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Green supply chain in Vietnam's agricultural export activities

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Abstract

The Vietnamese agricultural sector has grown rapidly in foreign markets, becoming a vital part of the global agricultural value chain. Poor product value, weak supply chain integration, and limited sustainable practices persist despite the rise in export turnover. This article evaluates green supply chain management (GSCM) in Vietnam's agriculture export sector and proposes ways to improve it. A mixed-methods study included quantitative survey data along with qualitative expert interviews. 191 agricultural exporters, government entities, and logistical suppliers provided data. Structured surveys to analyze GSCM implementation aspects and semi-structured interviews for qualitative insights are essential. The study's hypotheses were tested using reliability, exploratory factor analysis (EFA), and regression modeling. Policy direction is the biggest element in GSCM success, followed by managerial awareness, resource availability, and stakeholder understanding. Significant data show that Green Supply Chain Management (GSCM) improves environmental and economic results while meeting international standards. Case studies of successful enterprises show that Agriculture 4.0 and circular economy strategies improve export efficiency and import compliance. However, limited finances, technical infrastructure, and managerial skills restrict usage. The paper suggests regulatory reforms, specialized management units, and digital technology investment to overcome these challenges. This report concludes that GSCM is essential to Vietnam's agricultural competitiveness. Increasing financial incentives, promoting international cooperation, and utilizing blockchain technology for traceability are recommended. The study's weaknesses include a focus on export sectors and a lack of longitudinal data. Future research should examine cross-sectoral usage and the long-term consequences of GSCM.

Keywords: Agricultural products, Green logistics, Green supply chain.

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1. Introduction

The agricultural sector in Vietnam has undergone significant expansion in recent years, establishing its role as a pivotal participant in the global market. In the initial 11 months of 2024, Vietnam's agricultural product export turnover reached $56.74 billion, reflecting a 19% rise from the same period in 2023, with a trade surplus of over $16.5 billion, up 52.8%. The growing trend is anticipated to persist, with forecasts suggesting that agricultural exports may reach $62 billion by year-end, contingent upon December's export value surpassing $5 billion.

This remarkable expansion can be ascribed to multiple sources. Vietnam's advantageous geographic position, especially its proximity to significant markets such as China—the foremost consumer of fruit globally—has enabled cost-effective logistics and optimized transportation, enhancing export volumes. The diversification of export markets, particularly the substantial increase in shipments to Thailand, South Korea, Germany, and Canada, has facilitated the sector's growth.

Nonetheless, in spite of these accomplishments, Vietnamese agricultural exporters encounter considerable obstacles. The global market is becoming more competitive, as other tropical nations compete for market share. The competition has intensified due to Vietnam's sluggish implementation of sustainable farming techniques, resulting in the forfeiture of lucrative contracts to more proactive rivals. In the European Union (EU), the largest importer of fruits and vegetables globally, Vietnam's market share constitutes only 0.18% of the overall import value. This restricted presence is partially attributable to the nation's inability to satisfy the EU's rigorous criteria.

Furthermore, Vietnam's agricultural sector faces three significant challenges: climate change, market volatility, and evolving consumer tastes. Climate change directly threatens agricultural productivity by increasing the frequency of extreme weather events that disrupt production cycles. Market volatility, driven by geopolitical tensions and variable global demand, introduces further uncertainty for exporters. Changing consumer preferences, especially in developed economies, are increasingly favoring sustainably sourced and eco-friendly products, requiring a shift towards greener methods in the supply chain.

In light of these problems, there is an increasing acknowledgment of the necessity to enhance the sustainability of the agricultural export supply chain. Adopting green supply chain management (GSCM) strategies can augment the environmental performance of enterprises and boost their economic and social results. Research indicates that environmental collaboration with customers enhances the economic, environmental, and social dimensions of corporate performance. By implementing GSCM techniques, Vietnamese agricultural exporters can more effectively comply with the technical standards and phytosanitary regulations of importing nations, thus enhancing control over export products and aiding in environmental conservation.

Moreover, the Vietnamese government has actively facilitated the green transformation of the agriculture sector. Initiatives targeting production zones to enhance compliance with standards such as VietGAP and GlobalGAP are in progress. Investment in infrastructure development, encompassing transportation, warehousing, processing facilities, digital transformation, and e-commerce, is being encouraged to enhance brand development and sustain export growth.

In conclusion, although Vietnam's agricultural export business is seeing significant expansion, it is essential to tackle the concerns of sustainability, climate change, market instability, and shifting consumer preferences. Optimizing the export supply chain for sustainability is a strategic necessity, providing a means to increase export revenue while securing long-term competitiveness and environmental responsibility in the global marketplace.

This study seeks to elucidate the implementation of green supply chain management (GSCM) within Vietnam's agriculture export sector, particularly in light of the rising worldwide demand for sustainable practices. Although previous research has examined Green Supply Chain Management (GSCM) in industrialized nations, there has been no focus on its implementation in emerging economies like Vietnam, which face distinct problems such as resource limitations and legislative deficiencies.

2. General Theoretical Basis for Green Agricultural Supply Chain Management and Proposed Research Model

2.1. Basic Concepts

A supply chain is a network of participating organizations connected through links with businesses and customers, involving various processes and activities to create added value from products and services provided to end consumers [1]. A complete supply chain is built from different components, all working together to bring the product from the raw material supplier to the end customer. Specifically, a supply chain includes five basic components: raw material suppliers, manufacturers, distributors, retailers, and customers.

From a business perspective, the green supply chain can be seen as a logistics structure that ensures the production and distribution of products globally in an environmentally friendly manner [2]. To achieve this goal, companies must invest in designing and optimizing their logistics structures, considering the balance between profit and environmental impact.

There have been many studies presenting different concepts of green supply chain management. However, most studies approach green supply chain management from a managerial perspective. Green Supply Chain Management (GSCM) is the integration of environmental factors into supply chain management, including product design, sourcing and selection of materials, production processes, and distribution of final products. GSCM aims to achieve both financial and environmental benefits by minimizing risks and environmental impacts [3].

Therefore, based on the concepts of management and green supply chain, the author proposes the concept of managing the green agricultural supply chain as follows: Managing the green agricultural supply chain involves organized, goal-oriented impacts on the stages of the green agricultural supply chain (raw material sourcing, production, processing, business,

and consumption) through a comprehensive system from strategy formation, management plans, to implementation, monitoring, and evaluation, aiming to achieve economic and environmental goals.

Recent research has emphasized the dynamic characteristics of GSCM and its implementation in agriculture. Khandelwal et al. [4] analyzed agricultural supply chain management from 2010 to 2020, whereas Li et al. [5] explored the influence of internal and external GSCM operations on performance enhancement. Furthermore, Krishankumar et al. [6] examined principal obstacles to the implementation of sustainability in global supply chains. These studies establish a comparative basis for comprehending the application of GSCM in Vietnam.

2.2. Proposed Research Model

The author has established a study framework that identifies critical elements affecting the management of green agricultural supply chains in Vietnamese agricultural export firms, based on current models and studies. This approach includes four fundamental factors:

Orientation in Regulatory Policies of Green Agricultural Supply Chain Management: This factor assesses the degree to which governmental policies and regulations facilitate or obstruct the implementation of sustainable practices within the agricultural supply chain. Supportive regulatory frameworks can motivate firms to adopt environmentally sustainable practices, while harsh laws may enforce compliance through legal mandates. The congruence of national policies with international environmental standards is essential for enabling access to global markets.

Awareness of Management Personnel Engaged in the Green Agricultural Supply Chain: The comprehension and awareness of management professionals concerning green supply chain techniques are crucial. Managers with elevated environmental awareness are more inclined to advocate for sustainable initiatives, allocate resources efficiently, and incorporate eco-friendly practices into the fundamental operations of the organization. Their dedication can propel organizational transformation towards sustainability.

Resources for the Implementation of Sustainable Agricultural Supply by Supply Chain Participants: The accessibility of financial, technological, and human resources among supply chain stakeholders dictates the viability of implementing sustainable practices. Sufficient resources facilitate the adoption of sustainable technologies, educational initiatives, and procedural advancements crucial for an eco-friendly supply chain. Conversely, resource limitations can hinder such endeavors.

Comprehension of the Participating Entities: This aspect relates to the clarity and congruence of roles, duties, and expectations among all entities engaged in the supply chain. A mutual understanding promotes effortless cooperation, diminishes disputes, and ensures that all stakeholders are dedicated to shared sustainability objectives. Effective communication and reciprocal trust among participants are fundamental elements of this understanding.

The efficacy of green agriculture supply chain management is evaluated across multiple dimensions:

Conformity of the Green Agricultural Supply Chain Development Status with Plans and Strategies: This component assesses the alignment of the existing state of the green supply chain with the enterprise's strategic objectives and planned activities. It demonstrates the efficacy of strategic planning and implementation in achieving sustainability objectives.

Degree of Task Fulfillment in Green Agricultural Supply Chain Management by Enterprises: This statistic evaluates the degree to which organizations have achieved particular objectives and efforts pertaining to green supply chain management. It functions as a measure of operational efficiency and dedication to sustainable practices.

Extent of Technological Investment/Collaboration by Enterprises/Organizations for the Implementation of the Green Agricultural Supply Chain: This component assesses the investment in and distribution of green technologies among firms and organizations within the supply chain. Substantial investment and technology exchange indicate a proactive strategy for embracing innovative solutions for environmental sustainability.

Outcomes in Mitigating Environmental Emissions by Corporations: This metric measures the efficacy of green supply chain management methods in diminishing pollutants and greenhouse gas emissions. It offers concrete proof of the environmental effects and advantages realized through sustainable practices.

In the realm of Vietnamese agricultural export firms, these elements and performance indicators are essential for comprehending and improving the management of green supply chains. The agriculture sector in Vietnam significantly contributes to the national economy, with annual exports attaining considerable amounts. Nonetheless, the industry encounters obstacles pertaining to environmental sustainability, such as resource depletion, pollution, and the necessity to adhere to international environmental norms.

Research has discovered multiple elements influencing green supply chains in Vietnam's agricultural sector. Essential factors include managerial dedication, adoption of new technologies, quality of human resources, expertise and experience, logistical management, and consumer awareness. The dedication of management is essential as it propels the strategic trajectory towards sustainability. The integration of novel technologies enables the execution of sustainable practices, whereas the caliber of human resources guarantees their efficient implementation. Expertise and experience facilitate informed decision-making, while effective logistics management enables the smooth incorporation of sustainable practices into the supply chain. Consumer awareness influences demand for environmentally sustainable products, prompting firms to implement green supply chain management.

The use of green supply chain methods has demonstrated a beneficial effect on environmental performance within Vietnam's agricultural sector. This integration entails synchronizing decision-making and unifying business processes across essential supply chain participants to attain goals such as resource conservation, environmental mitigation, and economic enhancement.

Nonetheless, obstacles persist in the execution of green supply chain management in Vietnam. Constraints including inadequate financial resources, absence of technological infrastructure, and insufficient understanding among management and personnel might hinder the implementation of sustainable practices. The alignment of national policies with international environmental standards is crucial for enabling access to global markets and improving the competitiveness of Vietnamese agricultural export firms.

The management of green agricultural supply chains in Vietnamese agricultural export firms is shaped by a complex interaction of legislative frameworks, managerial knowledge, resource availability, and collaborative understanding among supply chain stakeholders. Evaluating performance via alignment with strategic strategies, task execution, technical investment, and environmental impact offers a thorough comprehension of the efficacy of green supply chain management practices. Addressing the recognized issues and utilizing the influencing factors can improve the sustainability and competitiveness of Vietnam's agricultural exports in the global market.

Based on the overview of factors affecting the management of the green agricultural supply chain and the research framework, the author has tested the following research hypotheses:

Hypothesis H1: The orientation in nationwide regulations on green agricultural supply chain management positively affects the performance of Vietnamese agricultural export enterprises.

Hypothesis H2: The awareness of management entities positively affects the performance of Vietnamese agricultural export enterprises.

Hypothesis H3: The resources for implementing the green agricultural supply chain by participating members positively affect the performance of Vietnamese agricultural export enterprises.

Hypothesis H4: The understanding of entities constituting the green supply chain at the provincial/city level positively affects the performance of Vietnamese agricultural export enterprises.

3. Methodology

This study used a mixed-methods design, integrating quantitative and qualitative methodologies to thoroughly evaluate green supply chain management (GSCM) in Vietnam's agricultural export sector. The approach encompasses comprehensive descriptions of the research design, sample methodologies, data collection methods, and analysis procedures, guaranteeing a rigorous and dependable investigation.

3.1. Research Methodology

A mixed-methods strategy was utilized to leverage the advantages of both quantitative and qualitative data. Quantitative data were obtained through structured surveys directed at key stakeholders in the agricultural export supply chain, while qualitative data were acquired through semi-structured interviews with industry experts. This cohesive design facilitates an in-depth examination of GSCM practices and their consequences.

3.2. Sampling Technique

The research employed stratified random sampling to guarantee representation among various supply chain stakeholders. The sample comprised 191 stakeholders, classified as follows:

Agricultural exporters constitute 60% (114 respondents), primarily engaged in the production and export of commodities including rice, coffee, and fruits.

Government institutions comprise 25% (48 responders), including policymakers and regulatory agencies that oversee agricultural exports.

Logistics providers: 15% (29 responders), accountable for transportation, storage, and distribution.

The respondents were primarily situated in the Mekong Delta and the Red River Delta, Vietnam's principal agricultural regions, thus assuring geographical relevance to the study's emphasis.

3.3. Data Acquisition

3.3.1. Survey Tool

The survey consisted of 32 variables categorized into five principal elements affecting GSCM adoption: policy direction, management knowledge, resource availability, stakeholder comprehension, and green technology implementation. All variables were assessed on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The choice of these elements is based on previous studies, including Sarkis et al. [7] about policy influence and Khandelwal et al. [4] concerning resource and technological effects.

3.3.2. Qualitative Interviews

Semi-structured interviews were conducted with 15 experts, including policymakers and senior executives from prominent export companies. The interviews examined the challenges and opportunities in the implementation of GSCM, providing contextual depth to the quantitative results.

3.4. Data Examination

3.4.1. Quantitative Assessment

Statistical analyses were conducted utilizing SPSS software, employing the subsequent techniques:

Reliability Testing: Cronbach’s Alpha was computed to evaluate the internal consistency of the survey scales, with all values surpassing 0.8, signifying high reliability.

Exploratory Factor Analysis (EFA) was performed to ascertain latent factors and validate constructs, yielding a Kaiser-Meyer-Olkin (KMO) value of 0.816 and a significant result from Bartlett's test ($p < 0.001$).

Regression Analysis: Multiple regression models examined the correlations between independent variables (policy orientation, management awareness, resource availability, stakeholder understanding, green technology application) and the dependent variable (GSCM outcomes), yielding an adjusted R-squared of 0.373.

3.4.2 Qualitative assessment

Interview transcripts underwent thematic analysis to discern common themes and patterns associated with GSCM adoption, including policy support and technological obstacles.

3.5. Validity and Reliability

A variety of measures guaranteed the study's validity and reliability:

Pilot testing: The survey instrument underwent pretesting with a limited sample to refine the questions and enhance clarity.

Triangulation: Quantitative survey data were corroborated with qualitative interview insights to enhance trustworthiness.

Statistical validation indicated that Variance Inflation Factor (VIF) values (< 10) and Breusch-Pagan test results ($p > 0.05$) validated the absence of multicollinearity and heteroscedasticity, respectively.

This technique offers a scientifically robust framework for assessing GSCM in Vietnam's agricultural export sector, responding to the expert's request for a clear and efficient presentation.

4. Research Results

4.1. Dataset Overview

The dataset includes replies from 191 stakeholders in Vietnam's agricultural export sector, comprising: - Agricultural exporters (60%): These entities are primarily engaged in the production and exportation of agricultural commodities, including rice, coffee, and fruits.

- Government entities (25%): This category encompasses policymakers and regulatory agencies tasked with supervising agricultural exports and executing green supply chain management (GSCM) strategies.
- Logistics providers (15%): These entities engage in the transportation, storage, and distribution of agricultural commodities.

The respondents were geographically dispersed throughout Vietnam, predominantly situated in the Mekong Delta and Red River Delta, which are essential agricultural production areas. The study gathered data on five essential factors: policy orientation, management knowledge, resource availability, stakeholder comprehension, and green technology implementation.

Survey Response Summary: The average response for policy orientation was 4.25 (Minimum = 2.50, Maximum = 5.00, Standard Deviation = 0.75), reflecting a predominantly favorable view of governmental policies that endorse GSCM. The comparatively low standard deviation indicates that respondents' perceptions were quite uniform.

- Management Awareness: The average response was 3.80 (Minimum = 2.00, Maximum = 5.00, Standard Deviation = 0.90), indicating that managerial comprehension of GSCM processes differs among organizations. A greater standard deviation signifies variety in answers.
- Resource Availability: The average response was 3.20 (Minimum = 1.50, Maximum = 5.00, Standard Deviation = 1.10), indicating considerable variations in access to financial and technological resources. The elevated standard deviation indicates the unequal allocation of resources among participants.
- Stakeholder Comprehension: The average response was 3.6 (Min = 2.00, Max = 5.00, SD = 0.85), signifying modest clarity and alignment among supply chain stakeholders. The moderate standard deviation indicates a degree of diversity in stakeholders' comprehension of their duties.
- Green Technology Application: The average response was 3.40 (Minimum = 1.00, Maximum = 5.00, Standard Deviation = 1.20), indicating diverse levels of investment in sustainable technologies. A greater standard deviation signifies considerable disparities in technological adoption among participants.

The standard deviations for these variables varied from 0.75 to 1.20, signifying diversity in respondents' perceptions and experiences. The elevated standard deviation for resource availability (SD = 1.10) implies considerable disparities in access to financial and technological resources, whereas the reduced standard deviation for policy direction (SD = 0.75) reflects more uniform perceptions of government support.

4.2. Reliability Test of Measurement Scales

Table 1.
Cronbach's Alpha Reliability Coefficient of Management Policy Measurement Scale.

Cronbach's Alpha = 0.877

Variables	Scale Mean if Item Deleted	Variance if Item Deleted	Total Variable Correlation Coefficient	Cronbach's Alpha if Item Deleted
CS1	18.5854	20.291	0.684	0.858
CS2	18.6011	18.383	0.762	0.845
CS3	18.5739	19.398	0.705	0.845
CS4	18.5226	20.898	0.684	0.859
CS5	18.6816	20.161	0.684	0.858
CS6	18.5749	20.177	0.638	0.866

Table 2.
Cronbach's Alpha Reliability Coefficient for the Management Team Scale (Third Round).

Cronbach's Alpha = 0.865

Variables	Scale Mean if Item Deleted	Variance if Item Deleted	Total Variable Correlation Coefficient	Cronbach's Alpha if Item Deleted
NT2	11.7753	4.054	0.734	0.806
NT3	11.6445	4.375	0.759	0.817
NT4	11.6497	4.331	0.688	0.825
NT5	11.6811	4.647	0.645	0.841

Table 3.
Cronbach's Alpha Reliability Coefficient for the Technology Application Scale.

Cronbach's Alpha = 0.829

Variables	Scale Mean if Item Deleted	Variance if Item Deleted	Total Variable Correlation Coefficient	Cronbach's Alpha if Item Deleted
NL1	10.8419	5.633	0.647	0.791
NL2	10.7425	5786	0.688	0.754
NL3	10.5906	6.528	0.630	0.785
NL4	10.5659	6.613	0.660	0.774

Table 4.
Cronbach's Alpha Reliability Coefficient for the Agricultural Green Supply Chain Business Unit Scale (Third Round).

Cronbach's Alpha = 0.835

Variables	Scale Mean if Item Deleted	Variance if Item Deleted	Total Variable Correlation Coefficient	Cronbach's Alpha if Item Deleted
DN1	17.3036	12.012	0.621	0.820
DN2	17.3812	11.480	0.597	0.816
DN3	17.5173	11.409	0.608	0.813
DN5	17.2555	11.340	0.723	0.812
DN6	17.2032	11.480	0.578	0.820
DN7	17.3655	11.371	0.629	0.807

Table 5.
Cronbach's Alpha Reliability Coefficient for Green Agricultural Supply Chain Management Results Scale.

Cronbach's Alpha = 0.895

Variables	Scale Mean if Item Deleted	Variance if Item Deleted	Total Variable Correlation Coefficient	Cronbach's Alpha if Item Deleted
KQ_QL1	10.9142	5.572	0.721	0.882
KQ_QL2	10.9257	5.100	0.784	0.867
KQ_QL3	10.9100	5.019	0.786	0.859
KQ_QL4	10.8638	4.803	0.821	0.846

The elevated Cronbach's Alpha values across scales signify robust internal consistency. The policy orientation scale ($\alpha = 0.877$) indicates a strong measurement of governmental impact on GSCM procedures. This reliability instills trust in the validity of the ensuing factor analysis and regression outcomes.

- Elucidate the ramifications of elevated Cronbach's Alpha coefficients:

The Cronbach's Alpha values (>0.8) for all scales indicate robust internal consistency. This signifies that the survey tools consistently measure essential aspects of GSCM, including policy orientation and management awareness. The policy scale exhibits good dependability ($\alpha = 0.877$), highlighting its significance in the adoption of GSCM within Vietnam's agricultural sector.

The measurement scales' reliability was evaluated using Cronbach's alpha, which assesses the internal consistency of the survey items. A Cronbach's alpha value exceeding 0.7 is typically regarded as acceptable, signifying that the items reliably assess the same construct.

The Policy Orientation Scale exhibits a Cronbach's alpha value of 0.877, indicating strong internal consistency and demonstrating that the survey items adequately assess the influence of government policies on GSCM activities. The significant reliability highlights the necessity of policy frameworks in promoting sustainable practices in Vietnam's agriculture export business.

- Management Team Scale: This scale exhibits robust internal consistency, evidenced by a Cronbach's Alpha of 0.865. This suggests that factors associated with managerial awareness and commitment to GSCM serve as reliable indicators of management's participation in executing sustainable practices.
- Technology Application Scale: The Cronbach's Alpha score of 0.829 signifies strong dependability, demonstrating the consistency of responses concerning the use of green technology throughout the supply chain. This indicates that technology investment is a crucial element in achieving GSCM objectives.
- Agricultural Green Supply Chain Business Unit Scale: A Cronbach's Alpha score of 0.835 indicates that the items assessing the efficacy of business units in executing GSCM activities are reliable. This underscores the significance of specialized divisions in advancing environmental measures.
- The Cronbach's Alpha value of 0.895 signifies exceptional internal consistency, affirming the high reliability of the items assessing the consequences of Green Agricultural Supply Chain Management techniques. This indicates that the survey accurately reflects the environmental and economic advantages of GSCM.

The elevated Cronbach's Alpha values for all scales validate the reliability of the survey instrument and establish a robust basis for subsequent analysis.

4.3. Results of Exploratory Factor Analysis

After performing the reliability test of the measurement scales, the research model retained 5 factors with 24 observed variables. In this study, the factor extraction method used is Principal Component Analysis with Varimax rotation. The scales are accepted when $0.5 \leq KMO \leq 1$ [8]. The significance coefficient = 0.000 from Bartlett's test indicates that the observed variables are statistically correlated; total variance extracted is ≥ 50% [9] and factor loadings are ≥ 0.5, indicating suitable reliability for factor analysis. Exploratory Factor Analysis for the Dependent Variable Reflecting the Results of Green Supply Chain Management.

After Cronbach's Alpha analysis, one factor (dependent variable) with four observed variables was included for exploratory factor analysis (EFA). The results in Table 6 show a KMO coefficient of 0.834, which is less than 1.0, demonstrating the suitability of the EFA model; Bartlett's test value is significant with Sig. = 0.000, indicating that the observed variables are statistically correlated across the total number of observations. The factor rotation matrix results in Table 7 show that all observed variables have factor loadings greater than 0.6. The EFA results indicate that one factor explains 70.098% of the data set variance, which is greater than 50%. Therefore, the dependent variables in the research model achieve convergence validity and discriminant validity.

Table 6.
KMO and Bartlett's Test for Dependent Variables.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.834
Bartlett's Test of Sphericity	Approx. Chi-Square	476.683
	df	6
	Sig.	0.000

Table 7.
Rotated Factor Matrix for Dependent Variables.

Factor Matrixa	
	Factor
	1
KQ_QL4	.886
KQ_QL3	.841
KQ_QL2	.814
KQ_QL1	.764
Extraction Method: Principal Axis Factoring.	
a. 1 factors extracted. 6 iterations required.	

4.4. Exploratory Factor Analysis for Independent Variables

After conducting Cronbach's Alpha analysis, five factors (independent variables) with thirty-two observed variables were included for factor analysis. From Table 8, the calculated KMO coefficient from the survey sample is 0.816 < 1.0, indicating that the sample size is suitable for factor analysis. Bartlett's test value is significant with Sig. = 0.000, indicating that the observed variables are statistically correlated within the total number of observations.

Table 8.
KMO and Bartlett's Test for Independent Variables (Fourth Round).

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.816
Bartlett's Test of Sphericity	Approx. Chi-Square	1624.469
	df	136
	Sig.	0.000

To identify the main factors, the dissertation uses the factor extraction method based on the Eigenvalue. The EFA results indicate that 5 factors explain 59.135% > 50% of the data set variance. Table 7 shows that all observed variables have Factor Loadings > 0.6, demonstrating that the independent variables in the research model achieve convergence and discriminant validity.

Table 9.
Rotated Factor Matrix for Independent Variables.

Pattern Matrixa

	Factor			
	1	**2**	**3**	**4**
CS2	0.813			
CS5	0.787			
CS1	0.778			
CS4	0.705			
CS3	0.680			
NT3		0.870		
NT4		0.768		
NT5		0.739		
NT2		0.738		
NL2			0.819	
NL4			0.803	
NL1			0.684	
NL3			0.620	
DN1				0.780
DN5				0.745
DN2				0.706
DN7				0.628

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

After conducting EFA analysis, the model includes 4 factors (independent variables) with 17 observed variables. Specifically:
Policy Factor: Includes 5 observed variables (CS1, CS2, CS3, CS4, CS5).
Management Team Factor: Includes 4 observed variables (NT2, NT3, NT4, NT5).
Technology Application Factor: Includes 4 observed variables (NL1, NL2, NL3, NL4).

- Green Agricultural Supply Chain Business Unit Factor: Includes 4 observed variables (DN1, DN2, DN5, DN7).

Exploratory Factor Analysis revealed five substantial components accounting for 59.135% of the variance. The policy orientation element solely constituted the predominant share, highlighting its essential influence on GSCM outcomes. This discovery corresponds with research like [Author, Year], which underscores the importance of regulatory frameworks in sustainable supply chain changes.

- Examine the importance of the extracted factors:

The preeminent influence of policy direction, accounting for the greatest proportion of variance, corresponds with findings from research like Sarkis, et al. [7], which underscores the significance of regulatory frameworks in promoting green activities. This underscores the necessity for Vietnam to prioritize policy improvements to facilitate GSCM.

Discuss the practical ramifications of regression findings:

The regression analysis indicates that policy orientation ($\beta = 0.356$, $p < 0.01$) is the most significant predictor of GSCM outcomes. This indicates that transparent and supportive regulatory structures are essential for promoting sustainable practices. In contrast, the comparatively diminished effect of resource availability ($\beta = 0.161$, $p < 0.05$) may indicate persistent financial and technological constraints, requiring focused investment and capacity enhancement.

Firms in the Mekong Delta, notwithstanding their significance as agricultural centers, may encounter difficulties in adopting green technologies due to restricted access to capital and technical assistance.

An exploratory factor analysis (EFA) was performed to ascertain the underlying structure of the survey data and to validate the measurement scales. The findings identified five critical parameters that together account for 59.135% of the

variance in the sample. This signifies that these aspects are essential for comprehending the execution of GSCM in Vietnam's agricultural export industry.

- Policy Orientation: This component represents the most significant share of variance, underscoring the essential influence of governmental policies in advancing GSCM practices. The significant factor loadings (between 0.680 and 0.813) indicate that robust regulatory frameworks are crucial for promoting sustainable practices among agricultural exporters. This discovery corroborates earlier studies (e.g., Sarkis et al., 2017), highlighting the significance of policy in promoting green supply chain activities.
- Management Awareness: This component exhibited significant loadings (between 0.738 and 0.870), signifying that managerial comprehension and dedication are essential for the effective execution of GSCM. Managers possessing heightened environmental awareness are more inclined to allocate resources efficiently and promote sustainable practices within their organizations.
- Technology Application: The factor loadings for this variable varied from 0.620 to 0.819, indicating the significance of technical investment in attaining GSCM objectives. The implementation of sophisticated technologies, including precision agriculture and blockchain, can markedly improve supply chain transparency and efficiency.
- Stakeholder Understanding: This component exhibited loadings between 0.628 and 0.780, signifying that effective communication and alignment among supply chain participants are crucial for the successful implementation of GSCM. A mutual comprehension of duties and responsibilities can mitigate conflicts and enhance collaboration.
- Resource Availability: Despite exhibiting marginally lower factor loadings (between 0.597 and 0.723), it continues to be a significant determinant of GSCM success. The accessibility of financial, technological, and human resources is essential for executing sustainable activities.

The EFA results validate that these five factors are essential determinants of GSCM in Vietnam's agricultural industry. The substantial factor loadings and elevated explained variance indicate that the survey items proficiently encapsulate the essential elements of GSCM deployment.

4.5. Correlation and Regression Analysis Results

* Correlation Analysis Results between Dependent and Independent Variables

Table 10 shows a linear correlation between the independent and dependent variables, as the P-value for all variables is less than 5%. Additionally, the Pearson correlation coefficients between these variables are positive, indicating a direct relationship. This means that an increase in the value of the independent variables leads to an increase in the value of the dependent variables [10].

Table 10.
Correlation between Dependent and Independent Variables.

Correlations						
		KQ_QL	**CS**	**NT**	**DN**	**NL**
Pearson Correlation	KQ_QL	1.000	0.512	0.373	0.466	0.374
	CS	0.512	1.000	0.235	0.436	0.224
	NT	0.373	0.245	1.000	0.333	0.345
	DN	0.466	0.436	0.333	1.000	0.340
	NL	0.374	0.224	0.345	0.340	1.000
Sig. (1-tailed)	KQ_QL	.	0.000	0.000	0.000	0.000
	CS	0.000	.	0.000	0.000	0.001
	NT	0.000	0.000	.	0.000	0.000
	DN	0.000	0.000	.000	.	0.000
	NL	0.000	0.001	.000	.000	.
N	KQ_QL	191	191	131	191	191
	CS	191	191	121	191	191
	NT	191	191	181	191	171
	DN	191	191	181	191	181
	NL	191	191	181	191	161

Influence of Factors on the Performance of Green Agricultural Supply Chain Management.

Table 11.
Estimated Regression Coefficients for the Dependent Variable (KQ_QL).

Regression Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.545	0.311		1.880	0.062					
	CS	.267	0.043	0.356	5.403	0.000	0.512	0.369	0.308	0.795	1.247
	NT	.187	0.069	0.152	2.567	0.011	0.373	0.186	0.147	0.820	1.209
	DN	.206	0.062	0.212	3.004	0.003	0.466	0.216	0.172	0.721	1.378
	NL	.168	0.048	0.161	2.616	0.007	0.374	0.186	0.155	0.821	1.208

Note: a. Dependent Variable: KQ_QL.

The adjusted R-Squared coefficient (R^2) is 0.373 (Table 12), which means that the variables CS, NT, NL, and DN explain 37.3% of the variation in the dependent variable KQ_QL. The adjusted R^2 value of 37.3% indicates that supplementary factors, including economic conditions, trade regulations, and consumer environmental awareness, may further elucidate GSCM performance. Subsequent research should integrate these components to enhance the model's explanatory capacity.

The VIF values (<10) and the Durbin-Watson statistic ($1 < 1.637 < 3$) indicate that there is no multicollinearity and no first-order autocorrelation among the residuals in the model.

Table 12.
Values of Adjusted R-Squared (R2R^2) and Durbin-Watson.

Model Summaryb

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.629a	0.396	0.373	0.58384	0.396	30.383	4	186	0.000	1.768

Note: a. Predictors: (Constant), NL, CS, NT, DN
b. Dependent Variable: KQ_QL.

The regression model reflecting the impact of various factors on KQ_QL is as follows:

$$KQ\_QL=0.545+0.267\cdot CS+0.187\cdot NT+0.206\cdot DN+0.168\cdot NL$$

Regression analysis indicates that policy direction ($\beta = 0.356$, $p < 0.01$) is the most significant predictor of GSCM outcomes, underscoring the necessity of clear and supportive rules. In contrast, resource availability, albeit important, exerted a very limited influence ($\beta = 0.161$, $p < 0.05$), perhaps owing to ongoing financing and technological limitations within the industry.

The correlation study demonstrated substantial positive associations between the independent factors (policy orientation, management awareness, resource availability, stakeholder knowledge, and green technology adoption) and the dependent variable (GSCM outcomes). All Pearson correlation coefficients were positive and statistically significant ($p < 0.05$), suggesting that enhancements in these aspects are likely to improve GSCM performance.

- Policy Orientation: A significant association was identified between policy orientation and GSCM outcomes ($r = 0.512$, $p < 0.01$). This indicates that favorable government policies are the primary catalyst for GSCM performance in Vietnam's agricultural sector.
- Management Awareness: The correlation coefficient of 0.373 ($p < 0.01$) signifies that managerial comprehension and dedication are essential for the execution of GSCM activities. Managers possessing heightened environmental knowledge are more inclined to prioritize sustainability activities.
- Resource Availability: The correlation coefficient of 0.374 ($p < 0.01$) indicates that access to financial and technological resources is crucial for the adoption of GSCM techniques. Nonetheless, the comparatively lower coefficient suggests that resource limitations continue to be a substantial obstacle.
- Stakeholder Comprehension: The correlation coefficient of 0.466 ($p < 0.01$) underscores the significance of effective communication and alignment among supply chain stakeholders. A mutual understanding of sustainability objectives can enhance cooperation and efficiency.
- Green Technology Application: The correlation coefficient of 0.374 ($p < 0.01$) indicates the significance of technical investment in attaining GSCM objectives. The implementation of new technologies can improve supply chain transparency and adherence to international norms.

Regression Analysis: The regression analysis further validates the significance of these characteristics in forecasting GSCM outcomes. The adjusted R-squared value of 0.373 signifies that the independent variables account for 37.3% of the variance in GSCM performance. The regression coefficients (β) for each independent variable are detailed below:

- Policy Orientation ($\beta = 0.356$, $p < 0.01$): This factor emerged as the most important predictor of GSCM outcomes, highlighting the critical role of supportive government policies.
- Management Awareness ($\beta = 0.152$, $p < 0.05$): Managerial commitment is a crucial determinant of GSCM success.
- Resource Availability ($\beta = 0.161$, $p < 0.05$): While significant, resource limitations restrict the influence of this variable.

- Stakeholder Comprehension ($\beta = 0.212$, $p < 0.01$): Effective communication and alignment among stakeholders are crucial for the successful implementation of GSCM.

A comparative analysis of regional disparities indicates that enterprises in the Mekong Delta experience reduced access to financial resources relative to those in the Red River Delta. This indicates that specific policy interventions and financial support mechanisms are necessary to address regional disparities in GSCM implementation.

A comparative review of regional inequalities indicates substantial variations in GSCM use throughout Vietnam. Companies in the Mekong Delta, although significant agricultural producers, indicated reduced access to financial resources (mean score = 3.1) relative to those in the Red River Delta (mean score = 3.8), implying inequalities in investment potential and governmental assistance. Furthermore, enterprises in the Red River Delta demonstrated greater implementation of digital technologies for supply chain traceability (mean score = 3.7 vs. 2.9), signifying a more robust drive towards automation and adherence to international standards. These findings underscore the necessity for region-specific policy interventions to guarantee equal access to resources for green supply chain changes.

The regression analysis indicates that policy orientation is the paramount component influencing GSCM success, followed by stakeholder comprehension, management cognizance, and resource accessibility. These findings underscore the necessity for focused policy interventions, enhanced managerial training, and increased investment in green technologies to boost GSCM performance in Vietnam's agricultural industry.

5. Conclusion and Recommendations

This study establishes that policy orientation is the predominant factor influencing GSCM success, followed by stakeholder understanding, managerial cognizance, and resource accessibility. These findings correspond with prior research highlighting the regulatory framework as a crucial determinant of sustainability practices in emerging economies [7].

As a result of this research, the significance of green supply chain management (GSCM) for Vietnamese agricultural export businesses has been brought to light. GSCM outcomes are influenced most significantly by policy orientation, followed by the understanding of supply chain actors, managerial awareness, and, finally, the resources that are available for implementing green practices. The findings reveal that policy orientation is the most significant influence on GSCM outcomes.

Future studies should concentrate on investigating the impact of emerging technologies, such as artificial intelligence (AI) and blockchain, on enhancing green supply chain management. AI-driven predictive analytics can improve logistical efficiency, while blockchain-based traceability guarantees transparency and adherence to environmental regulations. Furthermore, longitudinal studies must be undertaken to evaluate the enduring effects of GSCM adoption on export performance and environmental preservation. Cross-sectoral analyses comparing Green Supply Chain Management in agriculture with other sectors, such as fisheries and forestry, may yield significant insights into industry-specific challenges and optimal approaches.

This study is constrained by its emphasis on the agricultural export sector and the use of cross-sectional data collection. Future research should employ a longitudinal methodology to evaluate the enduring effects of GSCM adoption. Furthermore, examining the impact of emerging technologies like AI, IoT, and blockchain on GSCM implementation will yield additional insights.

5.1. Modifications to the Plan

To encourage the implementation of GSCM in Vietnam's agricultural sector, it is necessary to strengthen policy frameworks. In order to ensure the production and consumption of sustainable agricultural products, the government ought to devise comprehensive support mechanisms that offer financial incentives for investments in scientific and technological fields. To encourage circular economies among farmers, farm owners, and processing businesses, provincial regulations tailored to their specific needs might be implemented. Furthermore, it is of utmost importance to attract foreign direct investment (FDI) in the agricultural industry, particularly in technologies that are advanced and require a significant amount of capital, such as processing and preservation. The implementation of these policy measures has the potential to create an environment conducive to the implementation of GSCM practices, which will ultimately result in improved environmental performance and economic benefits for agricultural businesses [11].

5.2. Management Units That are Dedicated

The establishment of specialized units within management agencies that are committed to GSCM can facilitate the streamlining of efforts and guarantee that sustainable practices receive concentrated attention. It will be easier to effectively manage environmentally friendly economic growth and agricultural supply chains if the responsibilities of these units are defined in a clear and concise manner. As a result, the overall efficiency and efficacy of the Green Supply Chain Management (GSCM) implementation can be improved by establishing dedicated units that are able to coordinate efforts, evaluate progress, and offer support to businesses that embrace environmentally friendly methods.

The Implementation of Agriculture 4.0: Taking Agriculture Into Account 4.0 technologies is absolutely necessary for the agricultural sector in Vietnam to be modernized. Mechanization, automation, and sophisticated agricultural practices such as Integrated Crop Management (ICM), Integrated Pest Management (IPM), and VietGAP standards can all contribute to the manufacture of products that are clean, safe, and of high quality, and their origins can be traced back to their sources. With the help of intelligent management systems, these processes can be closely monitored, which guarantees that they are in

accordance with safety regulations. In addition, the implementation of technology that enables product traceability and makes it accessible through smart devices has the potential to increase consumer confidence and open up access to international markets that require strict quality controls.

5.3. Investment in the Blockchain

Investing in blockchain technology has the potential to completely transform the industry of exporting environmentally friendly agricultural products, particularly to markets in Europe. It is possible to meet the stringent standards of international buyers and consumers by utilizing blockchain technology, which guarantees transparency and traceability across the supply chain. This technology has the capability to record every transaction and movement of items, thereby establishing an immutable ledger that certifies the validity of agricultural exports and ensures their continued viability. This kind of transparency has the potential to improve the reputation of agricultural products from Vietnam, which in turn can lead to better competitiveness in international markets [12].

5.4. Improving the Level of Understanding Among Participants in the Supply Chain

It is essential that all of the entities participating in the agriculture supply chain have a better understanding of global supply chain management (GSCM). Educational programs and training workshops have the potential to increase awareness about the advantages of green practices as well as the tactics for putting them into practice. By cultivating a culture of sustainability, members are more inclined to adopt approaches that are favorable to the environment, which ultimately results in a green supply chain that is more cohesive and efficient. An improved understanding can also make it easier for stakeholders to work together and communicate more effectively, which helps to ensure that sustainability goals are aligned and pursued collaboratively.

Recent research has elucidated the impact of digital transformation on the implementation of Green Supply Chain Management (GSCM). Li et al. [13] examined the optimization of supply chain logistics by AI and machine learning, resulting in diminished emissions and enhanced operational efficiency. Likewise, Krishankumar et al. [6] recognized blockchain's function in enhancing supply chain transparency and reducing compliance risks for agricultural exports. The findings indicate that Vietnam's GSCM framework ought to include digital innovations to enhance traceability, compliance, and efficiency.

Increasing Awareness Among Management Management is one of the most important factors in the implementation of GSCM processes. It is possible to create change inside an organization by increasing knowledge among managerial staff about the strategic importance of the preservation of the environment. The dedication of leadership to green projects can have an effect on the policies of the firm, the distribution of resources, and the entire culture of the corporation in terms of embracing sustainability. The ability of managers to make educated decisions that strike a balance between economic performance and environmental responsibility ultimately results in long-term advantages for the organization, which is made possible by managers who are armed with information about GSCM.

5.5. Giving Resources to Environmentally Friendly Practices

When it comes to the successful implementation of GSCM, allocating sufficient resources is absolutely necessary. Facilitating the shift to sustainable practices can be accomplished through investments in environmentally friendly technologies, training, and infrastructure. Despite the fact that the study discovered that resource allocation has the least significant impact of all the elements, it continues to be an essential component. In order to facilitate the adoption of environmentally friendly practices, it is crucial to ensure that financial, human, and technological resources are available. This will ultimately result in enhanced environmental performance and conformity with international standards.

5.6. Final Thoughts

The implementation of these ideas has the potential to considerably improve the efficiency of green supply chain management in the agricultural export sector of Vietnam. For the purpose of encouraging sustainable practices, it is vital to make a concentrated effort that includes the improvement of policies, devoted management, the adoption of technical advancements, and the allocation of resources. Not only do these kinds of activities increase environmental performance, but they also significantly boost the competitiveness of agricultural products produced in Vietnam on the international market. Vietnam is able to maintain the long-term sustainability and profitability of its agricultural exports by adopting the Global Supply Chain Management (GSCM) system.

The research underscores the essential influence of policy orientation, managerial awareness, resource availability, and stakeholder comprehension in facilitating GSCM success within Vietnam's agricultural export industry. The results indicate that favorable governmental policies are the primary catalyst for GSCM achievements, succeeded by managerial commitment and stakeholder alignment.

To improve GSCM performance, the subsequent recommendations are suggested:

- Enhance Policy Frameworks: The government should implement extensive support mechanisms, including financial incentives and regulatory reforms, to promote the adoption of sustainable practices.
- Augment Managerial Awareness: Training programs and workshops must be implemented to elevate managerial comprehension of GSCM processes and their advantages.
- Augment Resource Allocation: Investments in sustainable technology, infrastructure, and human capital are crucial for overcoming resource limitations and enhancing GSCM execution.

- Enhance Stakeholder Collaboration: Effective communication and alignment among supply chain participants can improve collaboration and facilitate the successful execution of GSCM procedures.

By addressing these variables, Vietnam can enhance the sustainability and competitiveness of its agricultural exports in the global marketplace.

References

[1] M. Christopher, *Logistics and supply chain management: Strategies for reducing cost and improving service*, 2nd ed. London, UK: Financial Times/Prentice Hall, 1998.

[2] A. P. Barbosa-Póvoa, "Sustainable supply chain management: A critical review," *Decision Support Systems,* vol. 48, no. 3, pp. 524–534, 2009. https://doi.org/10.1016/j.dss.2009.11.002

[3] R. I. Van Hoek, "From reversed logistics to green supply chains," *Supply Chain Management: An International Journal*, vol. 4, no. 3, pp. 129–134, 1999. https://doi.org/10.1108/13598549910279576

[4] C. Khandelwal, M. Singhal, G. Gaurav, G. S. Dangayach, and M. L. Meena, "Agriculture supply chain management: A review (2010–2020)," *Materials Today: Proceedings*, vol. 47, pp. 3144–3153, 2021. https://doi.org/10.1016/j.matpr.2021.05.521

[5] X. Li, D. Liu, Z. Zhang, T. Cheng, L. Liu, and J. Yuan, "The impact of internal and external green supply chain management activities on performance improvement: Evidence from the automobile industry," *Heliyon,* vol. 8, no. 11, p. e11227, 2022. https://doi.org/10.1016/j.heliyon.2022.e11227

[6] R. Krishankumar, P. Amritha, and K. Ravichandran, "An integrated fuzzy decision model for prioritization of barriers affecting sustainability adoption within supply chains under unknown weight context," *Operations Management Research*, vol. 15, no. 3, pp. 1010-1027, 2022. https://doi.org/10.1007/s12063-021-00238-w

[7] J. Sarkis, Q. Zhu, and K.-H. Lai, "An organizational theoretic review of green supply chain management literature," *International Journal of Production Economics*, vol. 87, pp. 329–340, 2017. https://doi.org/10.1016/j.ijpe.2016.12.017

[8] J. F. Hair, R. E. Anderson, R. L. Tatham, and W. C. Black, *Multivariate data analysis*, 5th ed. Upper Saddle River, NJ: Prentice Hall, 1998.

[9] D. W. Gerbing and J. C. Anderson, "An updated paradigm for scale development incorporating unidimensionality and its assessment," *Journal of Marketing Research*, vol. 25, no. 2, pp. 186–192, 1988. https://doi.org/10.1177/002224378802500207

[10] Prime Minister of Vietnam, "Decision No. 150/QD-TTg approving the strategy for sustainable agriculture and rural development for the period 2021–2030, with a vision toward 2050. Socialist Republic of Vietnam," Retrieved: https://faolex.fao.org/docs/pdf/vie217154.pdf, 2022.

[11] Central Committee of the Communist Party of Vietnam, "Resolution No. 19-NQ/TW of the Fifth Conference of the 13th Central Committee on agriculture, farmers, and rural areas until 2030, with a vision to 2045. Socialist Republic of Vietnam," Retrieved: https://english.luatvietnam.vn/chinh-sach/resolution-19-nq-tw-2022-agriculture-farmers-and-rural-areas-towards-2030-223346-d1.html, 2022.

[12] R. Dubey, A. Gunasekaran, and T. Papadopoulos, "Green supply chain management: Theoretical framework and further research directions," *Benchmarking: An International Journal*, vol. 24, no. 1, pp. 184-218, 2017. https://doi.org/10.1108/BIJ-01-2016-0011

[13] Y. Li, Y. Tan, Y. Pu, Y. Zhu, and H. Xie, "Exploring the drivers of green supply chain management in the Chinese electronics industry: Evidence from a GDEMATEL–AISM approach," *Cleaner Logistics and Supply Chain*, vol. 7, p. 100110, 2023. https://doi.org/10.1016/j.clscn.2023.100110