

Exploring Green Logistics Adoption among Indonesian SMEs: Drivers, Barriers, and Stakeholder Perspectives

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ABSTRACT: This study examines the drivers and barriers of green logistics adoption among Indonesian SMEs, along with their adaptation strategies and the role of stakeholders in supporting implementation. Using a qualitative single-case study design in Surabaya, East Java, data were collected in March 2025 through semi-structured interviews with nine informants (SME owners, logistics practitioners, a government official, an academic, and a customer), supplemented by observation and document review, and analyzed thematically. The findings show that green logistics adoption is driven by customer demand, competitive pressure, managerial commitment, environmental awareness, operational efficiency, and government encouragement. However, SMEs still face significant barriers, including high implementation costs, limited financial resources, inadequate technical knowledge, restricted access to green suppliers, limited availability of green technologies, and organizational resistance to change. Rather than adopting comprehensive technological solutions, SMEs tend to implement gradual adaptation strategies aligned with their resource capacity. Collaboration among government agencies, logistics providers, universities, customers, and business partners proves essential in supporting knowledge transfer and sustainable logistics implementation. The study concludes that successful green logistics adoption requires integrating organizational commitment, operational efficiency, stakeholder collaboration, and supportive public policies to accelerate the transition toward more environmentally responsible logistics practices.

Keywords: Green Logistics, Small and Medium-Sized Enterprises, Sustainable Supply Chain Management, Sustainability, Stakeholder Collaboration, Indonesia, Qualitative Case Study



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INTRODUCTION

Environmental sustainability has become one of the most influential issues shaping contemporary supply chain and logistics management. The rapid growth of industrialization, globalization, and electronic commerce has significantly increased logistics activities, including transportation, warehousing, packaging, and distribution, which collectively contribute to greenhouse gas emissions, energy consumption, resource depletion, and waste generation. As governments, industries, and society become increasingly concerned about climate change and environmental

degradation, organizations are under growing pressure to integrate sustainability into their operational activities. Within this context, green logistics has emerged as an important strategic approach that seeks to minimize the environmental impacts of logistics operations while simultaneously maintaining economic performance and creating social value. Rather than focusing solely on environmental protection, green logistics represents a comprehensive management philosophy that integrates environmental, economic, and social objectives throughout logistics processes, thereby contributing to the broader concept of sustainable supply chain management (Aden et al., 2022; Agyabeng-Mensah et al., 2020; Aldakhil et al., 2018; Arroyo et al., 2023; Vrchota et al., 2020).

The concept of green logistics has evolved beyond isolated environmental initiatives into a systemic approach encompassing green transportation, environmentally friendly packaging, energy-efficient warehousing, reverse logistics, green purchasing, and resource optimization across the supply chain. These practices are designed to reduce emissions, improve resource efficiency, and enhance operational performance while creating value for multiple stakeholders, including customers, governments, business partners, and society. Consequently, green logistics is increasingly regarded as an integral component of sustainable logistics rather than a standalone environmental initiative. The literature further distinguishes green logistics from related concepts such as eco-logistics and low-carbon logistics by emphasizing its broader integration of environmental objectives within the triple-bottom-line framework that simultaneously considers environmental protection, economic performance, and social responsibility (Cezarino et al., 2016; Chepurna et al., 2025).

A substantial body of literature demonstrates that green logistics contributes positively to organizational sustainability across environmental, economic, and social dimensions. From an environmental perspective, green logistics reduces carbon emissions, minimizes waste generation, improves energy efficiency, and promotes more sustainable resource utilization throughout logistics operations. Environmentally responsible logistics practices have been associated with improved environmental performance and lower ecological footprints across various industrial sectors (Aldakhil et al., 2018; Khan et al., 2019; M. & Jeyalakshmi, 2025; Aden et al., 2022). Economically, green logistics enhances operational efficiency through optimized transportation routes, reduced fuel consumption, improved inventory management, and lower operating costs, thereby strengthening organizational competitiveness and long-term business performance (Khan, 2019). In addition, green logistics contributes to social sustainability by strengthening corporate social responsibility, enhancing organizational reputation, increasing stakeholder trust, and promoting ethical business practices that align with broader societal expectations (Arroyo et al., 2023; Aldakhil et al., 2018).

Although the benefits of green logistics are increasingly recognized, its adoption remains uneven, particularly among Small and Medium-sized Enterprises (SMEs). SMEs constitute the backbone of many national economies, including Indonesia, where they account for the overwhelming majority of business establishments and make substantial contributions to employment, regional development, and economic growth. Nevertheless, SMEs generally possess fewer financial resources, more limited technological capabilities, and less formal organizational structures than large corporations. These characteristics make the adoption of environmentally sustainable logistics practices considerably more challenging. Previous studies indicate that successful green

logistics adoption depends not only on organizational commitment but also on leadership support, financial capability, government incentives, technological readiness, and stakeholder collaboration (Naz et al., 2024; Youngswaing et al., 2024). Consequently, understanding how SMEs respond to these enabling and constraining factors has become an important area of sustainable supply chain research.

Existing studies consistently identify multiple determinants that encourage organizations to implement green logistics. Internal organizational commitment, environmental leadership, and awareness of sustainability issues motivate firms to integrate environmentally responsible practices into their logistics operations. External pressures are equally influential, particularly increasing customer demand for environmentally friendly products, stricter environmental regulations, stakeholder expectations, and market competition. Customers increasingly prefer products distributed through environmentally responsible logistics systems, encouraging firms to adopt green packaging, optimize transportation, and reduce waste generation as part of their competitive strategies. Government policies, including environmental regulations, financial incentives, training programs, and sustainability standards, also play an important role by creating institutional environments that encourage green investments. Moreover, pressure from suppliers, investors, industry associations, and society reinforces organizational commitments to sustainable logistics and strengthens the legitimacy of green logistics initiatives (Youngswaing et al., 2024; Arroyo et al., 2023; Khan et al., 2019).

Despite these encouraging drivers, SMEs in developing countries continue to encounter substantial barriers that slow the implementation of green logistics. Financial constraints remain one of the most frequently reported obstacles because environmentally friendly packaging, green technologies, and cleaner transportation systems often require investments that exceed SMEs' available resources. In addition, many SMEs experience shortages of technical knowledge, limited employee competencies, inadequate technological infrastructure, and weak collaboration with supply chain partners. Organizational resistance to change and limited managerial awareness further complicate the transition toward sustainable logistics. At the institutional level, inconsistent environmental regulations, limited access to targeted incentives, insufficient public-private collaboration, and underdeveloped logistics infrastructure create additional implementation challenges (Jayarathna et al., 2023; Saha et al., 2021). These findings suggest that green logistics adoption cannot be understood solely from an organizational perspective but should also be examined within broader institutional and stakeholder environments.

The Indonesian context presents a particularly relevant setting for investigating these issues. Indonesia has experienced rapid growth in logistics activities driven by urbanization, digital commerce, and expanding domestic markets. At the same time, Indonesian SMEs face increasing expectations from customers, governments, and business partners to improve environmental performance while maintaining competitiveness. Surabaya, one of Indonesia's largest commercial and logistics centers, provides an appropriate empirical context because it hosts a highly developed logistics ecosystem comprising seaports, industrial estates, logistics service providers, marketplaces, and thousands of SMEs operating modern distribution systems. The city's economic characteristics enable an in-depth examination of how SMEs understand green logistics, identify implementation challenges, and develop practical adaptation strategies within an emerging economy.

Although previous studies have significantly advanced knowledge regarding green logistics, several important research gaps remain. Existing literature is dominated by quantitative analyses conducted in large organizations or developed economies, whereas qualitative evidence explaining the decision-making processes, contextual barriers, and adaptation strategies of SMEs remains relatively limited. Furthermore, researchers have highlighted the need for additional empirical studies focusing on emerging economies, particularly Southeast Asia and Indonesia, where institutional environments, resource availability, and market conditions differ considerably from those in developed countries (Naz et al., 2024; Aldakhil et al., 2018). Indonesia-specific evidence is especially limited regarding how government policies interact with SME capabilities, how stakeholder collaboration facilitates implementation, and how green logistics contributes simultaneously to environmental, economic, and social performance. There is also a need for industry-specific and firm-level analyses capable of informing more effective managerial practices and public policy interventions.

Responding to these gaps, the present study investigates the drivers and barriers of green logistics adoption among Indonesian SMEs through a qualitative single-case study conducted in Surabaya. The study explores the factors motivating SMEs to adopt environmentally responsible logistics practices, examines the barriers encountered during implementation, identifies organizational adaptation strategies, and analyzes the roles of customers, government agencies, logistics providers, and academic institutions in facilitating adoption. By integrating multiple stakeholder perspectives, this research seeks to develop a context-sensitive understanding of green logistics implementation within Indonesian SMEs. The study contributes to the literature by extending qualitative evidence on green logistics adoption in emerging economies, enriching theoretical discussions concerning sustainability transitions in resource-constrained organizations, and providing practical recommendations for policymakers and SME practitioners seeking to accelerate sustainable logistics development in Indonesia.

METHOD

Research Design

This study employed a qualitative research approach using a single-case study design to investigate the adoption of green logistics among Small and Medium-sized Enterprises (SMEs) in Surabaya, Indonesia. A qualitative approach was selected because green logistics adoption is a complex and context-dependent phenomenon shaped by organizational characteristics, stakeholder interactions, institutional environments, and operational practices. Rather than examining predefined causal relationships, qualitative research enables an in-depth exploration of participants' experiences, perceptions, motivations, and decision-making processes regarding sustainable logistics implementation.

The case study strategy is particularly appropriate for examining contemporary organizational practices in real-life settings where researchers have limited control over events. Previous studies have demonstrated that qualitative case studies provide rich insights into sustainable supply chain management (SSCM) and green logistics by revealing organizational routines, governance mechanisms, inter-firm collaboration, and practical implementation challenges that are difficult to

capture using quantitative methods (Gloet & Samson, 2019; Vargas & Moreno-Mantilla, 2017). Moreover, qualitative case studies are valuable for theory building in emerging economies because they explain how contextual factors including government policies, stakeholder pressures, and organizational capabilities influence sustainability transitions within SMEs (Jaegler & Goessling, 2020; Sodhi & Tang, 2017).

Surabaya was selected as the study site because it is one of Indonesia's largest logistics and commercial centers. The city hosts major seaports, industrial estates, logistics service providers, e-commerce platforms, and a large number of SMEs operating modern distribution systems. These characteristics provide a suitable context for exploring how SMEs adopt green logistics within a rapidly evolving logistics ecosystem.

Research Setting and Participants

The study was conducted in March 2025 in Surabaya, East Java, Indonesia. Participants were selected using purposive sampling to ensure that each informant possessed direct knowledge or experience relevant to green logistics implementation. Purposive sampling is widely recommended in SSCM and green logistics research because it facilitates the selection of information-rich participants capable of providing detailed insights into organizational practices and stakeholder interactions (Adams et al., 2022; Brockhaus et al., 2013).

To obtain a comprehensive understanding of green logistics adoption, the study incorporated maximum variation sampling by involving participants representing different stakeholder groups across the logistics ecosystem. This approach enables researchers to capture diverse perspectives regarding organizational practices, policy influences, collaboration mechanisms, and customer expectations (Ayuso et al., 2013; Morali, 2021).

Nine participants were involved:

- Three SME owners representing the food, fashion, and furniture sectors.
- Three logistics practitioners comprising an operations manager, a warehouse manager, and a logistics coordinator.
- One government representative from the Department of Cooperatives and SMEs.
- One academic specializing in supply chain management.
- One customer representing market perspectives on environmentally responsible logistics.

Where appropriate, snowball sampling was applied to identify additional stakeholders who could enrich the understanding of green logistics adoption and stakeholder collaboration (Adams et al., 2022).

Data Collection

Primary data were collected through semi-structured interviews, supported by field observations and document analysis. Semi-structured interviews were selected because they provide a balance between consistency across participants and flexibility to explore emerging issues during the interview process. This interview format has been extensively employed in qualitative SSCM and green logistics studies to investigate organizational motivations, implementation barriers, operational strategies, and sustainability outcomes (Brockhaus et al., 2013; Vargas & Moreno-Mantilla, 2017).

An interview guide was developed based on the research objectives and existing literature on green logistics. The guide included questions concerning participants' understanding of green logistics, adoption drivers, implementation barriers, operational practices, stakeholder roles, perceived benefits, adaptation strategies, and future expectations. Prior to formal data collection, the interview protocol was reviewed to ensure clarity, logical flow, and alignment with the study objectives.

In addition to interviews, field observations were conducted to obtain contextual information regarding packaging practices, warehouse operations, transportation activities, and logistics processes. Documentary evidence, including government policy documents, organizational records, sustainability-related materials, and relevant reports, was also collected to complement interview findings. Combining multiple sources of evidence strengthened data triangulation and enhanced the credibility of the research (Song et al., 2018).

Data Analysis

The collected data were analyzed using thematic analysis because it provides a systematic yet flexible approach for identifying, organizing, and interpreting recurring patterns within qualitative datasets. Thematic analysis has become one of the most widely applied analytical methods in SSCM and green logistics research due to its ability to synthesize complex stakeholder perspectives into coherent conceptual themes (Dubey et al., 2017).

The analysis followed six iterative stages:

1. Data familiarization. Interview recordings were transcribed verbatim and repeatedly reviewed to gain an overall understanding of participants' experiences and viewpoints.
2. Initial coding. Meaningful text segments were assigned descriptive codes representing key ideas, actions, perceptions, or organizational practices related to green logistics adoption.
3. Theme development. Similar codes were grouped into broader categories to identify preliminary themes describing drivers, barriers, stakeholder roles, adaptation strategies, and perceived benefits.
4. Theme refinement. Emerging themes were continuously compared across participants and refined to ensure internal consistency and conceptual distinctiveness.
5. Interpretation. The final themes were interpreted by relating empirical findings to established theories and previous studies, including Resource-Based View (RBV), Natural Resource-Based View (NRBV), and Stakeholder Theory (Yan et al., 2024; Jaegler & Goessling, 2020).
6. Reporting. The findings were presented using narrative explanations supported by representative quotations, thematic matrices, and conceptual figures illustrating relationships among the identified themes.

Although qualitative data analysis software such as NVivo or MAXQDA is frequently recommended for organizing interview data (Haan-Hoek et al., 2020), the analytical procedure in this study emphasized transparent coding, systematic categorization, and careful documentation of analytical decisions throughout the research process.

Research Trustworthiness

To enhance the rigor and trustworthiness of the study, several quality assurance strategies were employed.

Credibility was strengthened through methodological triangulation by integrating interview data with field observations and documentary evidence. The inclusion of multiple stakeholder groups also reduced single-source bias and provided a more comprehensive understanding of green logistics implementation.

Dependability was maintained by documenting the interview protocol, coding procedures, analytical decisions, and theme development process. Maintaining an audit trail supports transparency and enables future researchers to understand how interpretations were generated.

Confirmability was promoted through reflexive analysis in which coding decisions were continuously reviewed to ensure that interpretations remained grounded in empirical evidence rather than researcher assumptions.

Transferability was addressed by providing detailed descriptions of the research setting, participant characteristics, and organizational context, allowing readers to evaluate the applicability of the findings to similar SME environments.

Finally, data saturation served as the primary criterion for determining sample adequacy. Interviews continued until no substantial new themes or insights emerged from subsequent participants, consistent with recommendations for qualitative SSCM and logistics research.

Ethical Considerations

Ethical principles were observed throughout the research process. All participants voluntarily agreed to participate after receiving an explanation of the study's objectives. Participants were informed that their responses would be treated confidentially and used exclusively for academic purposes. To protect anonymity, each participant was identified using an interview code (I1–I9) rather than personal identifiers. Interview transcripts and supporting documents were securely stored, and participants retained the right to withdraw from the study at any stage without consequence.

RESULT AND DISCUSSION

Overview of the Findings

The thematic analysis identified five interrelated themes that explain green logistics adoption among Small and Medium-sized Enterprises (SMEs) in Surabaya. These themes comprise: (1) internal organizational drivers, (2) external market and stakeholder drivers, (3) operational efficiency considerations, (4) barriers to implementation, and (5) institutional support and adaptation strategies. The findings indicate that green logistics adoption does not result from a single factor. Instead, it emerges through the interaction of organizational capabilities, customer expectations, operational pressures, financial limitations, and institutional conditions.

The nine informants demonstrated a broadly consistent understanding of green logistics as an effort to reduce the environmental impact of logistics activities through environmentally friendly packaging, efficient transportation, reduced material waste, reuse of logistics assets, and better resource utilization. However, the depth of this understanding varied according to professional

role. SME owners generally emphasized packaging and customer expectations, whereas logistics practitioners focused more strongly on route optimization, fuel efficiency, warehouse management, and shipment consolidation. The government representative and academic informant framed green logistics more broadly as part of sustainable business transformation and sustainable supply chain management.

Internal Organizational Drivers

Managerial Awareness and Environmental Commitment

Managerial awareness emerged as an important internal factor encouraging green logistics adoption. SME owners and operational managers increasingly recognized that logistics decisions have environmental consequences and that business sustainability requires attention to packaging, transportation, waste, and energy use. The food SME owner described green logistics as reducing environmental impacts from packaging to product delivery, while the furniture SME owner associated it with energy-efficient distribution and waste reduction.

These findings are consistent with studies emphasizing managerial commitment, organizational culture, and environmental leadership as key internal determinants of green logistics and sustainable supply chain practices (Youngswaing et al., 2024; Adams et al., 2022; Haan-Hoek et al., 2020). In SMEs, where decision-making is often centralized, owner or senior management commitment strongly influences whether environmental practices are translated into operational changes.

Environmental awareness also supported the legitimacy of green initiatives within the organization. The academic informant emphasized climate change awareness, while the government representative positioned green logistics as part of the broader transformation of SMEs toward sustainable business. These perspectives indicate that adoption is partly motivated by normative beliefs regarding responsible business behavior.

Internal Capabilities and Knowledge

Internal capabilities shaped the extent to which SMEs could translate sustainability intentions into operational practices. The operations manager emphasized the need to adjust work systems and train employees, while the warehouse manager noted that not all workers understood new procedures. These findings suggest that environmental commitment alone is insufficient without adequate technical knowledge, employee competence, and process management capabilities.

This result reflects the resource-based and natural resource-based perspectives, which argue that firms require internal resources and capabilities to convert environmental strategies into competitive and operational outcomes (Triguero et al., 2014). Knowledge management and organizational learning were particularly important because SMEs often lack formal sustainability departments or specialized environmental personnel.

The furniture SME owner reported learning from the experience of other SMEs, while the logistics coordinator emphasized collaboration with logistics companies. These practices indicate that inter-organizational learning can compensate for limited internal expertise. Previous studies similarly highlight knowledge sharing, absorptive capacity, and collaborative learning as enablers of green logistics and sustainable supply chain practices (Gloet & Samson, 2019; Brockhaus et al., 2013).

Strategic and Economic Orientation

SMEs were also motivated by the expectation that green logistics could improve competitiveness and long-term business performance. The fashion SME owner sought to improve the firm's image, while the furniture SME owner identified business competition as a reason for following green business trends. These responses suggest that green logistics was not perceived solely as an environmental obligation but also as a strategic mechanism for market differentiation.

The operations manager emphasized operational cost efficiency as the main reason for adoption. Similarly, the logistics coordinator associated green logistics with route optimization and lower fuel consumption. This strategic orientation corresponds with literature showing that green logistics adoption becomes more likely when environmental practices are aligned with core business strategy, cost reduction, and long-term competitiveness (Sodhi & Tang, 2017).

External Drivers of Green Logistics Adoption

Customer Demand

Customer demand emerged as the most visible external driver. The food SME owner reported that customers had begun asking about environmentally friendly packaging, while the fashion SME owner observed that customers increasingly appreciated sustainable packaging. The furniture SME owner stated that some customers explicitly requested the elimination of plastic from product packaging.

The customer informant confirmed this tendency by expressing greater trust and loyalty toward SMEs that demonstrate environmental concern. The customer was also willing to accept slightly higher product prices when the environmental benefits were clearly communicated. These findings indicate that customer expectations influence both the symbolic and operational dimensions of green logistics.

This result aligns with previous studies identifying customer demand as a strong market-based driver of environmentally sustainable logistics practices (Arroyo et al., 2023; Vrchota et al., 2020). Customer expectations encourage firms to adopt green packaging, environmentally responsible distribution, and other practices that signal corporate social responsibility and reinforce market legitimacy (Aldakhil et al., 2018; Ayuso et al., 2013; Haan-Hoek et al., 2020).

The evidence further shows that customer pressure extends beyond final consumers. The logistics coordinator reported that large corporate clients increasingly required environmentally responsible practices. Marketplace platforms also began encouraging the use of sustainable packaging. Consequently, customer influence operates across multiple levels of the supply chain, including end consumers, corporate buyers, and digital platforms.

Competitive Pressure and Business Partner Requirements

Competitive pressure was another significant external driver. SME owners perceived green business practices as increasingly relevant to market positioning, reputation, and access to business opportunities. The furniture SME owner indicated that competition required firms to follow

sustainable business trends, while the fashion SME owner linked green logistics to an improved business image.

Business partner requirements were especially influential in logistics relationships. The logistics coordinator reported that larger companies had begun to require their logistics partners to comply with environmentally responsible practices. This suggests that sustainability expectations can diffuse through supply chain relationships, encouraging smaller firms to adopt green logistics to maintain contracts, market access, and legitimacy.

These findings support the view that green logistics adoption is shaped by stakeholder pressure and supply chain governance. Customer requirements, supplier expectations, industry norms, and business partner standards can create both incentives and compliance pressures that encourage SMEs to modify logistics practices (Arroyo et al., 2023; Aldakhil et al., 2018).

Operational Efficiency as an Adoption Driver

Transportation and Fuel Efficiency

Operational efficiency was a major motivation, particularly among logistics practitioners. The operations manager stated that scheduling distribution activities reduced the likelihood of vehicles traveling without loads. The logistics coordinator emphasized that route optimization lowered fuel consumption and transportation costs. Shipment consolidation was also used to combine multiple orders into a single trip.

These findings demonstrate that SMEs often approach green logistics through practical efficiency improvements rather than through environmental technology investments. Route optimization, delivery scheduling, shipment consolidation, and improved vehicle utilization simultaneously reduce fuel consumption, emissions, and operating costs.

Previous research similarly identifies operational efficiency as a central business justification for green logistics adoption. Efficiency improvements can mediate the relationship between environmental practices and economic performance by generating fuel savings, better loading rates, improved resource utilization, and reduced waste (Arroyo et al., 2023; Aldakhil et al., 2018).

Warehousing and Material Efficiency

Efficiency-related practices were also evident in warehouse and packaging activities. The warehouse manager reported reusing pallets and cartons and strengthening supervision over material use. The food SME replaced plastic bags with paper bags, while the fashion SME reduced bubble wrap. These initiatives reflect a gradual effort to minimize waste and improve material productivity.

The warehouse manager also noted that better material management made the warehouse more organized. This suggests that environmental improvements can produce operational benefits beyond direct cost savings. Reduced material waste, improved storage discipline, and reuse of logistics assets may improve warehouse control and process consistency.

The findings support literature indicating that green logistics practices can improve both environmental and operational performance through waste minimization, energy efficiency, and

process integration (Mahesh et al., 2023). However, the informants also recognized that some benefits emerge only over time.

Short-Term Cost and Long-Term Benefit Trade-Offs

Several informants described an initial increase in costs followed by gradual operational savings. The food SME owner explained that costs increased at the beginning but became more manageable over time. The fashion SME owner observed that packaging costs rose while waste declined. The customer informant considered moderate price increases acceptable when environmental benefits were transparent.

These responses reveal a trade-off between short-term implementation costs and long-term efficiency gains. SMEs may hesitate to adopt green logistics because immediate costs are visible, whereas savings from lower fuel use, reduced waste, improved customer loyalty, and enhanced reputation accumulate gradually.

This pattern is consistent with studies showing that green logistics investments may increase short-term expenditure but generate long-term economic benefits through efficiency, reduced resource consumption, and stronger competitive positioning (Vu et al., 2024; Youngswaing et al., 2024).

Barriers to Green Logistics Adoption

Financial Constraints

Financial limitations represented the most prominent barrier. The food SME owner reported that environmentally friendly packaging remained expensive, while the furniture SME owner emphasized limited business capital. The academic informant similarly identified capital limitations as a common obstacle among SMEs.

These findings indicate that SMEs often recognize the value of green logistics but lack the financial capacity to invest in sustainable materials, technologies, or vehicles. High initial costs make incremental adoption more feasible than comprehensive transformation. This result is consistent with research showing that financial constraints restrict eco-innovation and environmental investments, particularly among small firms with limited access to external finance (Majid et al., 2023).

Supplier and Technology Limitations

The fashion SME owner reported difficulty finding suppliers of environmentally friendly packaging. The logistics coordinator also noted the limited availability of low-emission vehicles. These conditions demonstrate that adoption barriers extend beyond the boundaries of individual SMEs. Even committed firms may be unable to implement green logistics when sustainable inputs, technologies, or logistics services are inaccessible or unaffordable.

Supplier limitations also increase transaction costs by requiring SMEs to search for specialized materials or accept higher prices. Limited availability of green transportation technology further restricts the scope of operational change, particularly for firms dependent on external logistics providers.

Human Resources and Organizational Change

Knowledge gaps and employee readiness also hindered implementation. The warehouse manager indicated that not all workers understood new procedures, while the government representative observed that many SMEs still lacked knowledge of green logistics. The operations manager added that changes to work systems required time.

These findings show that implementation involves behavioral and organizational transformation. New procedures must be communicated, employees must be trained, and operational routines must be revised. Without sustained managerial support, green practices may remain informal or inconsistently applied.

Government and Institutional Support

Government support was viewed as important but insufficiently developed. SME owners expected more training, broader mentoring programs, financial incentives, and greater access to technology. The logistics coordinator proposed government-issued operational standards for green logistics, while the customer informant supported incentives for environmentally responsible SMEs.

The government representative reported that socialization and training programs had already been implemented. However, the responses of SME owners suggest that current support may not yet fully address practical needs. In particular, SMEs require financial assistance, technical guidance, accessible standards, and implementation support tailored to different sectors and business capacities.

These findings align with the literature showing that tax incentives, subsidies, low-interest financing, environmental standards, and regulatory clarity can reduce financial uncertainty and accelerate green logistics adoption (Ghadge et al., 2017). Institutional pressure can encourage adoption, but its effectiveness depends on alignment with SME resources and capabilities.

The academic informant emphasized the need for stronger collaboration among government, universities, and industry. This view was reinforced by the logistics coordinator, who highlighted cooperation with logistics partners, and by the government representative, who emphasized SME mentoring. These results indicate that green logistics adoption requires an ecosystem approach rather than isolated firm-level action.

Adaptation Strategies

SMEs primarily relied on gradual, low-cost adaptation strategies. These included replacing plastic with paper bags, reducing bubble wrap, improving vehicle capacity utilization, scheduling deliveries to avoid empty trips, reusing pallets and cartons, consolidating shipments, training employees, learning from other SMEs, and collaborating with logistics providers.

The gradual nature of these practices reflects the limited capital and technological resources available to SMEs. Rather than adopting expensive green technologies immediately, firms prioritized operational changes that could be implemented within existing capabilities. This incremental approach enabled them to balance environmental objectives with financial survival.

Collaboration and learning were particularly important. SMEs learned from peer experience, sought support from logistics partners, and participated in government training. These mechanisms reduced uncertainty and allowed firms to adopt practices progressively.

Integrated Findings

Overall, green logistics adoption among SMEs in Surabaya is driven by the interaction of internal commitment, customer demand, competitive pressure, operational efficiency, and institutional encouragement. At the same time, adoption is constrained by high costs, limited capital, knowledge gaps, supplier shortages, technological limitations, and organizational adjustment requirements.

The findings suggest that SMEs are most likely to adopt green logistics when environmental practices also generate visible business value. Customer loyalty, reduced fuel consumption, lower material waste, improved reputation, and stronger competitiveness provide practical justification for adoption. However, sustainable implementation requires external support through incentives, training, standards, infrastructure, and stakeholder collaboration.

The emerging pattern indicates that green logistics adoption among Indonesian SMEs is best understood as a gradual adaptation process. SMEs do not necessarily undertake comprehensive environmental transformation. Instead, they adopt selected practices that align with available resources, operational priorities, stakeholder expectations, and anticipated economic benefits.

The findings demonstrate that green logistics adoption among SMEs in Surabaya is shaped by a dynamic interaction between internal organizational capabilities and external institutional and market pressures. Customer demand, operational efficiency, environmental awareness, managerial commitment, competitive pressure, and government encouragement function as adoption drivers, whereas limited capital, inadequate knowledge, supplier constraints, technological limitations, and organizational adjustment costs impede implementation. These factors do not operate independently. Instead, the ability of external pressures to stimulate meaningful adoption depends substantially on whether SMEs possess sufficient resources and capabilities to translate expectations into operational practices. This supports the contingent view that internal readiness and external support jointly determine green logistics outcomes among resource-constrained firms (Dung & Binh, 2026; Duzgun, 2026; Triguero et al., 2014).

Customer demand emerged as one of the most influential external drivers. Participants reported increasing requests for environmentally friendly packaging, reduced plastic use, and more responsible delivery practices. Customer loyalty and acceptance of moderately higher prices also provided market justification for adoption. These findings reinforce Stakeholder Theory by showing that SMEs respond to expectations from customers, corporate buyers, marketplaces, regulators, and logistics partners to preserve legitimacy, competitiveness, and market access. However, stakeholder pressure alone does not guarantee implementation. Its effectiveness depends on organizational learning, knowledge sharing, and the availability of operational resources. SMEs that collaborate with logistics providers, learn from peer businesses, and participate in government-supported training are better able to convert stakeholder expectations into feasible practices (Gloet & Samson, 2019; Brockhaus et al., 2013; Ayuso et al., 2013).

Operational efficiency represents an important mediating mechanism between adoption drivers and implementation barriers. The SMEs in this study did not generally begin with advanced green

technologies. Instead, they introduced route optimization, shipment consolidation, improved vehicle loading, material reuse, delivery scheduling, and packaging reduction. These practices reduced fuel use, avoided empty trips, minimized waste, and improved warehouse organization. Such outcomes created a practical business case for green logistics by linking environmental responsibility to measurable economic benefits. This finding is consistent with previous research suggesting that efficiency gains can offset perceived risks and initial investment costs, thereby increasing management willingness to adopt sustainable logistics practices (Arroyo et al., 2023; Khan et al., 2019). Conversely, when anticipated returns remain unclear or require a long payback period, financial barriers become more severe and adoption is delayed.

The findings can be further interpreted through the Resource-Based View and Natural Resource-Based View. These perspectives explain why managerial competence, employee knowledge, financial resources, operational routines, and sustainability-oriented capabilities influence the scale and speed of adoption. SMEs with stronger internal resources are more capable of implementing green logistics and deriving competitive value from environmental practices. The Natural Resource-Based View extends this argument by positioning environmental capabilities as potential sources of efficiency, legitimacy, differentiation, and long-term advantage (Raza et al., 2021; Siddiqi et al., 2024). In the present study, however, internal resources were often insufficient for comprehensive transformation, compelling SMEs to rely on incremental changes that could be integrated into existing operations.

Dynamic Capabilities Theory also provides a useful explanation for the observed adaptation process. The participating SMEs sensed changes in customer preferences, regulatory direction, and market competition; seized opportunities through packaging modification, material reuse, and logistics optimization; and gradually reconfigured routines through training, collaboration, and revised distribution practices. This incremental process reflects the ability to adapt existing resources rather than acquire expensive technologies immediately. Dynamic capabilities are therefore particularly relevant to SMEs operating in uncertain and resource-constrained environments, where sustainable transformation depends on continuous learning and gradual operational reconfiguration (Issa et al., 2024).

Institutional Theory complements these internal perspectives by explaining the roles of government policy, environmental standards, industry expectations, and business partner requirements. Participants acknowledged that government socialization and training had encouraged awareness, but they also expected clearer standards, financial incentives, broader mentoring, and improved access to technology. This indicates that institutional pressure is most effective when regulatory expectations are accompanied by enabling mechanisms. Regulations without technical and financial support may increase compliance burdens, whereas incentives, accessible guidelines, and collaborative programs can strengthen SMEs' ability to respond (Majid et al., 2023; Ghadge et al., 2017). The findings therefore support an integrated theoretical framework combining RBV, NRBV, Dynamic Capabilities Theory, Institutional Theory, and Stakeholder Theory.

The Surabaya findings also reflect several characteristics commonly reported in developing economies. Similar to SMEs in other emerging markets, participants faced more severe financial, technological, knowledge, and infrastructure constraints than firms typically examined in developed economies. Consequently, government assistance, external financing, and capacity-

building programs become more decisive. In developed economies, stronger regulatory institutions, established green supplier networks, higher technological readiness, and greater access to finance can support faster diffusion and more advanced implementation. Nevertheless, the underlying adoption drivers remain comparable across contexts, including customer pressure, management commitment, operational efficiency, and sustainability expectations. The principal difference concerns the intensity of barriers and the degree of institutional assistance required to overcome them (Duzgun, 2026; Dung & Binh, 2026; Agyabeng-Mensah et al., 2022; Siddiqi et al., 2024).

The results also carry important managerial implications. SME managers should avoid treating green logistics as a separate environmental program and instead integrate it into operational and competitive strategy. Low-cost measures such as shipment consolidation, packaging reduction, route planning, pallet reuse, and employee training can serve as feasible starting points. Managers should also strengthen collaboration with suppliers, logistics providers, customers, universities, and peer SMEs to obtain knowledge and reduce implementation uncertainty. Viewing green logistics as a dynamic capability development process may help firms move progressively from basic operational improvements toward more advanced green technologies.

Policy interventions should be tailored to SME size, sector, and readiness. Financial incentives, tax reductions, low-interest loans, and subsidies can reduce capital barriers, while clear standards and practical implementation guidelines can improve regulatory predictability (Hernández et al., 2021; Cecere et al., 2018; Bolaji et al., 2024; Ghadge et al., 2017). Government agencies should also expand training, certification, pilot programs, and technical assistance in cooperation with universities, industry associations, and logistics companies. Knowledge-sharing platforms and business clusters can facilitate peer learning and accelerate the diffusion of effective practices (Gloet & Samson, 2019; Brockhaus et al., 2013; Dissanayake et al., 2019; Herbst, 2023). Overall, green logistics adoption among Indonesian SMEs is most likely to progress when market pressure, internal capability development, economic incentives, institutional clarity, and collaborative learning are addressed as interconnected elements of a broader sustainability ecosystem.

CONCLUSION

This study examined the drivers and barriers of green logistics adoption among Small and Medium-sized Enterprises in Surabaya, Indonesia. The findings show that adoption is shaped by the interaction of market pressure, organizational capability, operational priorities, and institutional support. Customer demand, competitive pressure, environmental awareness, managerial commitment, and expectations of operational efficiency emerged as the principal drivers. These factors encouraged SMEs to introduce environmentally responsible practices in packaging, transportation, warehousing, and distribution.

Despite this motivation, implementation remained constrained by high initial costs, limited capital, insufficient technical knowledge, restricted access to sustainable suppliers, limited availability of low-emission technology, and the organizational effort required to change established routines. These barriers were particularly significant because SMEs generally operate with narrower financial and human resource capacities than larger firms. Consequently, most participating SMEs did not pursue immediate, large-scale technological transformation. Instead, they relied on gradual and

affordable adaptation strategies, including packaging reduction, the use of paper-based alternatives, shipment consolidation, route optimization, improved vehicle loading, material reuse, employee training, and collaboration with logistics partners.

The study also demonstrates that operational efficiency serves as an important bridge between environmental intentions and business feasibility. Green logistics practices became more acceptable when SMEs could associate them with lower fuel consumption, reduced material waste, improved warehouse organization, stronger customer loyalty, and better competitive positioning. However, the benefits were generally perceived as long-term outcomes, while the costs of implementation were experienced immediately. This imbalance explains why many SMEs require external support before making more substantial investments.

A major contribution of this research lies in its context-sensitive explanation of green logistics adoption in Indonesian SMEs. The findings indicate that adoption should not be understood as a simple response to environmental awareness or regulation. Rather, it is a gradual organizational adaptation process in which internal resources, stakeholder expectations, institutional conditions, and perceived economic value jointly determine the scope and pace of implementation. This insight enriches the application of the Resource-Based View, Natural Resource-Based View, Dynamic Capabilities Theory, Institutional Theory, and Stakeholder Theory in the context of resource-constrained firms in emerging economies.

Practically, SME managers should integrate green logistics into their operational and competitive strategies rather than treat it as a separate environmental program. Affordable measures with visible operational benefits can provide realistic entry points for adoption. At the policy level, government agencies should combine environmental standards with financial incentives, technical assistance, training, certification, and accessible implementation guidelines. Universities, logistics providers, business associations, customers, and large corporate buyers should also be involved in knowledge transfer, collaborative pilot programs, and the development of sustainable supplier networks.

Future research should extend the study across multiple cities, industries, and SME categories to assess the transferability of the findings. Longitudinal research is also needed to examine how green logistics practices evolve over time and whether the expected economic, environmental, and social benefits are sustained. Further studies may compare SMEs at different levels of technological readiness, investigate the effects of policy incentives, and develop measurable indicators for evaluating green logistics performance. Such research would strengthen understanding of how Indonesian SMEs can move from incremental environmental improvements toward more comprehensive and resilient green logistics systems.

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