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Determinants of Green Finance and SMEs Performance: An Empirical Study in the Vietnamese Agricultural Sector

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ABSTRACT

This study investigates how financial institutions, regulatory frameworks, and enterprise-level initiatives can collectively expand access to green finance for small and medium-sized enterprises (SMEs) in Vietnam's agricultural sector. For financial institutions, three critical points emerge: (1) the development of tailored financial products that address collateral constraints, (2) the strategic adoption of digital finance solutions, and (3) active engagement in capacity-building partnerships with SMEs. Using SmartPLS software and a sample of 245 respondents, the findings show that addressing traditional collateral requirements through innovative financial instruments, such as cash-flow-based lending or guarantees, can significantly enhance SME access to capital for sustainable investments. Integrating digital finance tools, including mobile banking and online loan platforms, enables financial institutions to reduce transaction costs and extend their outreach to underserved rural areas. These innovations are vital in agriculture, where many SMEs lack fixed assets but demonstrate strong operational potential. Complementing the role of financial institutions, supportive regulatory frameworks—including targeted subsidies, green credit lines, and transparent eligibility guidelines—reinforce confidence in green lending. Moreover, SME-level factors such as environmental awareness and managerial capacity are pivotal in ensuring that green finance translates into real-world sustainability outcomes, improving operational efficiency and long-term competitiveness. By aligning financial offerings with sustainability goals, institutions manage risk more effectively and contribute to Vietnam's national green growth and climate resilience agenda. This study highlights the transformative potential of green finance in achieving dual objectives: environmental sustainability

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and economic resilience. Future research should explore emerging digital finance models and collaborative financial mechanisms to empower SMES further and strengthen the green finance ecosystem.

Keywords: Green Finance; Performance; Financial Institutions; Collateral; Regulatory Framework; Environmental Awareness; SMEs; Agricultural Sector

1. Introduction

Green finance has emerged as a pivotal mechanism for enhancing the performance of Small and Medium Enterprises (SMEs) in the agricultural sector, particularly in developing countries like Vietnam. This financial approach promotes sustainable practices and is essential for facilitating access to funds that support environmentally friendly initiatives, thereby enhancing sustainability performance within SMEs [1,2]. The agricultural sector, typically reliant on traditional financing methods such as subsidies, faces significant challenges in financing modern and sustainable agricultural practices. Although all enterprises and cooperatives could secure credit upon providing collateral, none initially received the full amount requested. On average, the disbursed credit met only 80.64%, 43.03%, and 44.28% of the requested amounts for households, cooperatives, and enterprises, respectively. The primary constraint contributing to this credit shortfall is the insufficient availability of high-value collateral. Furthermore, membership in farmer-based unions and formal bank account ownership significantly increase the likelihood of accessing credit. Higher education levels among household heads, larger farm sizes, and belonging to the Kinh ethnic majority are positively correlated with receiving greater credit amounts. In contrast, households engaged in traditional cinnamon farming, those with more dependents, and those lacking union membership are more prone to experiencing credit rationing.

Green finance offers innovative financial instruments such as green credit, bonds, and funds that can alleviate financing constraints by providing SMEs with the necessary capital to invest in green technologies and practices [3]. These financial products address the immediate funding needs of agricultural SMEs and align their operations with broader environmental goals, enhancing their competitiveness and efficiency in an increasingly eco-conscious market. In Vietnam, the integration of green finance has seen a significant push from both the public and private sectors to develop agricultural enterprises that contribute to sustainable development. Findings suggest that the practical application of green finance principles leads to enhanced operational practices within SMEs, promoting innovation and encouraging eco-friendly approaches. Financial institutions in Vietnam are gradually adapting their services to include green financing options tailored to the agricultural needs of small and medium-sized enterprises (SMEs), thereby facilitating their growth and sustainability. Moreover, empirical studies have shown that SMEs adopting green practices and securing green financing can improve their productivity and overall economic performance, highlighting the intrinsic link between sustainable finance and SME success in agriculture. The role of digital finance in promoting sustainable agricultural practices cannot be overlooked, as it has proven to be a transformative tool in this regard. Digital inclusive finance empowers agricultural SMEs by providing easier access to financial resources, enabling them to procure the necessary equipment, achieve modernisation, and sustainably maintain operations [4]. This digital shift not only broadens the financial inclusion of SMEs but also contributes to agricultural innovation and the efficient utilisation of resources, leading to a more sustainable agricultural sector in Vietnam. In general, green finance represents a crucial catalyst for enhancing the performance of SMEs in Vietnam's agricultural sector. Green finance can significantly improve these enterprises' operational capabilities and competitive stance by facilitating access to sustainable funding sources, promoting environmentally friendly practices, and leveraging digital financial solutions. As the agricultural sector continues to evolve, the importance of green finance in ensuring successful transitions toward sustainability will only increase.

The paper consists of the following sections: Section 2, "Literature Review/Theoretical Framework and Methods," encompasses the literature review, hypothesis development, research methods, and methodology. Section 3, "Results and Discussion," presents the main findings and provides a discussion. Finally, Section 4, "Conclusions and Policy Implications," presents the concluding remarks and suggests policy implications.

2. Materials and Methods

Understanding the determinants of green finance and the performance of small and medium-sized enterprises (SMEs) in the Vietnamese agricultural sector is crucial for assessing how these enterprises can contribute to sustainable development amid escalating environmental challenges. Existing literature has highlighted several key dimensions that influence the adoption and effectiveness of green finance, including contextual local factors, leadership characteristics, the involvement of financial institutions, regulatory and policy frameworks, managerial awareness, and the integration of green technologies.

2.1. Conceptual Framework

This study is guided by the central research question: "What factors influence SMEs' adoption of green finance, and how does this adoption affect their performance in Vietnam's agricultural sector?"

To address this question, we propose a conceptual framework (see **Figure 1**) that synthesizes key insights from institutional theory, resource-based view (RBV), stakeholder theory, and leadership theory. This integrative framework systematically maps how internal and external factors influence SMEs' decisions to adopt green finance, and how this adoption subsequently drives performance outcomes.

The framework categorizes influencing factors into external and internal determinants and positions green finance adoption as a mediating construct between these drivers and SME performance, the ultimate outcome.

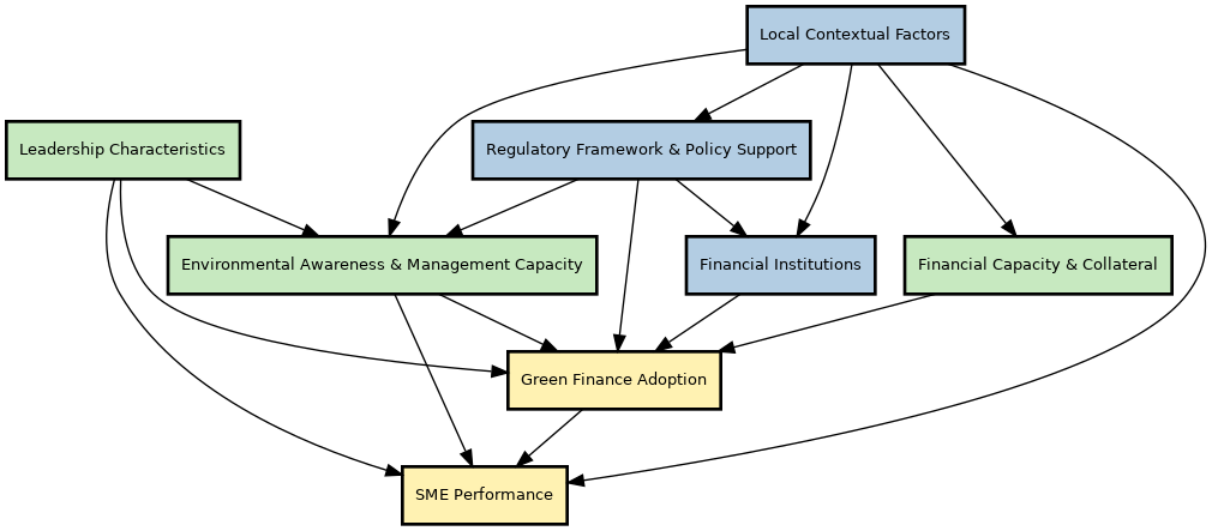

Figure 1. Conceptual Framework.

(1) External Determinants:

Local Factors: These include regional economic strength, supportive local regulations, and technology infrastructure, which collectively create an enabling environment for green finance adoption [5].

Role of Financial Institutions: Financial institutions facilitate SMEs' access to capital by providing tailored financial products and risk mitigation mechanisms such as green credit guarantees, enhancing SMEs' capacity to engage in sustainable investments [6].

Regulatory Framework and Policy Support: Clear regulatory guidelines and targeted policy incentives encourage SMEs to align their practices with sustainability goals, thereby increasing their likelihood of adopting

green finance solutions [7].

(2) Internal Determinants:

Leadership Characteristics: Transformational and ethical leadership fosters a proactive sustainability culture within SMEs, encouraging the adoption of innovative green practices.

Environmental Awareness and Management Capacity: SMEs whose leaders and managers perceive environmental sustainability as a strategic opportunity rather than a compliance obligation are more likely to adopt green finance, leveraging it for competitive advantage and operational efficiency [8,9].

Financial Capacity and Collateral: SMEs with stronger financial capacities and suitable collateral are better positioned to access traditional green financing, although innovative financial mechanisms can also help mitigate collateral-related barriers.

(3) Mediating Construct – Green Finance Adoption:

Green finance adoption is the linchpin of the framework, mediating the relationship between determinants and SME performance. By securing green finance, SMEs can invest in cleaner technologies, reduce operational costs, innovate, and improve their market position [10].

(4) Dependent Construct – SME Performance:

SME performance is conceptualized through metrics such as profitability, efficiency, innovation capacity, and competitive strength. The framework posits that higher engagement with green finance leads to improved performance across these dimensions.

This conceptual framework offers a structured lens to explore the dynamic interconnections influencing green finance adoption and its implications for SME success in emerging economies. The relationships depicted here are further detailed through specific hypotheses (H1–H7) in the following sections.

2.2. Local Factors and Green Finance

Local factors significantly enhance the effectiveness of green finance by providing contextual support for sustainable economic practices. Several studies have identified various local characteristics that facilitate the development of green finance, including regional economic conditions, local policy frameworks, and community engagement.

A notable example is the study by Hong, Zheng [11], which highlights the relationship between local economic factors, such as GDP, and the development of green finance in the Yangtze River Delta of China. The findings suggest that a robust local economy positively influences green finance initiatives. This impact is further reinforced by Ye, Xiang [12], who underscores the importance of regional pilot projects in encouraging governments to adopt and implement more effective green finance policies. Such initiatives contribute to enhancing financial flows toward sustainable development.

In addition to economic factors, local regulations also play a critical role in shaping corporate behaviour toward sustainability. Xue, Dong [13] find that localised green finance policies significantly augment corporate ESG performance, particularly among non-state-owned enterprises and firms in less polluting industries. Their study demonstrates that when businesses are subject to stricter environmental regulations, they are more likely to adopt green practices, improve sustainability metrics, and attract green investments.

The influence of local conditions also extends to innovation in green technologies. Irfan, Razzaq [14] argue that green finance fosters technological innovation within local industries, leading to better environmental performance and lower carbon emissions. This aligns with Sun, Feng [15], who contends that green credit products effectively reduce pollution and emissions at the microeconomic level, thereby contributing to sustainable regional development.

Furthermore, the efficiency of green finance initiatives is tied to local environmental factors. For example, Wang, Elahi [3] observe that the impact of green finance on inclusive economic growth varies by region. Their research notes that central and western areas of China experience more pronounced benefits than eastern regions, which may already have well-developed infrastructures for sustainability. This regional variability underscores the importance of tailoring green finance strategies to the specific environmental and economic contexts in which they are implemented.

In conclusion, local economic and institutional factors critically enhance the effectiveness of green finance by creating enabling conditions for sustainability-ori-

ented investment, supporting the enforcement of regulatory frameworks, and driving innovation in environmentally relevant sectors. Therefore, a comprehensive understanding of these local determinants is essential for designing and implementing green financing mechanisms that contribute meaningfully to long-term sustainable development outcomes.

H1. *Local characteristics have a positive impact on green finance.*

2.3. Characteristics of Leaders and Green Finance

Leaders' characteristics significantly enhance the efficacy of green finance initiatives by fostering environments conducive to sustainability and innovation. Effective leadership traits, transformational leadership and a commitment to green principles, are crucial in directing an organisation's focus towards achievable environmental goals, positively influencing green finance outcomes.

Transformational leadership has been identified as a powerful driver of sustainable business performance. Unlike transactional leaders, transformational leaders inspire employees to exceed standard expectations, fostering an organisational culture prioritising green initiatives. Siregar, Afiff [16] notes that this leadership approach can significantly boost productivity and employee commitment to sustainable finance projects, ultimately improving financial performance and advancing environmental stewardship.

In addition to transformational leadership, integrating Green Human Resource Management (GHRM) principles has been linked to effective leadership practices. Hidayat and Abdurachman [17] highlight how leaders play a pivotal role in embedding GHRM into organisational strategy, thereby cultivating a culture of environmental awareness and driving the adoption of green finance mechanisms.

Servant leadership also contributes meaningfully to organisational sustainability. Research by Darvishmotevali and Altinay [18] demonstrates that servant leadership enhances environmentally conscious behaviours by focusing on service and community-building. This leadership style strengthens the connection between GHRM and green organisational performance, reinforcing the implementation of sustainable finance strategies.

Similarly, authentic leadership fosters extra-role behaviours among employees that support sustainability goals. According to Farrukh, Rafiq [19], this leadership style enhances trust and moral commitment within organisations, essential for successful green finance implementation.

Green entrepreneurial leadership further contributes to sustainability performance and innovation. Nivedha and Prabadevi [20] observe that leaders who exemplify this style are more likely to implement effective green initiatives due to their proactive and environmentally committed approach. These leaders help organisations become more agile and competitive in emerging sustainable markets.

Beyond the organisational level, leadership also influences industry-wide green finance practices. Song, Tao [21] argue that effective leadership can optimise industrial structures by reducing financing costs for environmentally responsible firms while increasing costs for polluters, thereby incentivising cleaner production. Wang and Zhang [22] support this, showing that green finance policies guided by strategic leadership can catalyse corporate green innovation, reinforcing the link between leadership and positive environmental outcomes.

In summary, leadership characteristics, particularly transformational, servant, authentic, and green entrepreneurial styles, play a critical role in shaping green finance strategies. These leadership approaches cultivate organisational cultures that value sustainability, enhance employee engagement, and promote innovation. Collectively, they contribute to advancing green finance adoption, improving competitiveness, and supporting broader sustainability and financial performance goals.

H2. *The characteristics of leaders have a positive impact on green finance.*

2.4. Environmental Awareness, Management Capacity of Enterprises and Green Finance

An enterprise's environmental awareness and management capacity significantly influence its adoption of green finance. This relationship encompasses managerial attitudes, corporate strategies, and financial mechanisms that promote sustainable practices.

Firstly, top management's environmental awareness is critical in shaping an enterprise's environmental strategy. Research indicates that when managers perceive environmental issues as opportunities rather than threats, they are more likely to adopt proactive environmental strategies aligned with green finance initiatives [8]. This proactive stance enhances a firm's reputation and increases its attractiveness to green financing opportunities, which are often tied to environmental performance metrics [3].

Secondly, SMEs demonstrating a strong commitment to sustainability tend to experience better access to green finance. Financial institutions are more inclined to support enterprises that showcase robust environmental management practices [9]. Empirical evidence suggests that such firms contribute positively to their communities and ecosystems, thereby fulfilling core objectives of green finance [23].

Moreover, external pressures from stakeholders, particularly regulatory bodies and consumers, play a pivotal role in shaping SMEs' environmental strategies. As public awareness of environmental concerns grows, enterprises must adopt sustainable practices to comply with regulations and maintain market competitiveness. These external pressures can also amplify the impact of green finance policies, making firms that proactively implement sustainability measures more likely to receive financial incentives and institutional support [24].

Finally, technological innovation and adopting green practices are essential mediators between green finance and enterprise performance. Green finance facilitates investment in cleaner technologies, improving operational efficiency and reducing environmental impact [12]. This innovation cycle is especially critical for SMEs, strengthening their competitive positioning and aligning their operations with the increasing demand for sustainable products and services [25].

H3. *Environmental awareness and management capacity of enterprises positively impact green finance.*

2.5. Role of Financial Institutions in Green Finance

Financial institutions are crucial in facilitating green finance for small and medium-sized enterprises (SMEs). Nguyen, Do [1] emphasised that local and foreign-owned commercial banks in Vietnam increasingly adopt green financing practices essential for supporting sustainable development initiatives. These banks offer tailored financial products encouraging SMEs to invest in environmentally friendly technologies and sustainable business practices.

However, the lack of long-term financing and the low rate of return on green investments remain key challenges. Taghizadeh-Hesary and Yoshino [26] identify these factors as significant barriers to investment in renewable energy projects. They argue that public financial institutions can play a central role in mitigating these obstacles by introducing green credit guarantee schemes, which can help de-risk green investments and incentivise broader SME participation.

As intermediaries in the green finance ecosystem, financial institutions are pivotal in providing the capital needed for SMEs to transition toward sustainability. Liu and Tobias [6] describe green finance as a transformative model that facilitates low-carbon transitions among enterprises. By offering financing instruments tailored to support renewable energy and eco-innovation, financial institutions can significantly strengthen SMEs' ability to adopt sustainable practices, particularly in developing economies like Vietnam, where SMEs face considerable barriers to traditional financing channels.

Further contributions by Taghizadeh-Hesary and Yoshino [26] reinforce the importance of enabling long-term green investments through public-sector involvement. They propose that green credit guarantee schemes can lower the perceived risk of green projects and enhance financial institutions' willingness to extend credit to SMEs engaged in environmentally responsible initiatives.

One of the primary challenges for SMEs remains limited access to capital. Qin and Hong [27] explores supply chain finance (SCF) as an innovative mechanism that addresses these constraints. By enabling SMEs to leverage receivables or inventory as collateral, SCF im-

proves liquidity and promotes sustainable practices within supply chains, thereby enhancing SMEs' overall performance and competitiveness.

Lastly, Ozili [28] highlights the importance of financial inclusion in expanding access to green finance. Ensuring that SMEs can access a range of financial services, particularly through digital finance, can reduce transaction costs and improve the efficiency of fund disbursement. This is especially pertinent in emerging economies, where digital platforms offer a scalable solution to reach underserved SME segments and encourage their engagement in green initiatives.

H4. *Financial institutions have a positive impact on green finance.*

2.6. Regulatory Framework and Policy Support

The regulatory environment significantly impacts the effectiveness of green finance in Vietnam. Tran [29] discusses how government policies can influence CO_2 emissions and the broader economic landscape, highlighting that well-structured regulations can enhance the efficacy of green finance. Regulatory frameworks establish the rules and guidelines governing financial practices, including those tied to sustainability.

A robust regulatory environment can incentivise SMEs to adopt environmentally friendly practices by providing clear guidance and support mechanisms. For instance, emphasises that the Vietnamese government has introduced supportive policies such as credit packages with preferential interest rates. These initiatives improve access to finance and encourage SMEs to invest in green technologies, enhancing competitiveness.

In addition to regulatory clarity, the integration of green corporate governance is critical. Wang, Liu [7] underline the role of regulatory frameworks in fostering sustainable performance through the adoption of green finance principles. This alignment allows SMEs to meet environmental performance metrics increasingly linked to eligibility for green finance products.

Policy supports also plays a central role in scaling access to green finance. Public funding and financial incentives empower SMEs to innovate and adopt environmentally sustainable practices. Cecere, Corrocher [30] argue that while regulatory guidance is necessary, the actual availability of financial resources, both public and private, is often a more decisive factor in enabling eco-innovation.

However, barriers to accessing finance remain a persistent challenge. Gaglio, Kraemer-Mbula [31] identify high costs and limited infrastructure as significant impediments to SME engagement in green finance. Therefore, policy strategies must be targeted and pragmatic, addressing these barriers directly to foster an enabling environment for green transition.

Fiscal instruments such as environmental taxes and subsidies can further influence SME behaviour. Tingbani, Salia [10] note that while green taxes can promote eco-innovation, their impact may be limited without complementary incentives. This underscores the need for comprehensive government action that combines regulatory mandates with financial support to drive meaningful change.

Finally, integrating green finance into broader macroeconomic and supply chain policies is essential. Qin and Hong [27] emphasized the importance of government participation in supply chain finance as a tool for advancing sustainable development. Such integration creates a cohesive ecosystem that encourages SMEs to pursue green initiatives while addressing financial limitations.

H5. *Regulatory framework and policy support positively impact green finance.*

2.7. Financial Capacity, Collateral and Green Finance

Financial capacity and collateral requirements significantly impact the accessibility of green finance for small and medium-sized enterprises (SMEs). Financial capacity refers to SMES' ability to secure funding for operational needs, including investments in green technologies. However, limited financial capacity has been consistently identified as a significant barrier to green finance adoption among SMEs.

Calabrese, Girardone [32] emphasized that restricted access to external financing is a critical challenge for

SMEs, frequently leading to high failure rates. Financial institutions approach SME lending cautiously, often imposing high interest rates and stringent collateral requirements. These lending conditions can deter SMEs from pursuing loans for environmentally sustainable investments.

Collateral requirements present a significant financing obstacle. Rahman, Jaroslav [33], using data from the World Business Environment Survey, found that collateral is among the most influential factors affecting SMEs' ability to obtain loans. This issue is especially pronounced in green finance, where SMEs often require additional capital to implement eco-friendly practices and technologies.

Without adequate financial capacity and access to affordable credit, SMEs may struggle to invest in sustainable innovations, thereby limiting their potential for long-term, environmentally responsible growth. Collateral plays a dual role—not only as a form of security for lenders but also as a mechanism to reduce risks associated with information asymmetry and moral hazard in SME financing.

Banks are more inclined to lend when collateral is available, particularly in sectors perceived as high-risk, such as green projects. Naili and Lahrichi [34] notes that developing countries' banks rely heavily on collateral to offset perceived credit risks. However, this reliance can disproportionately disadvantage SMEs, many lacking substantial assets. As a result, these enterprises face significant barriers to credit access, which can constrain their ability to invest in green initiatives and hinder their contributions to national sustainability goals.

H6. *Financial capacity and collateral have a positive impact on green finance.*

2.8. Green Finance and The Performance of Small and Medium Enterprises

Green finance has emerged as a vital mechanism for enhancing the performance of small and medium-sized enterprises (SMEs), particularly in developing economies such as Vietnam. As SMEs constitute a significant portion of the economic landscape, their ability to access green finance is crucial for fostering sustainable practices and driving innovation. This relationship is influenced by various factors that impact how green finance affects SME performance.

One of the primary ways green finances affect SMEs is by alleviating financial constraints that often hinder their ability to invest in environmentally sustainable technologies. Research by Du, Wang [35] suggested that digitally inclusive finance can overcome traditional barriers imposed by financial institutions, thereby reducing costs and expanding access to financial services for SMEs. This accessibility enables SMEs to engage in green innovation, improving operational efficiency and competitiveness. By providing the necessary capital for investments in renewable energy, energy-efficient equipment, and sustainable practices, green finance empowers SMEs to enhance their overall performance.

Moreover, fiscal policies and government support play a critical role. Tingbani, Salia [10] highlighted that while environmental taxes can encourage sustainable practices, these measures alone cannot drive significant behavioural change among SMEs. Therefore, government intervention through financial stimuli is essential to promote eco-innovation. This support can include grants, subsidies, or favourable loan conditions targeted at green projects, thereby facilitating the transition of SMEs to more sustainable operations.

In addition, integrating green corporate governance practices with green finance has positively impacted SME performance. Wang, Liu [7] argued that adopting corporate social responsibility (CSR) initiatives enhances stakeholder engagement and strengthens a firm's reputation, which in turn improves access to finance and supports sustainable outcomes. The alignment of financial strategies with sustainability goals is thus essential for SMEs aiming to remain competitive.

Finally, innovative financing models, such as supply chain finance, have been identified as practical tools for addressing the financing difficulties faced by SMEs. Zhang, Yan [36] note that supply chain finance can reduce the costs associated with evaluating enterprises and mitigate credit risks, thereby enhancing SMEs' access to necessary funding. This approach supports the financial health of SMEs and encourages them to adopt greener practices within their supply chains.

H7. *Green finance has a positive impact on the performance of small and medium-sized enterprises.*

2.9. The Research Model Development

This study employs Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine the hypothesized relationships. The selection of PLS-SEM over Covariance-Based Structural Equation Modeling (CB-SEM) is driven by methodological considerations that align closely with the study's exploratory objectives, predictive focus, and data characteristics.

Firstly, PLS-SEM is highly suitable for exploratory research aiming to predict and explain variances in dependent constructs. Given that this research investigates factors influencing SMEs' adoption of green finance and their subsequent performance, the predictive accuracy and theory-building capabilities of PLS-SEM provide a distinct methodological advantage.

Secondly, PLS-SEM effectively manages complex structural models with multiple indicators and latent constructs without imposing restrictive sample size requirements. Given the moderate sample size of 245 respondents, PLS-SEM maintains analytical rigor and statistical robustness. In contrast, CB-SEM typically demands larger samples for reliable and stable estimations.

Additionally, PLS-SEM efficiently accommodates both reflective and formative measurement models within the same analytical framework. This flexibility is particularly advantageous for constructs such as financial capacity, environmental awareness, and regulatory frameworks, which naturally exhibit mixed measurement characteristics.

Moreover, PLS-SEM demonstrates robustness against violations of statistical assumptions such as normality and homoscedasticity. Considering that survey data from SMEs, especially within diverse agricultural contexts, commonly exhibit non-normal distributions, this methodological robustness significantly benefits the research. Conversely, CB-SEM's reliance on multivariate normality and continuous data distributions often limits its practical utility under similar conditions.

The study's primary objective—to explore and validate relationships among latent constructs—also aligns seamlessly with PLS-SEM's predictive orientation. This methodological fit ensures meaningful interpretations that directly inform policy recommendations and managerial strategies aimed at enhancing SMEs' green finance adoption and performance.

Following Cohen's [37] guidelines, the minimum sample size required was calculated using parameters of 80% statistical power, a 5% significance level, and an anticipated minimum R^2 value of 0.1, resulting in a threshold of 122 observations. The study exceeded this threshold, acquiring 276 valid responses through a simple random sampling of Vietnamese SMEs from listed company records.

Data collection involved structured questionnaires targeted at key informants such as chief executive officers, chief accountants, departmental managers, and opational staff. The survey instrument was developed based on prior literature and expert consultations, refined through in-depth interviews with green finance specialists to ensure contextual relevance and clarity. Technical terminology was simplified, combining multiple-choice and open-ended questions to capture both quantitative and qualitative insights.

Multiple channels—including online platforms, emails, and in-person interviews—were utilized to accommodate diverse technological capabilities among SMEs. Clear instructions, accessible support contacts, and follow-up reminders to non-respondents were employed to maximize participation rates, reinforcing the survey's significance for informing practical and contextually tailored green finance policies.

Data were subsequently cleaned and analyzed using SmartPLS software, ensuring robustness and reliability of findings through the ordinary least squares (OLS) algorithm embedded within PLS-SEM.

Multiple observed variables represent the constructs utilised in this study. Local factors are denoted as LOCAL (comprising four observed variables), leadership characteristics as LEADER (4 observed variables), and environmental awareness and management capacity as MANA (8 observed variables). Financial institutions are captured by the construct of INST (6 observed variables), while the regulatory framework and policy are represented by REGU (4 observed variables). Financial capacity and collateral are denoted as **COLLA**

(six observed variables), green finance is captured by GREEN (three observed variables), and the performance of small and medium enterprises is measured by PERFORM (five observed variables) (**Table 1**). Based on the hypothesis, the following summarises the descriptive scales.

Table 1. The variables description.

Variables name	Coding of variables		Description
	Major variables	*Minor variables*	
Local factors	LOCAL	LOCAL1	The strength of the local economy, as measured by GDP and industrial output, supports the development of green finance initiatives.
		LOCAL2	Local environmental regulations encourage firms to adopt sustainable practices aligned with green finance principles.
		LOCAL3	Local government policies and pilot projects facilitate the implementation and growth of the green finance mechanism.s
		LOCAL4	The local context fosters innovation in green technologies, enhancing green finance's effectiveness.
The characteristics of leaders	LEADER	LEADER1	My organisation's leaders inspire employees to go beyond their standard duties for sustainability.
		LEADER2	Leadership decisions are made with a strong sense of ethical responsibility to society and nature.
		LEADER3	Our leaders promote long-term investments in green technology and sustainable innovation.
		LEADER4	Our leaders are transparent about challenges and progress related to green finance efforts.
Financial capacity and collateral	COLLA	COLLA1	The enterprise has sufficient access to external financing for investments in environmentally friendly projects.
		COLLA2	The enterprise possesses adequate collateral to secure loans for green investments.
		COLLA3	High interest rates discourage enterprises from seeking loans for green technology investment.
		COLLA4	Financial position and collateral availability increase the likelihood of obtaining loans for green finance.
		COLLA5	Banks perceive green investments as high-risk, making it difficult for enterprises to access loans.
		COLLA6	The enterprise has sufficient financial capacity to invest in green technologies and practices.
Green finance	GREEN	GREEN1	The ease with which SMEs can access financial resources is designed to support environmentally sustainable practices.
		GREEN2	The role of fiscal policies and government interventions in promoting eco-innovation and sustainable practices among SMEs.
		Aligning	The alignment of corporate governance and innovative financing models with sustainable goals to enhance SME performance.
Financial institutions	INST	INST1	The financial institution offers products specifically designed for sustainable or green investments.
		INST2	Long-term financing options are available for renewable energy and other green projects.
		INST3	Green credit guarantee schemes reduce the risks associated with green investments for SMEs.
		INST4	Our institution supports green investments through supply chain finance models.
		INST5	Digital finance has made green financing more accessible to SMEs.
		INST6	Our financial institution actively promotes low-carbon transformation projects.

Table 1. *Cont.*

Variables name	Coding of variables		Description
	Major variables	*Minor variables*	
Environmental awareness and management capacity	MANA	MANA1	Top management considers environmental challenges as opportunities to create competitive advantages.
		MANA2	The enterprise adopts forward-thinking environmental strategies aligned with sustainable practices.
		MANA3	We actively pursue green financing options to fund environmental projects.
		MANA4	Enterprise engages with stakeholders to address their environmental concerns effectively.
		MANA5	Prioritising investments in technologies that improve environmental performance.
		MANA6	Operations are consistently aligned with current environmental regulations.
		MANA7	Tracking and reporting environmental impact using key performance indicators
		MANA8	Sustainability initiatives enhance our reputation and market position.
Performance of small and medium enterprises	PERFORM	PERFORM1	Enhanced access to green finance enables SMEs to invest in sustainable technologies and practices, alleviating financial constraints.
		PERFORM2	Investment in sustainable practices improves operational efficiency and competitiveness, leading to better performance.
		PERFORM3	Green finance facilitates investments leading to cost savings and increased profitability for SMEs.
		PERFORM4	Access to green finance encourages SMEs to engage in eco-innovation, driving growth and market competitiveness.
		PERFORM5	Integrating green corporate governance and CSR practices improves stakeholder relationships and reputation, positively impacting performance.
Regulatory framework and policy	REGU	REGU1	Robust regulatory environments provide clear incentives and mechanisms for adopting environmentally friendly practices.
		REGU2	Supportive policies and public funding are crucial in enabling eco-innovation and enhancing SME competitiveness.
		REGU3	Targeted policy strategies are essential to overcome barriers and foster an environment conducive to green finance adoption.
		REGU4	Fiscal measures and government participation in supply chain finance enhance the ecosystem, supporting sustainable practices among SMEs.

Based on the survey findings, the sample statistics are classified into three main categories according to educational attainment levels.

Tables 2 and **3** present the frequency distribution and percentage composition of distinct groups in the survey sample, categorised by localisation of enterprises and occupational titles. The analysis is based on 245 valid responses, ensuring a diverse and representative sample that captures a wide range of professional roles and academic backgrounds across the population.

The sample statistics, categorised by position, are organised into three primary groups:

Table 2. Sample statistics by localisation of enterprises.

Localisation	Frequency	Percentage (%)
Central Vietnam	20	8.2
Southern Vietnam	198	80.8
Northern Vietnam	27	11.0
Total	245	100

Source: Collecting data from questionnaires by the researchers.

Table 3. Sample statistics by position.

Working position	Frequency	Percentage (%)
Senior Managers (CEOs)	51	20.8
Chief Accountants/Managers	169	69.0
Operating Staffs	25	10.2
Total	245	100

Source: Collecting data from questionnaires by the researchers.

3. Results

We provide the evaluation outcomes of our measurement model using the SmartPLS software (**Figure 2**). The findings reveal that the outer loading values for the observed variables MANA7 are below the acceptable threshold of 0.708. As a result, it is recommended that these variables be excluded from the model. This suggestion stems from their contribution to the latent variable, which accounts for less than 50% of their variance.

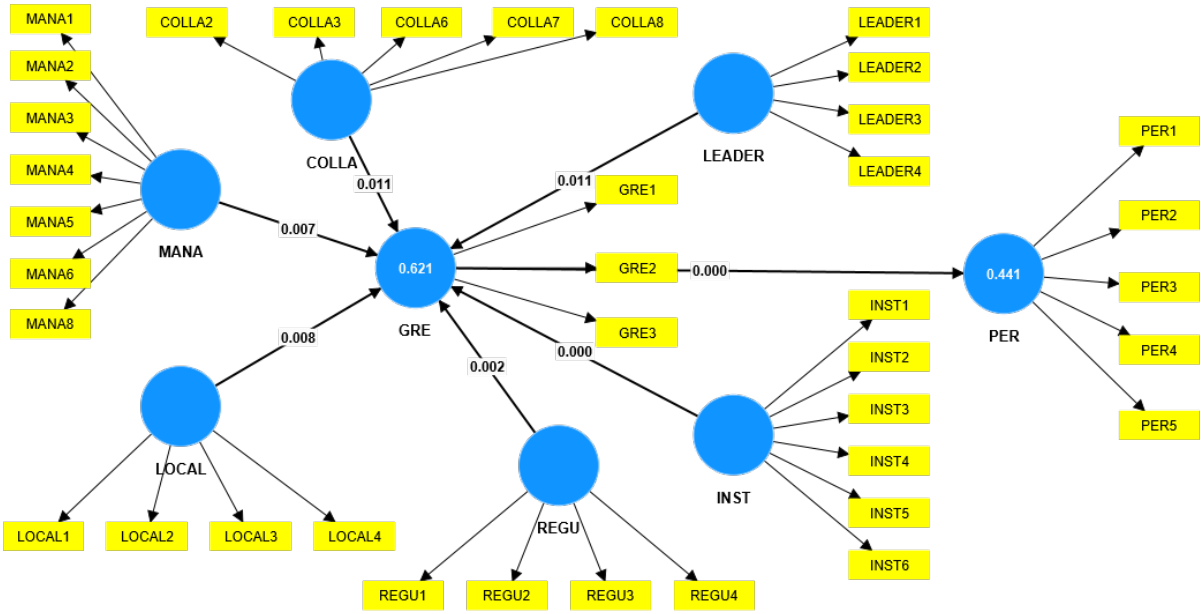

Figure 2. The results estimated from the SEM.

Furthermore, the study's factors present Cronbach's Alpha coefficients and Composite Reliability scores surpassing 0.7, indicating a strong reliability evaluation and highlighting the scale's high dependability. This also emphasises the appropriateness of the observed variables, confirming their consistency with the inherent properties of the latent variables. Notably, the factors demonstrate robust convergent validity, as evidenced by Average Variance Extracted (AVE) values surpassing 0.6 (**Table 4**).

Table 4. Reliability coefficients' results.

Name of variables	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
COLLA	0.861	0.863	0.900	0.643
GRE	0.725	0.743	0.845	0.647
INST	0.866	0.872	0.900	0.601
LEADER	0.802	0.819	0.870	0.627
LOCAL	0.793	0.798	0.865	0.617

Table 4. *Cont.*

Name of variables	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
MANA	0.886	0.897	0.910	0.593
PER	0.842	0.843	0.888	0.613
REGU	0.786	0.805	0.860	0.607

The evaluation of discriminant validity using the Heterotrait-Monotrait (HTMT) ratio approach indicates that all of the highest confidence values are below the threshold value of 0.85. This demonstrates how the basic PLS-SEM model's latent constructs/variables guarantee discriminant validity (Hair et al., 2022). The HTMT values in this model suggest good discriminant validity across the constructs. Constructs such as ESGP, SIZE, and BOD show moderate associations but remain distinct, while INVE shows low correlations with other constructs, reinforcing its uniqueness within the model. The evaluation of the HTMT index after the combination of variables is shown in **Table 5**.

Table 5. Discriminant value through HTMT.

Name of variables	COLLA	GRE	INST	LEADER	LOCAL	MANA	PER	REGU
COLLA								
GRE	0.587							
INST	0.591	0.923						
LEADER	0.204	0.657	0.658					
LOCAL	0.389	0.722	0.737	0.333				
MANA	0.177	0.377	0.256	0.241	0.248			
PER	0.354	0.842	0.575	0.370	0.406	0.363		
REGU	0.138	0.423	0.263	0.234	0.362	0.378	0.368	

To explore the relationships between the factors influencing ESG initiatives and their effects on investment decisions, we analysed the collected data using SmartPLS. This approach involved assessing multicollinearity through the Variance Inflation Factor (VIF) and utilising bootstrapping methods to evaluate the statistical significance of the path coefficients.

Table 6. Results of inner VIF value.

Name of variables	VIF
COLLA -> GRE	1.404
GRE -> PER	1.000
INST -> GRE	2.655
LEADER -> GRE	1.530
LOCAL -> GRE	1.673
MANA -> GRE	1.168
REGU -> GRE	1.195

According to the recommendations outlined by Hair, Risher [38], a Variance Inflation Factor (VIF) value below 3 indicates that multicollinearity is not a significant issue. In this study, which utilised SmartPLS for analysis, all VIF values were under 2. This confirms that multicollinearity is not a concern in the model. The results detailing the relationships among the variables are summarised in **Table 6**.

These results suggest that all the hypotheses above (H1, H2, H3, H4, and H5) are accepted because their T-statistics are high (above the typical threshold of 1.96), and the p-values are less than 0.05, indicating significant relationships with GREEN and PERFORM (**Table 7**). These results suggest that GREEN is significantly influenced by COLLA, INST, MANA, and REGU, and PERFORM significantly affects GREEN. Considering the f^2 values in **Table 8**, the results indicated the effect size of each independent variable on GREEN and PERFORM. In structural equation modelling, f^2 values help interpret each predictor's impact within the model. The

most decisive influence on GREEN is from INST (0.977), suggesting institutional factors are critical for GREEN. Besides, GREEN strongly impacts PERFORM (0.787), indicating its significant role in performance outcomes. Moreover, COLLA, MANA, and REGU have minimal impact on GREEN, as their probabilities are much lower.

Table 7. Research hypothesis results.

Hypothesis		Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T Statistics (|O/STDEV|)	*p* Values	Decision
H1	COLLA -> GRE	0.144	0.143	0.056	2.559	0.011	Accepted
H1	GRE -> PER	0.664	0.667	0.060	11.062	0.000	Accepted
H1	INST -> GRE	0.450	0.451	0.083	5.404	0.000	Accepted
H1	LEADER -> GRE	0.154	0.153	0.061	2.532	0.011	Accepted
H1	LOCAL -> GRE	0.132	0.133	0.050	2.664	0.008	Accepted
H1	MANA -> GRE	-0.095	-0.098	0.035	2.686	0.007	Accepted
H1	REGU -> GRE	-0.121	-0.122	0.039	3.121	0.002	Accepted

Table 8. f square.

Name of variables	f-Square
COLLA -> GRE	0.039
GRE -> PER	0.790
INST -> GRE	0.201
LEADER -> GRE	0.041
LOCAL -> GRE	0.027
MANA -> GRE	0.020
REGU -> GRE	0.032

Table 9. R square and R square Adjusted.

Name of variables	R-square	R-square adjusted
GRE	0.621	0.612
PER	0.441	0.439

The GREEN model yields an adjusted R-squared (R^2) value of 0.608, indicating that approximately 60.8% of the variability in the dependent variable GREEN can be explained by the independent variables included in the model (**Table 9**). The remaining 39.2% represents unexplained variance, which may arise from random noise, measurement error, or omitted variables not captured within the current model specification. This portion may also include systematic error, which refers to biases or structural influences consistently affecting the results but not accounted for by the model.

Similarly, the PERFORM model reports an adjusted R-squared of 0.438, suggesting that 43.8% of the variation in the dependent variable PERFORM is explained by the predictors in the model. The unexplained 56.2% reflects variance attributable to factors outside the model's scope, including potential latent variables, random fluctuations, or data imperfections.

In summary, both models demonstrate moderate explanatory power. While the GREEN model performs more strongly, both models underscore the importance of accounting for model limitations and the potential influence of unobserved or uncontrolled factors.

The findings underscore the critical role of financial institutions in facilitating SME access to green finance. By offering customised financial products and mitigating funding constraints, these institutions support integrating sustainable practices at the enterprise level. Further research should examine the development of innovative financing mechanisms and assess the role

of digital finance in advancing green initiatives among SMEs. This is consistent with Liu and Tobias [6]. Secondly, the financial resources and collateral prerequisites play a critical role in shaping access to green finance for small and medium enterprises (SMEs). Financial capacity and collateral requirements constrain SMEs' access to green finance due to limited resources and a lack of assets to secure traditional loans. Green investments often involve high upfront costs and long payback periods, deterring lenders and excluding credit-constrained SMEs. Addressing these barriers through policy instruments (e.g., credit guarantees, concessional loans) and innovative financing mechanisms (e.g., blended finance, ESG-linked loans) reduces perceived risks, enhances capital access, and enables greater SME participation in sustainable initiatives. This, in turn, supports broader environmental and economic goals. Thirdly, the regulatory framework and policy support are vital for enhancing green finance and the performance of SMEs in Vietnam. By establishing clear guidelines, providing financial incentives, and addressing barriers to access, policymakers can create an environment that fosters sustainable practices among SMEs, ultimately contributing to broader environmental and economic goals. This study supports prior research by Wang, Liu [7].

Enterprises' environmental awareness and management capacity are pivotal in shaping their engagement with green finance and overall performance. By fostering a culture of sustainability and integrating environmental considerations into their strategic frameworks, SMEs can leverage green finance to enhance their operational efficiency, market competitiveness, and long-term viability. The studies of Wang, Elahi [3] and Karaeva, Tolkou [9] also support these results.

Lastly, financial institutions play a pivotal role in advancing sustainable agriculture by mobilizing green finance for agricultural SMEs. Through instruments such as green loans, climate risk insurance, and sustainability-linked credit, they address capital constraints and enable investment in eco-friendly technologies and practices. These interventions not only improve productivity and resilience in the sector but also align agricultural growth with environmental goals. In Vietnam, where agriculture remains central to the economy, enhancing access to green finance via financial institutions is critical for achieving inclusive and sustainable development. Prior research confirms the positive impact of green finance on SME performance, including within agriculture [7,10].

4. Discussion

This study empirically investigated the determinants of green finance adoption and its impact on the performance of SMEs in Vietnam's agricultural sector. Grounded in a robust conceptual framework and guided by institutional theory, the resource-based view (RBV), stakeholder theory, and leadership perspectives, the findings offer meaningful insights into how internal and external factors interact to shape sustainable financial behaviors.

First, consistent with institutional theory, financial institutions emerged as the most influential enabler of green finance adoption ($\beta = 0.450$, $p < 0.001$, $f^2 = 0.201$). This reinforces the idea that targeted financial innovations—such as green credit guarantees and digital financing tools—can significantly reduce barriers and facilitate SMEs' transition to sustainable practices. This finding aligns with Liu and Tobias [6] and Nguyen, Do [1] highlighting the transformative role of financial institutions.

Second, the study validated a strong positive link between green finance adoption and SME performance ($\beta = 0.664$, $p < 0.001$, $f^2 = 0.790$), supporting the RBV's assertion that specialized resources like green finance enhance competitive advantage. Access to green finance empowers SMEs to invest in eco-innovation, improve operational efficiency, and boost market positioning, leading to substantial performance gains.

Third, financial capacity and collateral had a moderate but significant effect ($\beta = 0.144$, $p = 0.011$), reflecting persistent structural barriers in traditional lending. These findings emphasize the need for alternative financing models such as cash-flow-based or performance-linked lending, which could better accommodate SMEs' financial realities [7,33].

Fourth, regulatory frameworks and environmental management capacity showed significant but negative effects on green finance adoption ($\beta = -0.121$, $p = 0.002$ and $\beta = -0.095$, $p = 0.007$, respectively). This indicates

that misaligned or overly complex regulations and limited managerial competencies can inadvertently deter sustainable investments. These findings extend the work of Gaglio, Kraemer-Mbula [31] by highlighting the importance of context-sensitive and supportive policy design.

Fifth, local economic conditions (β = 0.132, p = 0.008) and leadership characteristics (β = 0.154, p = 0.011) were found to positively influence green finance engagement. This affirms the relevance of contextual and leadership factors in enabling sustainable transitions, corroborating the work of Gaglio, Kraemer-Mbula [16]. Transformational leadership, in particular, was shown to foster environmental awareness and a culture supportive of green finance.

In summary, this study makes several theoretical and practical contributions:

- Institutional Theory: Reinforced by the central role of financial institutions in enabling green transitions.
- Resource-Based View (RBV): Empirically confirmed that green finance functions as a strategic resource enhancing firm performance.
- Regulatory and Stakeholder Theory: Nuanced by evidence showing the potential for misaligned regulations to hinder rather than help.
- Leadership Theory: Advanced by demonstrating the significance of transformational leadership within conducive local contexts.

Together, these findings provide a comprehensive view of how green finance adoption is shaped in emerging economies and offer actionable guidance for policymakers, financial institutions, and SME leaders. The results emphasize that creating an enabling ecosystem—comprising institutional support, regulatory coherence, local vitality, and capable leadership—is essential for achieving sustainable development objectives through SME empowerment.

5. Conclusion

This study highlights the pivotal role of green finance in promoting sustainable development among Vietnam's small and medium-sized enterprises (SMEs). The findings reveal that financial institutions, regulatory frameworks, and enterprise-level capabilities collectively shape access to and utilisation of green finance, with significant implications for environmental and economic sustainability. Financial institutions play a critical role in facilitating access to green finance for SMEs by tailoring financial products to address unique financing constraints and align with supportive policies. These efforts enable SMEs to adopt sustainable practices and achieve operational efficiency. The availability of financial resources and collateral requirements are significant determinants of SMEs' access to green finance. Addressing these barriers through innovative financing models and policy interventions can enhance SME engagement in green initiatives, contributing to broader sustainability objectives. The regulatory environment profoundly influences the integration of green finance into SMEs' operations. Clear guidelines, financial incentives, and removing access barriers are essential to fostering sustainable practices, thereby advancing Vietnam's economic and environmental goals. SMEs' environmental awareness and management capacity are critical in shaping their engagement with green finance. Cultivating a culture of sustainability and embedding environmental considerations into business strategies enables SMEs to leverage green finance effectively, improving market competitiveness and long-term viability. Green finance empowers SMEs by addressing financial constraints, fostering innovation, and encouraging sustainable practices. By integrating supportive policies and financial mechanisms, stakeholders can create an ecosystem where SMEs thrive while advancing Vietnam's sustainable development priorities.

Based on the findings, several actionable recommendations for policymakers, financial institutions, and SMEs are raised to enhance the accessibility and impact of green finance. Firstly, develop and promote financial products tailored to SMEs' needs, such as green bonds, microfinance initiatives, and performance-based incentives, to reduce dependency on traditional collateral-based financing mechanisms. Secondly, comprehensive and transparent regulations should be established to promote the adoption of green finance. Policymakers should introduce tax incentives, subsidies, and grants to support SMEs adopting sustainable practices. Thirdly, training and awareness campaigns should be initi-

ated to enhance SMEs' understanding of green finance and its benefits. Capacity-building initiatives should focus on integrating sustainability into strategic business planning and improving management practices. In addition, leverage digital technologies to streamline green finance accessibility for SMEs. Digital finance platforms can lower transaction costs, improve transparency, and facilitate monitoring and evaluating funded projects. Last but not least, robust monitoring mechanisms should be developed to assess the impact of green finance on SME performance and sustainability outcomes. Regular assessments can inform policy refinements and promote accountability among stakeholders. By adopting these measures, Vietnam can strengthen the role of green finance in achieving sustainable economic growth while addressing environmental challenges. This approach will empower SMEs to enhance performance and contribute significantly to the country's long-term sustainability goals.

Author Contributions

Conceptualization, H.T.H. and N.H.T.; methodology, N.H.T.; software, N.H.T.; validation, H.T.H., N.H.T. and T.T.P.; formal analysis, N.H.T.; investigation, T.T.P.; resources, H.T.H.; data curation, N.H.T.; writing—original draft preparation, N.H.T.; writing—review and editing, H.T.H.; visualization, T.T.P.; supervision, H.T.H.; project administration, N.H.T.; funding acquisition, H.T.H. All authors have read and agreed to the published version of the manuscript.

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The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of Industrial University of Ho Chi Minh city for studies involving humans.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

Data requirement should contact with: tranngochung@iuh.edu.vn.

Conflicts of Interest

The authors declare no conflict of interest.

References

[1] Nguyen, A.H., Do, M.H.T., Hoang, T.G., et al., 2023. Green financing for sustainable development: Insights from multiple cases of Vietnamese commercial banks. Business Strategy and the Environment. 32(1), 321–335. DOI: https://doi.org/10.1002/bse.3132

[2] Ferretti, T., 2023. Impact investing and sustainable global value chains: Enabling small and medium enterprises sustainability strategies. AIB Insights. 23(8). DOI: https://doi.org/10.46697/001c.88529

[3] Wang, X., Elahi, E., Khalid, Z., 2022. Do green finance policies foster environmental, social, and governance performance of corporate? Inte-rnational journal of environmental research and public health. 19(22), 14920. DOI: https://doi.org/10.3390/ijerph192214920

[4] Ma, Z., Liu, Z., Zhang, P., et al., 2024. Analysis of the Impact of Digital Inclusive Finance on the Development of Green Agriculture. Agronomy. 14(12), 2777. DOI: https://doi.org/10.3390/agronomy14122777

[5] Ribeiro, N., Duarte, A.P., Filipe, R., et al., 2022. Does authentic leadership stimulate organizational citizenship behaviors? The importance of affective commitment as a mediator. Sustainability Accounting, Management and Policy Journal. 13(2), 320–340. DOI: https://doi.org/10.1108/SAMPJ-11-2019-0423

[6] Liu, L., Tobias, G.R., 2023. Application of Green Finance in Promoting Low-carbon Transformation of Enterprises. Advance in Sustainability. 3(1), 1–6. DOI: http://dx.doi.org/10.26855/as.2023.06.001

[7] Wang, Y., Liu, H., Zhou, J., et al., 2023. The Impact of Green Finance on China's Agricultural Trade. Sustainability. 15(9), 7688. DOI: https://doi.org/10.3390/su15097688

[8] Huang, Q., Chen, X., Zhou, M., et al., 2019. How Does CEO's Environmental Awareness Affect Technological Innovation? International Journal of

Environmental Research and Public Health. 16(2), 261. DOI: https://doi.org/10.3390/ijerph16020261

[9] Karaeva, A., Tolkou, A., Cioca, L.-I., et al., 2023. Family ISO 14000 standards as a tool of achieving environmental sustainability of enterprises. IOP Conference Series: Earth and Environmental Science. 1126(1), 012036. DOI: https://doi.org/10.1088/1755-1315/1126/1/012036

[10] Tingbani, I., Salia, S., Hussain, J.G., et al., 2021. Environmental tax, SME financing constraint, and innovation: evidence from OECD countries. IEEE Tran-sactions on Engineering Management. 70(3), 1006–1025. DOI: https://doi.org/10.1109/TEM.2021.3110812

[11] Hong, J., Zheng, R., Deng, H., et al., 2019. Green supply chain collaborative innovation, absorptive capacity and innovation performance: Evidence from China. Journal of Cleaner Production. 241, 118377. DOI: https://doi.org/10.1016/j.jclepro.2019.118377

[12] Ye, T., Xiang, X., Ge, X., et al., 2022. Research on green finance and green development based eco-efficiency and spatial econometric analysis. Sustainability. 14(5), 2825. DOI: https://doi.org/10.3390/su14052825

[13] Xue, L., Dong, J., Zha, Y., 2023. How does digital finance affect firm environmental, social and governance (ESG) performance? — Evidence from Chinese listed firms. Heliyon. 9(10), e20800. DOI: https://doi.org/10.1016/j.heliyon.2023.e20800

[14] Irfan, M., Razzaq, A., Sharif, A., et al., 2022. Influence mechanism between green finance and green innovation: Exploring regional policy intervention effects in China. Technological Forecasting and Social Change. 182, 121882. DOI: https://doi.org/10.1016/j.techfore.2022.121882

[15] Sun, G., Feng, Q., Wu, S., et al., 2025. The impact of China's green credit policy on the innovation of manufacturing enterprises. Journal of Innovation & Knowledge. 10(3), 100714. DOI: https://doi.org/10.1016/j.jik.2025.100714

[16] Siregar, A.A., Afiff, A.Z., Halim, R.E., 2023. Linking agile leadership and business sustainability through the mediation of political and social capabilities. Journal of Open Innovation: Technology, Market, and Complexity. 9(4), 100153. DOI: https://doi.org/10.1016/j.joitmc.2023.100153

[17] Elidjen, Hidayat, D., Abdurachman, E., 2022. The roles of gamification, knowledge creation, and entrepreneurial orientation towards firm performance. International Journal of Innovation Studies. 6(4), 229–237. DOI: https://doi.org/10.1016/j.ijis.2022.07.002

[18] Darvishmotevali, M., Altinay, L., 2022. Green HRM, environmental awareness and green behaviors: The moderating role of servant leadership. Tourism Management. 88, 104401. DOI: https://doi.org/10.1016/j.tourman.2021.104401

[19] Farrukh, M., Rafiq, M., Raza, A., et al., 2024. Beyond the surface: understanding the mechanism between green HR practices and employees' green creative behavior through mixed-methods exploration. Journal of Hospitality and Tourism Insights. 7(5), 3055–3072. DOI: https://doi.org/10.1108/JHTI-05-2023-0357

[20] Nivedha, E., Prabadevi, M., 2023. Green entrepreneurial leadership style. Available from: https://www.atlantis-press.com/proceedings/icetbm-23/125986531. (cited 15 April 2025).

[21] Song, M., Tao, W., Shen, Z., 2022. Improving high-quality development with environmental regulation and industrial structure in China. Journal of Cleaner Production. 366, 132997. DOI: https://doi.org/10.1016/j.jclepro.2022.132997

[22] Wang, H., Zhang, R., 2022. Effects of environmental regulation on CO_2 emissions: An empirical analysis of 282 cities in China. Sustainable Production and Consumption. 29, 259–272. DOI: https://doi.org/10.1016/j.spc.2021.10.016

[23] Gan, Q., Yang, L., Liu, J., et al., 2021. The Level of Regional Economic Development, Green Image, and Enterprise Environmental Protection Investment: Empirical Evidence from China. Mathematical Problems in Engineering. 2021(1), 5522351. DOI: https://doi.org/10.1155/2021/5522351

[24] Zeng, Y., Wang, F., Wu, J., 2022. The impact of green finance on urban haze pollution in China: a technological innovation perspective. Energies. 15(3), 801. DOI: https://doi.org/10.3390/en15030801

[25] Kashav, S., Cerchione, R., Centobelli, P., et al., 2018. Sustainability Orientation, Supply Chain Integration, and SMEs Performance: A Causal Analysis. Benchmarking An International Journal. 26(4). DOI: https://doi.org/10.1108/BIJ-08-2017-0236

[26] Taghizadeh-Hesary, F., Yoshino, N., 2020. Sustainable solutions for green financing and investment in renewable energy projects. Energies. 13(4), 788. DOI: https://doi.org/10.3390/en13040788

[27] Qin, C., Hong, Y.-T., 2023. Quadripartite Evolutionary Game of Sustainable Development of Supply Chain Finance with Government Participation. Sustainability. 15(4), 3788. DOI: https://doi.org/10.3390/su15043788

[28] Ozili, P.K., 2022. Green finance research around the world: a review of literature. International Journal

of Green Economics. 16(1), 56–75. DOI: https://doi.org/10.1504/IJGE.2022.10048432

[29] Tran, Q.H., 2022. The impact of green finance, economic growth and energy usage on CO_2 emission in Vietnam–a multivariate time series analysis. China Finance Review International. 12(2), 280–296. DOI: https://doi.org/10.1108/CFRI-03-2021-0049

[30] Cecere, G., Corrocher, N., Mancusi, M.L., 2020. Financial constraints and public funding of eco-innovation: empirical evidence from European SMEs. Small Business Economics. 54(1), 285–302. DOI: https://doi.org/10.1007/s11187-018-0090-9

[31] Gaglio, C., Kraemer-Mbula, E., Lorenz, E., 2022. The effects of digital transformation on innovation and productivity: Firm-level evidence of South Afri-can manufacturing micro and small enterprises. Technological Forecasting and Social Change. 182, 121785. DOi: https://doi.org/10.1016/j.techfore.2022.121785

[32] Calabrese, R., Girardone, C., Sclip, A., 2021. Financial fragmentation and SMEs' access to finance. Small Business Economics. 57(4), 2041–2065. DOI: https://doi.org/10.1007/s11187-020-00393-1

[33] Rahman, A., Jaroslav, B., Tomas, K., et al., 2017. Collateral requirements for SME loans: empirical evidence from the Visegrad countries. Journal of Business Economics and Management. 18(4), 650–675. DOI: https://doi.org/10.3846/16111699.2017.1357050

[34] Naili, M., Lahrichi, Y., 2022. The determinants of banks' credit risk: Review of the literature and future research agenda. International Journal of Finance & Economics. 27(1), 334–360. DOI: https://doi.org/10.1002/ijfe.2156

[35] Du, Y., Wang, Q., Zhou, J., 2023. How does digital inclusive finance affect economic resilience: Evidence from 285 cities in China. International Review of Financial Analysis. 88, 102709. DOI: https://doi.org/10.1016/j.irfa.2023.102709

[36] Zhang, W., Yan, S., Li, J., et al., 2022. Credit risk prediction of SMEs in supply chain finance by fusing demographic and behavioral data. Transportation Research Part E: Logistics and Transportation Review. 158, 102611. DOI: https://doi.org/10.1016/j.tre.2022.102611

[37] Cohen, J., 1992. Statistical power analysis. Current directions in psychological science. 1(3), 98–101. DOI: https://doi.org/10.1111/1467-8721.ep10768783

[38] Hair, J.F., Risher, J.J., Sarstedt, M., et al., 2019. When to use and how to report the results of PLS-SEM. European business review. 31(1), 2–24. DOI: https://doi.org/10.1108/EBR-11-2018-0203