

Measuring the Factors Influencing the Adoption of Green Supply Chain Management in Small and Medium-Sized Enterprises: A Case Study of Hanoi

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Abstract: As environmental issues become an increasingly global concern, green supply chain management has emerged as a strategic approach that helps enterprises improve operational efficiency and pursue sustainable development. This study aims to assess the factors influencing the adoption of green supply chain management among small and medium-sized enterprises in Hanoi. A total of 331 valid responses were collected, and quantitative analyses were performed using SPSS 26 at a 5% significance level. The results indicate that green technology adoption, leadership commitment, knowledge and experience, human resource quality, consumer pressure, and logistics management capability are the main factors directly impacting the level of green supply chain management adoption in small and medium-sized enterprises in Hanoi. Based on these findings, the study offers several managerial implications to support enterprises in making better management decisions and implementing green supply chain practices more broadly and effectively in the future.

Keywords: Green supply chain management, small and medium-sized enterprises, Hanoi.

1. INTRODUCTION

In the context of globalization and international economic integration, environmental issues and sustainable development have become an unavoidable focus in corporate governance. The negative effects of climate change and stricter environmental policies are increasing. The United Nations report (UNEP, 2023) indicates that global greenhouse gas emissions remain high, creating significant pressure to keep the global temperature rise below 1.5°C as outlined in the Paris Agreement. This results in more policies and legal regulations related to environmental protection, sustainable development, and corporate social responsibility in many countries. Along with institutional factors, market and stakeholder pressure is also growing stronger. Consumers, especially the younger generation, tend to prioritize choosing products and services that are environmentally friendly, transparent in production, and socially responsible. Partners in the international supply chain require enterprises to comply with environmental, energy, and sustainability standards in order to stay competitive and survive in a volatile economy. These challenges and requirements force enterprises to change their operations to be more environmentally friendly. In particular, green supply chain management has become an important strategy, not only helping enterprises minimize negative impacts on the environment but also improving operational efficiency, increasing competitive advantages, and meeting long-term sustainable development goals.

In Vietnam, especially in Hanoi, the country's political, economic, cultural, and scientific center, there is strong growth in the small and medium-sized enterprises (SMEs) sector, which plays a vital role in the economy. According to data, by the end of 2024, Hanoi will have more than 400,000 registered enterprises, with about 220,000 actively operating, and over 98% will be SMEs. The area generates approximately 55.1% of local jobs and contributes over 40% of the production value, making a significant contribution to the city's GRDP growth. With such high density and scale, SMEs are both a driving force for development and a major source of pressure on the environment and natural resources. In fact, environmental pollution in Hanoi has become an urgent issue. According to a report by the World Health Organization (WHO), the average concentration of PM_{2.5} fine dust in Hanoi during 2022-2023 ranges from 26 to 52 µg/m³, which is many times higher than the WHO's recommended threshold of 5 µg/m³ for the annual average and also exceeds the national standard. This not only leads to serious public health issues, such as increased respiratory and cardiovascular diseases, but also exerts significant pressure on the management policy system, challenging the goal of sustainable economic development in the future. In this context, implementing green supply chain management in SMEs is not only an internal way to optimize production and business activities but also an essential step to reduce environmental pressure, meet social expectations, and align with global development trends. However, the implementation of green supply chain management (GSCM) in SMEs in Hanoi still faces many limitations and barriers compared to large enterprises, including limited financial capital to invest in clean technology, lack of information and knowledge on green practices, difficulty accessing preferential financing, and a lack of

appropriate technical support. There are also barriers related to the level of governance and awareness among business leaders, a lack of practical information and experience, as well as asynchronous support from the State and intermediary organizations.

Therefore, studying and measuring the factors that influence the implementation of green supply chain management in small and medium-sized enterprises in Hanoi City helps strengthen the scientific foundation of green supply chain management in Vietnam's specific context. It also assists SMEs managers in identifying the key factors that affect the adoption of green supply chain practices, allowing them to make well-informed management decisions, improve business efficiency, and support sustainable development. Additionally, it offers management insights to encourage SMEs to adopt comprehensive and effective supply chain strategies in the future.

2. LITERATURE REVIEW AND RESEARCH MODEL

2.1. Theoretical background and overview

According to Han and Le (2025), supply chain management is a network of suppliers, production, assembly, distribution, and logistics facilities that perform functions from raw material procurement and conversion into semi-finished and finished products to distribution to consumers. This administrative activity includes coordinating, planning, and controlling the processes of production, inventory, transportation, and consumption of products or services, as well as managing the two-way flow of information between suppliers and customers. On that basis, green supply chains are seen as a vital condition for shaping and advancing industrial ecosystems sustainably. Unlike traditional supply chains, which emphasize cost, speed, and quality, green supply chain management incorporates environmental considerations throughout the entire product life cycle, from design and supplier selection to production, transportation, consumption, and post-consumer waste management. According to Srivastava (2007), green supply chain management aims not only to minimize negative environmental impacts but also to enhance economic efficiency through cleaner production, energy efficiency, and resource reuse. Similarly, Permana et al. (2022) emphasized that green supply chain management involves integrating environmental factors into all supply chain activities with the goal of both reducing pollution and increasing business efficiency. An ideal green supply chain should limit industrial waste, conserve energy, prevent the spread of harmful substances, and involve active participation from all stakeholders, from raw material suppliers to manufacturing and distribution enterprises.

Theoretically, two common approaches used to explain the dynamics of implementing green supply chain governance are resource theory and institutional theory. Resource theory highlights the importance of intrinsic resources such as technology, human resources, governance, and finance in encouraging enterprises to adopt green supply chain management. Meanwhile, institutional theory suggests that pressures from the market, policies, and society are factors that compel enterprises to "green" their supply chains to preserve their competitive advantage. According to Rauer and Kaufmann (2015), green supply chain governance is viewed as a strategic capability that combines governance policies and practices to control and reduce environmental impact, while also delivering economic benefits through enhanced social responsibility and brand reputation. The green supply chain management model is based on the integration of supply chain operations and environmental standards. Research on green supply chain management in enterprises started in the early 1990s when concerns about environmental crises and resource depletion became global issues. It then gained prominence after the 2000s, reflecting a trend of integrating environmental factors throughout the entire value chain (Srivastava, 2007; Seuring & Müller, 2008; Fahimnia et al., 2015). The characteristic of green supply chain management is that it integrates environmental factors into all activities in the supply chain, from product design, raw material procurement, production and operation to distribution and recycling. It aims to improve production and distribution efficiency, minimize negative environmental impacts, and create long-term competitive advantages for enterprises. Several international studies have demonstrated the multi-faceted benefits of green supply chain management in enterprises. Research by Rao and Holt (2005) confirms that adopting green practices in the supply chain can simultaneously boost environmental efficiency and provide a competitive edge for enterprises. Woo et al. (2016), through a survey of 103 construction industry suppliers in Korea, showed that collaboration on environmental protection between suppliers and enterprises helps reduce costs and enhances competitiveness. A study by Balasubramania and Shukla (2017) in the UAE, with data from 455 experts and 200 construction enterprises, shows that factors such as green design, green purchasing, green transportation, or green construction all positively affect both environmental and economic efficiency. Similarly, Çankaya and Sezen (2019), analyzing data from 281

manufacturing enterprises in Turkey, also confirmed the simultaneous economic, social, and environmental impacts of green production activities, green marketing, green packaging and distribution, and internal environmental management. Fianko et al. (2021) argue that green procurement, green design, and green building have a direct, positive relationship with environmental efficiency. This indicates that green supply chain management is not only an internal management approach but also involves collaborative relationships and shared responsibilities across the entire supply chain. Research by Zhu and Sarkis (2004) identified five core components of this model: (i) green procurement, (ii) environmentally friendly product design, (iii) green manufacturing, (iv) green distribution and logistics, and (v) post-consumer recovery and recycling. Each component has its own role: green procurement helps to select environmentally responsible suppliers; green design reduces waste from the input stage; green logistics optimizes transportation routes to lower carbon emissions; and recovery and recycling activities create conditions for closing the product life cycle, easing resource pressure. This system is often aligned with international standards such as ISO 14001 or ESG indicators to ensure compliance with sustainable development goals. In Vietnam, some scholars have also started to focus on green supply chain management, but the amount of research remains limited compared to developed countries. Le (2020) argues that green design and green manufacturing have a comprehensive positive impact on economic, social, and environmental performance, while green procurement only affects economic and social performance; there is no clear evidence on environmental impact. The extent of each component's impact in green supply chain management may vary depending on the context and the business's deployment capabilities. Tran (2022) examines green supply chain management from the perspective of green practices, highlighting the importance of environmental protection cooperation with suppliers and customers, as well as the need for environmental compliance monitoring throughout the supply chain. Nguyen and Dao (2025) note that the implementation level of green supply chain management largely depends on several key factors such as: commitment from business leaders, technological capacity, customer pressure, and the direction of government policies. Practice shows that when enterprises successfully implement green supply chain management, they not only gain benefits like cost savings and enhanced brand reputation, but also support the country's sustainable development strategies amid increasing climate change and globalization trends.

2.2. Hypothesis and research model

Based on the theory and review of various relevant domestic and international studies, the author selects and proposes a model of factors influencing the level of green supply chain management implementation in small and medium-sized enterprises in Hanoi City, along with the following hypotheses:

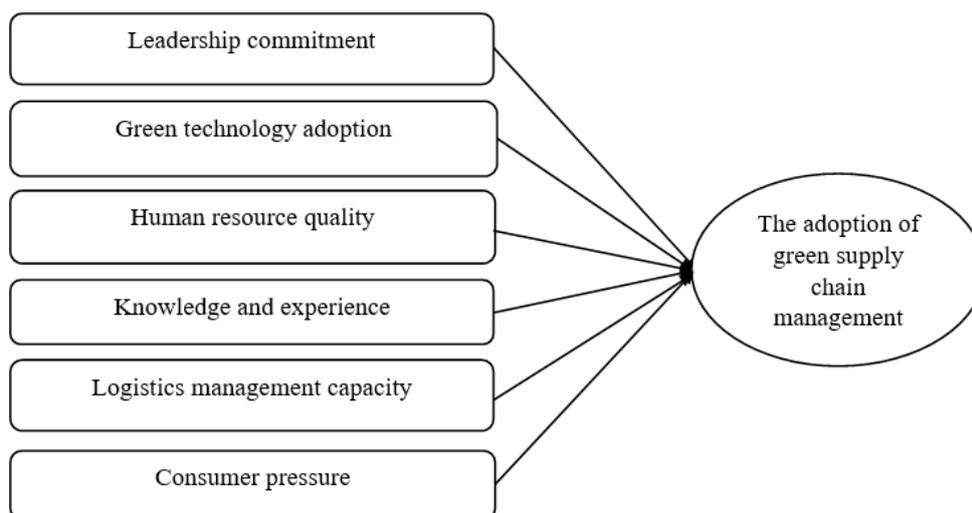


Figure 1. Research model

Source: Author's suggestion

H1: Leadership commitment positively influences the adoption of green supply chain management in SMEs.

H2: Green technology adoption positively influences the adoption of green supply chain management in SMEs.

H3: Human resource quality positively influences the adoption of green supply chain management in SMEs.

H4: Knowledge and experience positively influences the adoption of green supply chain management in SMEs.

H5: Logistics management capacity positively influences the adoption of green supply chain management in SMEs.

H6: Consumer pressure positively influences the adoption of green supply chain management in SMEs.

3. Research methods

The research scale is developed based on a literature review and selective adoption from various domestic and international studies, such as Zhu and Sarkis (2004), Srivastava (2007), Testa and Iraldo (2010), and Han and Le (2025). The author has made adjustments to the content, language, and wording of the observed variables to better fit the research context, avoiding ambiguity or misunderstandings during the survey. Additionally, the author conducted a group discussion with several experts and managers from SMEs. The discussion process aims to assess the clarity and logical relationships between factors, as well as the relevance of each observed variable across the scale. Based on this, the official scale was finalized, consisting of 30 observed variables, including 6 independent factors and 1 dependent factor.

The study used a 5-level Likert scale from 1 - Strongly Dissatisfied to 5 - Strongly Satisfied. The sample size was determined based on the optimal ratio in the EFA discovery factor analysis according to Hair et al. (2010), which is 10:1. However, to ensure the validity of the collected questionnaires, a total of 350 questionnaires were issued. Through a convenient non-probabilistic survey method, the survey form is distributed directly to managers and employees working in SMEs in Hanoi City from February 2025 to April 2025. At the end of the survey process, 331 questionnaires were obtained that satisfied the satisfactory conditions and were used in quantitative analysis. The data is processed using SPSS 26 software, with scale reliability testing (Cronbach's Alpha), exploratory factor analysis (EFA), correlation analysis, and multivariate linear regression. Accreditations are carried out at a statistically significant level of 5% to ensure the accuracy and reliability of the research results.

The research model is expressed as an equation below:

$$GSCM = \beta_0 + \beta_1 * LC + \beta_2 * GTA + \beta_3 * HRQ + \beta_4 * KE + \beta_5 * LMC + \beta_6 * CP + \epsilon$$

In which:

GSCM (dependent variable): The adoption of green supply chain management.

Independent variables (X_i): Leadership commitment (LC), Green technology adoption (GTA), Human resource quality (HRQ), Knowledge and experience (KE), Logistics management capacity (LMC), Consumer pressure (CP).

β_k : Regression coefficient ($k = 0, 1, 2, \dots, 6$).

ϵ : Random error

4. Research results

The statistical results from the 331 survey samples show that: regarding gender, male numbered 178, making up 53.8%, while female numbered 153, accounting for 46.2%. In terms of age, those under 25 years old totaled 42, which is 12.7%, the group from 25 to 35 years old was the largest with 137 people, or 41.4%. The 36 to 45 years age group had 98 people, representing 29.6%, and those over 45 years old totaled 54, or 16.3%. Regarding educational level, there were 56 college graduates (16.9%), 202 with university degrees (61.0%), and 73 with postgraduate degrees (master's, doctorates), making up 22.1%. In terms of job positions, employees made up the largest group with 194 people (58.6%), middle managers numbered 97 (29.3%), and senior managers totaled 40 (12.1%). Considering seniority, 61 people had less than 2 years of experience (18.4%), 124 had 2 to 5 years (37.5%), 92 had 6 to 10 years (27.8%), and 54 had more than 10 years (16.3%). Overall, the survey sample exhibits a diverse distribution that ensures representation and reflects various aspects of the workforce in SMEs in Hanoi City.

Table 1. Cronbach's Alpha and EFA

Scales	No.	Cronbach's Alpha	Corrected Total	Item-Correlation	Loadings	Eigenvalue
LC	4	0.784	0.649		0.825 - 0.793	6.289
GTA	3	0.792	0.628		0.834 - 0.805	5.827
HRQ	5	0.841	0.752		0.801 - 0.782	4.346
KE	4	0.817	0.735		0.812 - 0.767	3.754
LMC	4	0.839	0.696		0.848 - 0.794	2.675
CP	5	0.803	0.704		0.853 - 0.785	1.933

Scales	No.	Cronbach's Alpha	Corrected Item-Total Correlation (smallest)	Loadings	Eigenvalue
KMO = 0.791					
Bartlett's Test			Approx. Chi-Squared		5938.735
			df		318
			Sig.		0.000
% of Variance = 78.873%					
GSCM	5	0.848	0.713	0.817 - 0.789	1.532
KMO = 0.827					
Bartlett's Test			Approx. Chi-Squared		437.698
			df		5
			Sig.		0.000
% of Variance = 80.654%					

Source: Authors' analysis results

The results of the scale reliability analysis indicated that independent factors had a Cronbach's Alpha coefficient above 0.7, and the lowest Corrected Item-Total Correlation surpassed the threshold of 0.3. This confirms that the scales are highly reliable and that no observation variables need to be removed. Next, the results of the exploratory factor analysis (EFA) for the independent variables showed that the KMO coefficient was 0.791, which falls within the acceptable range ($0.5 < \text{KMO} < 1$), confirming that the data are suitable for factor analysis. The Sig. value of Bartlett's test was 0.000 (less than 0.05), indicating that the correlation matrix is statistically significant. With an eigenvalue greater than 1, six factors were extracted, accounting for a total variance of 78.873% (considerably above the 50% threshold), meaning these six factors explained 78.873% of the data's variability. Furthermore, all factor loadings were greater than 0.5, suggesting that the observed variables are of good quality and align with the expected theoretical structure. Therefore, the results fully satisfy the requirements for exploratory factor analysis (Hair et al., 2010).

Regarding the dependent scale, test results also show that the Cronbach's Alpha coefficient and the Corrected Item-Total Correlation both meet reliability standards (Cronbach's Alpha is greater than 0.7; Corrected Item-Total Correlation coefficient is greater than 0.3). EFA analysis for the dependent variable yielded a KMO coefficient of 0.827, further confirming that the data are suitable for factor analysis. At the same time, Bartlett's test has a Sig. of 0.000 (less than 0.05), proving that the correlation matrix is significant. With an eigenvalue of 1.532, only one factor was extracted, explaining a total variance of 80.654% (greater than 50%). The factor loadings are all above 0.5, indicating that the observed variables align well on the same factor. Therefore, the dependency scale fully meets the requirements for reliability and validity in exploratory factor analysis (Hair et al., 2010).

Table 2: Correlation analysis

	GSCM	LC	GTA	HRQ	KE	LMC	CP
GSCM	1						
LC	0.624**	1					
GTA	0.736**	0.327**	1				
HRQ	0.611**	0.231**	0.217**	1			
KE	0.742**	0.192**	0.338**	0.314**	1		
LMC	0.757**	0.275**	0.226**	0.309**	0.207**	1	
CP	0.719**	0.256**	0.325**	0.283**	0.181**	0.264**	1

* significant at $p < 0.05$. ** significant at $p < 0.01$

Source: Authors' analysis results

The results of the correlation analysis show that the independent factors are closely related and move in the same direction as the dependent factors. The Sig. values of the correlation coefficients are less than 0.01, confirming that the relationships are statistically significant at the 99% confidence level. At the same time, the correlation coefficient between the independent factors and dependent factors was greater than 0.4, indicating that the correlation is moderate to strong and suitable for further analysis. Additionally, among the independent factors, there is no suspicion of multicollinearity, making them eligible for inclusion in the regression analysis.

Table 3: Multivariate regression analysis

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.	Collinearity Statistics	
		Beta	Standard Deviation	Standardized Beta			Tolerance	VIF
1	Constant	2.064	0.035		4.862	0.000		
	LC	0.349	0.029	0.374	5.205	0.004	0.638	1.768
	GTA	0.367	0.031	0.387	4.643	0.001	0.744	1.791
	HRQ	0.315	0.025	0.326	5.776	0.000	0.751	1.726
	KE	0.332	0.022	0.359	5.589	0.002	0.617	1.811
	LMC	0.291	0.018	0.303	4.354	0.000	0.625	1.837
	CP	0.276	0.023	0.295	4.948	0.000	0.609	1.673
F = 217.752, Sig. = 0.000 R ² = 0.820, R ² adjusted = 0.808, Durbin-Watson = 1.849 a. Dependent variable: GSCM								

Source: Authors' analysis results

Table 3 shows that the corrected R² coefficient reaches 0.808, demonstrating that the model has a very high level of interpretation. In other words, the selected independent variables likely explain up to 80.8% of the variability in the dependent variable, and the remaining 19.2% could be due to factors outside the model. The Durbin-Watson coefficient of 1.849 falls within the range of 1.5 to 2.5, suggesting that the model does not violate the assumption of first-order autocorrelation of residuals. At the same time, the significance value of the F test of 0.000 < 0.05 confirms that the overall regression model is statistically significant and appropriate for extending the entire study data. Furthermore, the variance inflation factor (VIF) for all independent variables is below 2, and the tolerance exceeds 0.5. This shows there is no excessively high linear correlation among the independent variables, so multicollinearity is not an issue. Additionally, the test assumes that the residuals follow a normal distribution, with the mean value of the residuals approximately -3.21E-15 (effectively zero), and the standard deviation is 0.895. This suggests that the residuals behave as expected. Examining the scatterplot of the normalized residuals versus the predicted values shows that the points are randomly dispersed around zero and do not stray far from the expected line. Therefore, the assumptions of a linear relationship and constant variance of the residuals are met. The results support the hypotheses, and the regression equation based on the standardized beta coefficient is as follows:

$$\text{GSCM} = 0.387 \cdot \text{GTA} + 0.374 \cdot \text{LC} + 0.359 \cdot \text{KE} + 0.326 \cdot \text{HRQ} + 0.303 \cdot \text{LMC} + 0.295 \cdot \text{CP} + \varepsilon$$

Thus, six factors have a positive influence on the dependent variable in order of decreasing impact: green technology adoption, leadership commitment, knowledge and experience, human resources quality, logistics management capacity, and consumer pressure. The limitation of the study is that there are still factors outside the model, it was conducted with a small sample size and used a convenient non-probabilistic method. Additionally, the research only focuses on SMEs in Hanoi City. These points also serve as suggestions for future research directions.

5. Implications

First, enterprises need to thoroughly implement green technology throughout the entire supply chain, focusing on investing in energy-saving machinery and production lines; use intelligent management software (ERP, SCM) to optimize raw materials and minimize waste; and utilize IoT technology to monitor energy consumption and emissions in real-time. Additionally, enterprises should collaborate with technology providers to adopt new solutions, ensure sustainable production, and enhance competitiveness. Investment and technological innovation are essential to transforming the traditional supply chain into an environmentally friendly one. Enterprises should prioritize the adoption of clean production technologies, energy efficiency measures, smart logistics systems, and emission control. At the same time, it is important to strengthen partnerships with technology transfer centers, green startups, and research organizations to access solutions suitable for the scale and financial capacity of SMEs.

Second, enterprises need to strengthen their leadership's commitment to green supply chains by issuing clear policies and measuring progress with specific KPIs. Leaders should proactively allocate budgets for green projects, establish a set of indicators to evaluate the level of implementation (e.g., recycled material use rate, annual emission reduction), and periodically publish sustainability reports to show responsibility

to the environment and shareholders. Enterprises must also enhance the commitment and leadership of their management team in guiding and executing green supply chain governance activities by integrating sustainable development goals into their overall business strategy, linking environmental responsibility with governance performance assessment, and so on. At the same time, they should establish specialized departments responsible for green supply chains within the organization. Leadership demonstrates a clear commitment, creating motivation to foster a "green" culture throughout the business.

Third, enterprises need to enhance their knowledge and experience in green supply chain management among their staff. This can be achieved by organizing intensive training courses on green logistics, inviting environmental experts to consult directly on projects, or sending employees to participate in international training programs. Simultaneously, enterprises should develop an internal data warehouse of practical cases to help personnel learn from experience and gradually improve their skills. Enterprises need to create a structured training plan focused on technical skills and sustainable management for employees, especially in areas such as logistics management, product life cycle assessment (LCA), and environmental standards. Collaborating with training institutes, universities, and international organizations will help improve the quality of human resources, laying a foundation for the systematic and effective implementation of green supply chain management.

Fourth, enterprises must enhance the quality of their human resources related to green governance practices. Along with hiring workers knowledgeable about the environment and logistics, enterprises should develop compensation policies to retain qualified staff, establish conditions for them to research and suggest initiatives to cut emissions and reduce operational costs. For example, encouraging employees to participate in a "green idea program" with a reward system based on the effectiveness of their solutions. Fifth, enterprises need to actively respond to consumer pressure by making the production process transparent and clearly communicating about green products. They should print eco-labels on their packaging, share ISO 14001 certification or other international standards, and use digital communication channels so customers can easily access information. Additionally, it is recommended to conduct regular surveys to identify changes in consumption trends and adjust products accordingly. This helps raise market awareness and connect the green consumption ecosystem. Enterprises must promote both internal and external communication about their green efforts to boost brand value, build employee consensus, and gain consumer support. Participating in green business alliances, Environmental-Social-Governance (ESG) networks, or international certification programs will help enterprises strengthen their competitiveness and learn from successful models.

Sixth, enterprises need to enhance their green logistics management capabilities by optimizing transportation and warehousing. Specifically, they should implement route optimization software to cut down on travel distances, use fuel-efficient trucks or electric vehicles, and adopt a "green warehouse" model that includes LED lighting, solar energy, and waste segregation. Additionally, firms should collaborate with reputable logistics providers to implement green transportation solutions that both reduce costs and lessen environmental impact. Enterprises also need to reorganize logistics activities and supply chain practices toward sustainability. This involves optimizing shipping routes, utilizing fuel-efficient vehicles, managing warehouses smartly, and choosing environmentally responsible suppliers. Tools such as environmental impact assessments, ISO standards, or green labels should be employed to develop a supply chain that is transparent, eco-friendly, and adaptable to the demands of discerning markets.

Seventh, for the State, the competent authorities need to continue improving the system of mechanisms and policies aimed at encouraging SMEs to transition to green supply chains. This includes providing financial support, tax incentives, access to technology, and human resource training. Simultaneously, it is essential to promote programs that raise public and consumer awareness of green consumption, creating a supportive market environment for enterprises to adopt green supply chain management. Additionally, connecting SMEs with a network of experts, international organizations, and sustainable development projects is a key strategy to make green supply chain management an integral part of the long-term development plan of Vietnamese enterprises.

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