfaction reveal a more

moderate effect. Although green logistics practices significantly influence customer preferences for eco-friendly companies, the explanatory power of the model is relatively lower compared to the cost reduction model. This suggests that while environmental practices do influence consumer perceptions, they may not be the primary factor driving customer satisfaction in the e-commerce sector. Previous studies on sustainable consumption have similarly found that environmental responsibility influences customer attitudes, but its impact on purchasing decisions often interacts with other factors such as price, product quality, and delivery speed. For instance, research on green marketing and consumer behavior indicates that although consumers express positive attitudes toward environmentally responsible companies, their actual purchasing behavior may still be heavily influenced by convenience and cost considerations.

The moderate strength of the relationship observed in this study may reflect the complexity of consumer decision-making in e-commerce environments. Customers may appreciate sustainable packaging and eco-friendly delivery methods, but they may prioritize other service attributes such as fast delivery, product availability, and competitive pricing. This interpretation aligns with studies suggesting that the “attitude-behavior gap” often exists in sustainable consumption, where consumers support environmental initiatives in principle but may not consistently translate these attitudes into purchasing behavior. Consequently, while green logistics practices contribute positively to brand perception and customer trust, their direct impact on customer satisfaction may remain limited unless they are integrated with broader service quality improvements.

Despite this moderate effect, the study provides important insights into the growing relevance of sustainability as a strategic factor in e-commerce. Increasing environmental awareness among consumers has prompted many companies to incorporate eco-friendly packaging, carbon-neutral shipping, and energy-efficient logistics systems into their operations. The positive association identified in this study supports the argument that sustainability initiatives can enhance a company’s reputation and appeal to environmentally conscious customers. In this

sense, green logistics practices may function as a complementary factor that strengthens customer loyalty when combined with high-quality service delivery.

The findings of this study also have several implications for theory, policy, and managerial practice. From a theoretical perspective, the results contribute to the literature on green supply chain management by demonstrating that environmental logistics practices influence both internal operational outcomes and external market perceptions. This dual impact supports integrative frameworks that link environmental management with both operational performance and stakeholder value creation. Additionally, the findings highlight the need for future theoretical models to consider the differing strengths of these relationships, particularly the stronger operational benefits relative to customer-driven outcomes.

From a policy perspective, the results suggest that encouraging the adoption of green logistics practices in the e-commerce sector could generate broader economic and environmental benefits. Policymakers seeking to promote sustainable development may consider supporting initiatives such as incentives for electric delivery vehicles, digital documentation systems, and environmentally friendly packaging solutions. Such measures could help reduce carbon emissions and resource consumption while also improving the efficiency of logistics networks.

For practitioners in the e-commerce industry, the findings emphasize that sustainability initiatives should not be viewed solely as regulatory obligations or marketing strategies. Instead, green logistics practices may serve as a strategic investment that enhances operational efficiency while simultaneously improving corporate reputation. Companies that integrate sustainability into their logistics systems, through route optimization, energy-efficient transportation, and reduced packaging waste, may achieve long-term cost savings while appealing to environmentally conscious consumers.

Despite these contributions, several limitations should be acknowledged. First, the study relies on perceptual data collected through survey responses, which reflect respondents' perceptions rather than objective

performance measures. As a result, the findings may capture attitudes toward green logistics practices rather than their actual operational impact. Future studies could strengthen empirical evidence by incorporating objective data such as logistics costs, carbon emissions, or customer retention rates.

Second, the study uses a relatively limited number of variables to represent complex constructs such as operational cost reduction and customer satisfaction. In reality, these outcomes are influenced by multiple factors, including technological capabilities, supply chain integration, service quality, and competitive pricing strategies. The inclusion of additional variables in future models could provide a more comprehensive understanding of how green supply chain practices influence organizational performance.

Third, the study is based on a sample of respondents within a specific context, which may limit the generalizability of the findings. The perceptions and expectations of consumers may vary across different regions, cultures, and levels of environmental awareness. Future research could expand the scope of research by examining cross-country comparisons or by analyzing specific segments of the e-commerce market.

Another limitation relates to the cross-sectional nature of the data. Because the study captures responses at a single point in time, it cannot fully account for changes in consumer attitudes or operational practices over time. Longitudinal studies would allow researchers to examine how the adoption of green logistics practices influences operational performance and customer perceptions in the long term.

Based on these limitations and the findings of the study, several directions for future research can be proposed. First, future studies should explore additional dimensions of green supply chain management, such as sustainable packaging design, reverse logistics systems, and carbon-neutral delivery models. Second, researchers could investigate the moderate role of factors such as environmental awareness, brand reputation, or service quality in shaping the relationship between green logistics practices and customer satisfaction. Third, future research could employ mixed method approaches that combine quantitative analysis with qualitative insights

from logistics managers and industry experts to better understand the practical challenges of implementing green logistics initiatives.

In summary, this study provides empirical evidence that green supply chain practices contribute positively to both operational cost reduction and customer satisfaction within the e-commerce sector. While the operational benefits appear particularly strong, the influence on customer attitudes is more moderate, reflecting the complex nature of consumer decision-making. By highlighting these relationships, the study contributes to the growing discourse on sustainable supply chain management and underscores the importance of integrating environmental considerations into modern logistics systems.

## VI. CONCLUSION

This study sets out to examine the role of green supply chain practices in reducing operational costs and enhancing customer satisfaction within the e-commerce sector. Specifically, the research aimed to investigate whether the adoption of environmentally responsible logistics practices, such as eco-friendly delivery systems, sustainable packaging, and paperless processes, can contribute to operational efficiency while simultaneously improving customer perceptions and preferences. By employing regression analysis on survey data collected from 104 respondents, the study sought to provide empirical insight into the operational and market outcomes associated with green logistics practices in the rapidly expanding e-commerce environment.

The findings of the study indicate that green supply chain practices have a significant and positive impact on both operational cost reduction and customer satisfaction. The results demonstrate a moderately strong relationship between green logistics initiatives and perceptions of operational cost efficiency, suggesting that environmentally sustainable practices may contribute to long-term cost savings through improved resource utilization, energy efficiency, and waste reduction. In contrast, while the relationship between green supply chain practices and customer satisfaction was also positive and statistically significant, the strength of this relationship was comparatively moderate. This suggests that although

environmentally responsible practices positively influence consumer attitudes toward e-commerce companies, other service-related factors, such as price competitiveness, product availability, and delivery speed, continue to play a central role in shaping customer satisfaction.

These findings carry important implications for both theory and practice. From a theoretical perspective, the study contributes to the growing body of literature on sustainable supply chain management by providing empirical evidence that green logistics practices generate both internal operational benefits and external customer-related outcomes. The results support theoretical perspectives such as the natural resource-based view, which argues that environmentally sustainable practices can enhance organizational performance by improving operational capabilities and efficiency. By demonstrating the dual impact of green supply chain practices on cost management and customer perception, the study reinforces the idea that environmental sustainability can serve as a strategic capability within modern supply chains.

From a managerial standpoint, the findings highlight the strategic value of integrating sustainability into logistics and supply chain operations within the e-commerce sector. Organizations that invest in green logistics initiatives, such as energy-efficient transportation systems, optimized delivery routes, and eco-friendly packaging, may achieve operational efficiencies while strengthening their brand image among environmentally conscious consumers. As sustainability becomes an increasingly important expectation among stakeholders, companies that proactively adopt green supply chain practices may gain competitive advantages through improved operational performance and enhanced customer trust.

The study also has implications for policy and organizational decision-making. Policymakers and industry regulators aiming to promote sustainable development may encourage the adoption of green logistics practices through incentives, regulatory frameworks, and environmental standards. Such initiatives could support the broader transition toward environmentally responsible supply chain systems

while enabling e-commerce firms to operate more efficiently and sustainably.

Despite these contributions, the study is not without limitations. First, the analysis relies on perceptual data collected through survey responses, which may not fully capture the actual operational impact of green supply chain practices. Second, the study focuses on a limited set of variables and a relatively small sample size, which may constrain the generalizability of the findings. Additionally, the cross-sectional design of the study limits the ability to observe long-term changes in operational performance and customer behavior resulting from the adoption of green logistics practices.

Future research could address these limitations by incorporating larger and more diverse samples, as well as by using longitudinal research designs to examine how the implementation of green supply chain initiatives affects organizational performance over time. Researchers may also explore additional variables, such as technological innovation, supply chain integration, and environmental awareness, to gain a more comprehensive understanding of the factors influencing the success of green logistics strategies. Furthermore, comparative studies across different countries or industries could provide deeper insights into how contextual factors shape the adoption and effectiveness of sustainable supply chain practices.

In conclusion, this study advances understanding of the role of green supply chain practices in the e-commerce sector by demonstrating their potential to simultaneously support operational efficiency and enhance customer perceptions. As the global business environment increasingly emphasizes sustainability and environmental responsibility, integrating green logistics practices into supply chain strategies will likely become a critical component of long-term competitiveness and sustainable growth in e-commerce industries.

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