Policy Recommendations for Enhancing the Green Banking and Sustainable Development

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Abstract

This study examines the key factors influencing green banking and sustainable development in Vietnam to provide evidence-based policy recommendations to promote the integration of sustainability within financial institutions. A mixed-method approach combining qualitative and quantitative analyses was adopted. The research process began with focus group discussions with 30 banking experts, followed by in-depth interviews with senior managers to refine measurement scales. Subsequently, a structured survey was conducted among 900 commercial bank managers in the Southeast region, and the collected data (n = 845 valid responses) were analyzed using exploratory factor analysis, confirmatory factor analysis, and structural equation modeling (SEM). The findings reveal seven knowledge-driven factors that significantly affect green banking and sustainable development: the legal framework and supporting policies, awareness and trends in sustainable consumption, financial technology, leadership commitment and corporate culture, pressure from investors and international organizations, climate change and environmental risk management, and public-private partnerships. Among them, the legal framework and supporting policies emerged as the most influential drivers. Green banking practices are also shown to directly contribute to sustainable development by financing environmentally friendly projects and integrating ESG principles. The study's novelty lies in its knowledge-based economy perspective, demonstrating how policy knowledge, financial technology, and organizational learning interact to enhance sustainability. Practical implications highlight the need for regulatory reform, technology adoption, and cross-sectoral collaboration to accelerate Vietnam's transition to a green economy.

1- Introduction

Developing green banks plays an essential role in promoting sustainable development. Green banks focus on providing financial products and services that minimize negative environmental impacts while supporting renewable energy development projects, environmental protection, and deflation of carbon emissions [1, 2]. In this way, green banking protects the environment and facilitates long-term economic development, helping to ensure sustainable resources for future generations. Besides, sustainable development is an inevitable trend that profoundly impacts all economic aspects [3]. From heavy industries to manufacturing, technology, electronics, or information technology, businesses have made environmental commitments and considered environmental obligations as part of their business activities. Although the industry has the least environmental impact, the finance and banking industry is not out of this trend. The banking industry has also taken actions towards sustainable development through green banking [4].

Besides, developing green banks also helps improve the bank's image and reputation in the eyes of environmentally conscious investors and customers while meeting international standards and regulations on sustainable finance [5]. Therefore, green banking creates a stable financial ecosystem, promoting comprehensive and sustainable socio-economic development. The phrase "green banking" describes financial institutions that take measures to safeguard the environment, such as reducing paper consumption, recycling, or cutting down on carbon emissions, all from within their headquarters [6]. Green banking encompasses all aspects of a bank's operations, including economics, society, and the environment. It also helps change the public's perception of banks from those whose only purpose is to make money to those whose mission is to make money while doing good for the environment and society [7]. In reality, most industrialized nations have put explicit and obligatory legislation to channel public and private sector funding into environmentally friendly goods, allowing domestic financial institutions to increase their green investment. While industrialized and developing nations aim to intervene in the green banking sector, their methods and policies often diverge. Green banking entails a dual transformation that banks must navigate. First, as green corporations, banks must overhaul their internal processes to significantly reduce their environmental impact [8]. This transition necessitates the adoption of sustainable business operations, including carbon footprint reduction, paperless banking, energy-efficient data centers, and the integration of environmentally responsible supply chains. Such measures align with regulatory requirements and corporate social responsibility (CSR) principles while enhancing reputational and financial performance. The integration of environmental, social, and governance (ESG) factors within internal banking operations is thus a key dimension of this transformation [9].

Moreover, the banking industry in Vietnam has played an intermediary role in the country's economic transition towards green and sustainable development, which has helped mitigate some of the worst impacts of climate change on Vietnam; most studies on green banking have only stopped at the level of discussion and exploration of the green banking conceptual framework. There are very few in-depth studies on the development of green banking in Vietnam. Besides, the development of green banking in Vietnam still faces difficulties and barriers such as: (i) Although the Government and the State Bank have issued general guidelines on green banking development, there is still a lack of detailed guidelines and especially the implementation roadmap has not been expressly regulated; (ii) Lack of coordination between stakeholders in the process of implementing green banking, especially the lack of coordination and support from state management agencies and international organizations, causing banks to face difficulties in the implementation phase of green projects or products; (iii) The efficiency of green investment projects is not high with a relatively long payback period, thus causing risks for sponsoring banks; (iv) Issues related to the operational capacity of commercial banks when applying green banking; (v) Activities focusing on green banking development seem to be delayed amid economic difficulties in all sectors after the Covid-19 pandemic ends.

Green banking entails a dual transformation that banks must navigate. First, as green corporations, banks must overhaul their internal processes to significantly reduce their environmental impact. This transition necessitates the adoption of sustainable business operations, including carbon footprint reduction, paperless banking, energy-efficient data centers, and the integration of environmentally responsible supply chains. Such measures align with regulatory requirements and the CSR principles while enhancing reputational and financial performance. The integration of ESG factors within internal banking operations is thus a key dimension of this transformation. Second, as green financial intermediaries, banks play a pivotal role in redirecting financial capital from carbon-intensive "brown" industries to environmentally sustainable "green" value-added production [10]. This transition requires banks to develop innovative financial instruments such as green bonds, sustainability-linked loans, and climate risk-adjusted credit allocation frameworks. Banks enable corporations and industries to invest in eco-friendly technologies, renewable energy, and sustainable infrastructure through these financial mechanisms. Moreover, banks must enhance their ability to assess, price, and mitigate climate-related financial risks, ensuring that green investments align with profitability and sustainability goals.

These two dimensions - internal transformation as green corporations and external facilitation as green financial intermediaries are mutually reinforcing. A bank's ability to implement internal sustainability policies enhances its credibility and expertise in financing sustainable initiatives. Conversely, its role as a financial intermediary enables it to shape broader market trends by prioritizing sustainable investment decisions. The global shift toward a knowledge-based economy has transformed financial and banking systems, where knowledge creation, diffusion, and application play pivotal roles in shaping sustainable financial models [11]. Green banking, a critical component of sustainable finance, relies on applying financial, environmental, and technological knowledge to foster economic sustainability. While green banking has gained global attention, Vietnam's financial sector faces significant barriers to knowledge dissemination, technological adoption, and policy enforcement. This study investigates how knowledge creation, diffusion, and application impact green banking and sustainable development. The study also contributes to understanding how financial institutions, policymakers, and investors leverage knowledge to drive economic transformation. The knowledge economy emphasizes the role of innovation, expertise, and organizational learning in shaping economic and financial practices. As knowledge-intensive organizations, financial institutions generate and apply knowledge in regulatory compliance, risk management, and investment in green technologies. This study focused on knowledge-based economic development by exploring how banks create and implement knowledge-driven policies for green finance [12, 13].

The development of green banking activities at Vietnamese credit institutions still faces many difficulties and challenges, such as requiring enormous resources for implementation; the knowledge and experience of bank officers performing credit appraisal and approval related to social and environmental issues are generally limited. Lack of mechanisms and policies to support credit institutions to access long-term, preferential capital sources, especially mobilizing international resources to provide long-term and preferential interest rate credits for green industries/sectors. Therefore, the study' goal explores the key factors influencing green banking and sustainable development and policy recommendations proposed for fostering the application of green banking and sustainable development in Vietnam. To develop green banking in more detail, banks need to deploy specific strategies and policies to support green financial activities and contribute to promoting sustainable development. The following aspects can be the foundation for the development of green banking and contribute to sustainable development: (1) Legal framework and supporting policies, (2) Awareness and trends in sustainable consumption, (3) Financial technology, (4) Commitment from leadership and corporate culture, (5) Pressure from investors, partners, and international organizations, (6) Climate change and environmental risk management, and (7) Public-private partnerships and international cooperation.

Previous studies have explored GB practices in advanced financial markets, focusing on internal corporate sustainability [14], risk management and climate finance [15], and the role of financial technology in promoting transparency and efficiency [16]. In emerging economies, research highlights structural barriers, including limited legal frameworks, weak policy enforcement, and fragmented stakeholder coordination [17–20]. Yet, despite increasing scholarly attention, most empirical works remain concentrated on conceptual frameworks, with insufficient examination of how GB can be operationalized in specific national contexts [21–24]. In particular, Vietnam's banking sector plays a pivotal role in channeling resources toward renewable energy, clean production, and sustainable consumption. Still, studies often stop at descriptive analysis, lacking rigorous empirical models that explain the determinants of GB adoption [25–27].

This research seeks to fill that gap by systematically investigating the factors influencing GB and SD in Vietnam through a knowledge-based economy perspective. Building upon prior literature, the study integrates seven key drivers, including the legal framework and supporting policies, awareness of sustainable consumption, financial technology, leadership commitment and corporate culture, pressure from investors and international organizations, climate change and environmental risk management, and public-private partnerships, into a comprehensive model. By employing a mixed-methods approach that combines qualitative insights with quantitative validation using structural equation modeling (SEM) on survey data from commercial bank managers, the study provides robust empirical evidence. The contribution lies in (i) extending GB literature with a contextualized framework for emerging economies, (ii) demonstrating how knowledge creation and diffusion shape GB practices, and (iii) providing actionable policy recommendations to accelerate Vietnam's transition toward a sustainable financial ecosystem.

The structure of the article is organized as follows. Section 1 examines the theoretical underpinnings and pertinent literature about green banking and sustainable development. Section 2 delineates the study approach, encompassing the creation of measurement scales, data collection protocols, and analysis techniques. Section 3 presents the empirical findings, encompassing factor analysis and structural equation modeling results. Section 4 examines the findings in relation to the current literature and underscores their theoretical and practical consequences. Ultimately, Section 5 concludes the study by summarizing the principal contributions, outlining the limitations, and proposing directions for future research.

2- Literature Empirical Review and Hypothesis Development

2-1- Green Banking (GB)

Green banking is a banking model in which activities, products, services, and processes are designed and implemented to minimize environmental negative impacts while promoting sustainable projects and activities [13]. Green banking focuses on financial goals and aims to contribute to environmental protection, respond to climate change, and encourage sustainable economic development [14]. Critical aspects of green banking: (1) Financing green projects by providing preferential loans for environmentally friendly projects such as renewable energy, waste treatment, natural resource protection, and green technology development. Limit funding or refuse funding for projects that pollute the environment or risk damaging the ecosystem. (2) Green financial products and services based on green bonds can be developed by issuing bonds to mobilize capital for environmental protection projects. Green credit by providing loans specifically for sustainable production and business activities, minimizing greenhouse gas emissions. Green investment fund encourages customers to invest in sustainable businesses and projects. (3) Integrating environmental, social, and governance (ESG) standards following: ESG standards are used to assess risks and opportunities in credit, investment, and banking management activities [15]. ESG ensures that the bank's activities bring economic benefits and meet environmental protection and social responsibility requirements [16]. In addition, green banks also apply green technology and digitalization, manage climate risks, and build community awareness.

Green banking is a knowledge-intensive domain, requiring financial institutions to acquire, develop, and apply specialized knowledge on environmental risks, regulatory compliance, and green financial products. Studies indicate that banks investing in knowledge-sharing platforms and sustainability training achieve higher levels of green banking

efficiency. The literature on knowledge-based economic development emphasizes the need for financial institutions to act as knowledge intermediaries, connecting policymakers, investors, and consumers in the green finance ecosystem [17, 18]. This study builds upon previous research by investigating how Vietnamese banks develop and transfer knowledge related to green banking.

Banks, as financial intermediaries, enable the shift from a carbon-intensive economy to a sustainable, knowledge-driven economy. This duty is executed by promoting green investments via banks that allocate financial resources to enterprises and projects adhering to sustainability principles, encompassing renewable energy, environmentally friendly technologies, and climate adaptation activities. Creating novel financial products, such as green bonds, sustainability-linked loans, and ESG-aligned investment portfolios, facilitates the allocation of funds towards sustainable operations [19].

As corporate organizations, banks must exemplify the adoption of sustainable practices. This entails implementing sustainable banking practices rooted in internal environmental sustainability initiatives, such as reducing paper consumption, enhancing energy efficiency, and investing in sustainable office infrastructure, thereby contributing to the broader green economy. The literature on information-based economic development emphasizes the need for financial institutions to serve as knowledge intermediaries, connecting policymakers, investors, and consumers within the green finance ecosystem [20]. This study extends prior research by examining the methods via which Vietnamese banks cultivate and disseminate information about green banking.

Consequently, the primary function of green banking is to mitigate environmental damage by promoting the use of renewable energy and reducing carbon emissions. Foster a sustainable economy by establishing conditions that enable enterprises and individuals to secure funding for the execution of sustainable initiatives. Fostering a sustainable society by playing a pivotal role in teaching and transforming community consumption behaviors. Financial institutions play a crucial role in shaping and changing the community's spending patterns. This is evident in initiatives like financial literacy programs that promote sustainable investment, green credit products that encourage environmentally responsible purchasing, and partnerships with educational institutions to integrate sustainability into financial decision-making, such as the green finance education initiative in Europe. Banks influence public perceptions of green financing by offering incentives, such as special lending rates for eco-friendly projects, and executing awareness initiatives. Green banking is a growing trend in the financial sector, and it is a crucial strategy for tackling global concerns such as climate change, environmental degradation, and resource depletion.

2-2- Sustainable Development (SD)

Sustainable development meets the needs of the present generation without compromising the ability of future generations to meet their own needs. This concept emphasizes the balance between economic, social, and environmental aspects, intending to ensure harmony in development activities, protect natural resources, and improve the quality of life of humans [21]. Specifically, sustainable development includes: (1) Economic sustainability based on economic growth must be sustained long-term without causing natural resource degradation or social instability. Sustainable economic development focuses on short-term benefits and aims at long-term efficiency. (2) Social sustainability is based on ensuring equity, including access to education, healthcare, and employment for everyone. Build inclusive communities, reduce inequality, and improve people's quality of life. (3) Environmental sustainability is based on the wise use of natural resources to maintain ecosystems and reduce pollution. Develop solutions to protect the environment, respond to climate change, and preserve biodiversity [22].

The basic principles of sustainable development are based on integrating economic, social, and environmental factors into all development activities. Intergenerational equity by protecting the present generation's rights without compromising future generations' needs [23]. Efficient use of resources by encouraging reuse, recycling, and minimizing waste in exploitation, production, and consumption [24]. Participation and responsibility are based on the involvement of all stakeholders, from government businesses to communities, to ensure transparency and social responsibility. Therefore, sustainable development is a theoretical model and an essential strategy to face global challenges such as climate change, resource depletion, and social inequality, aiming towards sustainable development and a prosperous future for all humanity.

Moreover, knowledge creation in green banking involves developing policies, financial models, and risk assessment frameworks that integrate sustainability principles. Knowledge diffusion, on the other hand, requires financial institutions to share best practices, train employees, and collaborate with stakeholders [25]. Vietnam's financial sector has begun implementing knowledge-sharing initiatives, but challenges remain in scaling knowledge diffusion. This study examines how financial institutions create sustainable finance knowledge, the barriers to diffusion, and strategies for accelerating its application.

2-3- Green Banking (GB) Affecting Sustainable Development (SD)

Green banking and sustainable development have a close and reciprocal relationship in which green banking plays an essential driving force in promoting sustainable development goals through financial and management support resources

towards protecting the environment, improving quality of life, and ensuring long-term economic development [26]. Moreover, green banking is a tool to promote sustainable development. Green banking focuses on providing environmentally friendly financial products and services, directly supporting the three pillars of sustainable development: economic, social, and environmental [27]. Contribute to environmental sustainability by limiting the negative impact of economic activities based on the green banks refusing to finance environmentally harmful projects, such as unsustainable resource exploitation, polluting projects, and prioritizing projects green. Support renewable energy based on loans and investments in solar, wind, and hydropower help reduce greenhouse gas emissions and dependence on fossil energy. Applying environmentally friendly technology by encouraging modern technology solutions to conserve natural resources and improve energy efficiency [28]. Besides, green banking promotes economic sustainability and enhances long-term financial performance. Green sector investments often bring sustainable, stable, long-term benefits to banks and the economy [29]. Create job opportunities in the green sector based on the support of green industries, thereby promoting economic development through creating jobs in sustainable sectors such as renewable energy production, organic agriculture, mechanical, and clean technology [30]. Finally, green banking supports social sustainability, such as improving quality of life by funding projects on wastewater treatment, clean water supply, and green infrastructure development, which helps improve the living environment and health of the community. Reduce inequality through green banks can provide financial services accessible to poor populations or remote areas, ensuring equality in development.

2-4- Legal Framework and Supporting Policies (LP)

The legal framework and supportive policies from the government include green regulations and standards, such as the government issuing rules to encourage banks to invest in green projects while applying green standards for credit activities [31]. Financial incentive policies based on tax reductions, subsidies, or interest rate supports for green projects can motivate banks to participate in green finance [32]. In addition, the legal framework and supporting policies based on the regulations on green finance and green credit by countries and international organizations are increasingly promoting the development of specific rules on green finance, such as carbon emission reduction and environment, society, and governance (ESG) standards. Complying with these regulations helps banks minimize legal risks and facilitates access to green capital from international financial institutions [33]. Tax incentives and incentives based on the many governments provide tax incentives or financial support for green projects, helping banks minimize costs when investing in areas such as renewable energy and technology green turmeric. This encourages banks to prioritize green finance projects, creating a competitive advantage over financial institutions that do not have a sustainable orientation. Consequently, the authors put forth hypotheses H1 and H2 as follows:

H1: *Legal framework and supporting policies affect green banking.*

H2: *Legal framework and supporting policies affect sustainable development.*

2-5- Awareness and Trends in Sustainable Consumption (AC)

Sustainable consumption and trends include customer awareness based on customers' interest in sustainable products and services, so banks must meet this need with green financial products [34]. Trends shift to sustainable consumption, such as society and organizations increasingly prioritizing sustainable activities, and banks need to change to meet the demands of consumers and businesses. Moreover, customer awareness and trends in sustainable consumption include environmental and social awareness of customers in the context of global awareness of climate change; many customers choose sustainable services and financial services from banks committed to sustainability [35]. Green banks can meet this need by designing green credit and investment products and encouraging customers to undertake environmentally friendly activities [36]. Sustainable consumption trends in the circular economy based on the circular economy promote the efficient use of resources, reduce waste, and develop environmentally friendly products. Green banks support this trend by financing projects and businesses with high social and environmental responsibility. Consequently, the authors put forth hypotheses H3 and H4 as follows.

H3: *Awareness and trends in sustainable consumption affect green banking.*

H4: *Awareness and trends in sustainable consumption affect sustainable development.*

2-6- Financial Technology (FT)

Technology and innovation include digital technology and online banking based on the application of digital technology helps banks optimize processes, minimize resource waste and develop environmentally friendly digital services [37]. Innovation in green financial products based on the development of financial technologies (Fintech) allows banks to introduce many new and diverse green financial products, attracting more interested customers in sustainability [38]. Moreover, technological advances and financial innovations include financial technology and automation based on digital technology, such as digital banking and Fintech applications that help banks reduce energy and resource consumption in transaction processes [39]. Fintech also enables the development of innovative green financial products,

attracting sustainability-conscious customers and improving banks' operational efficiency. Using Big Data and artificial intelligence (AI) through big data and AI helps banks predict environmental risks, analyze customer needs, and optimize decision-making processes [40]. Thanks to that, the bank can focus on projects with green potential, minimize environmental risks, and enhance the ability to reach sustainable customers. Consequently, the authors put forth hypotheses H5 and H6 as follows.

H5: *Financial technology affects green banking.*

H6: *Financial technology affects sustainable development.*

2-7- Commitment from Leadership and Corporate Culture (CC)

Leadership commitment and corporate culture include management vision and commitment based on the bank leaders need to have a strong commitment and clear vision of sustainable development to promote programs and green products [41]. Corporate culture oriented toward sustainability through a corporate culture that encourages sustainable activities and values will help banks easily integrate green elements into daily operations. Moreover, commitment from leadership and corporate culture towards sustainability includes the Bank's strategic vision based on the leaders having a decisive role in setting green development goals and building long-term plans [42, 43]. A strong commitment from leadership motivates the entire bank towards sustainability and developing green financial products and services. Building a sustainable corporate culture through the corporate culture is essential in maintaining and promoting green values. Banks with sustainable cultures prioritize initiatives that protect the environment, minimize risks, and encourage employees to participate in sustainable activities. Consequently, the authors put forth hypotheses H7 and H8 as follows.

H7: *Commitment from leadership and corporate culture affect green banking.*

H8: *Commitment from leadership and corporate culture affect sustainable development.*

2-8- Pressure from Investors, Partners, and International Organizations (PO)

Pressure from investors and international organizations, including many investors today, requires banks to have a sustainable development strategy and invest in green projects to ensure long-term benefits [44]. International standards based on international financial institutions and prestigious organizations worldwide, such as the United Nations, often encourage banks to meet environmental, social, and governance standards to ensure sustainability in financial operations [45]. Moreover, pressure from investors, partners, and international organizations, including investors and shareholders, who are increasingly interested in sustainability factors in bank operations often raise high requirements on ESG. This forces banks to adjust their strategies to meet investor requirements, creating a balance between profits and social responsibility. International standards for green finance, established by entities like the World Bank and the International Monetary Fund, advocate for the adoption of ESG criteria and sustainable finance practices [46]. Complying with these standards helps banks build a reputation and quickly access capital from international financial institutions. Consequently, the authors put forth hypotheses H9 and H10 as follows.

H9: *Pressure from investors, partners and international organizations affect green banking.*

H10: *Pressure from investors, partners and international organizations affect sustainable development.*

2-9- Climate Change and Environmental Risk Management (SM)

Impacts of climate change and requirements for environmental risk management, including climate change from the effects of climate change, have created environmental risks for many industries, including banking; this requires banks to have strict environmental risk management policies [47]. Risk management costs are based on the banks' investment in environmental risk management, such as developing environmental impact assessment processes for loans and investments [48]. Moreover, the impacts of climate change and environmental risk management requirements, including climate change and related financial risks. Banks face increased financial risks due to the effects of climate change, including asset risk, operational risk, and legal risk [49]. Therefore, banks must invest in climate risk management tools, protecting asset values against climate change factors. Environmental impact assessment for credit projects through green banks often applies strict environmental impact assessment processes for credits and investment projects to ensure they do not harm the environment [50]. This helps the bank minimize environmental risks and maintain credibility with investors and customers. Consequently, the authors put forth hypotheses H11 and H12 as follows.

H11: *Climate change and environmental risk management affect green banking.*

H12: *Climate change and environmental risk management affect sustainable development.*

2-10- Public-Private Partnerships and International Cooperation (PC)

Collaboration and partnerships include Collaboration with environmental organizations through the banks, which can build partnerships with environmental organizations, NGOs, and government agencies to jointly implement green

projects [51]. Public-private partnerships, which establish public-private alliances between banks and the government or international financial organizations, help banks have more capital and opportunities to develop sustainable services [52]. Moreover, public-private partnerships and international cooperation include public-private partnerships based on the collaboration between banks and governments in green projects, which can help banks receive capital support, governments preferential policies, and opportunities to expand green services. This contributes to creating a sustainable financial ecosystem. International partnerships with international financial institutions and non-governmental organizations (NGOs) help banks quickly access international sources of knowledge and experience in sustainable finance. These partners can provide expertise and financial support to implement green initiatives. Consequently, the authors put forth hypotheses H13 and H14 as follows.

H13: *Public-private partnerships and international cooperation affect green banking.*

H14: *Public-private partnerships and international cooperation affect sustainable development.*

Green banking has a multidimensional impact on sustainable development, including environmental, economic, and regulatory components. Green banking is essential to long-term economic and environmental sustainability because it directs financial resources toward sustainable activities, enforces policy alignment, promotes financial inclusiveness, and improves risk management [53]. Empirical data from Vietnam corroborate the favorable association between green banking adoption and national sustainability outcomes, emphasizing the urgency for ongoing financial sector reforms toward a greener economy. Based on section 2.3 above, the authors proposed hypothesis H15 in Figure 1.

The theoretical foundation of this research is anchored in the knowledge-based economy (KBE) perspective, which emphasizes knowledge as a critical resource for innovation, competitiveness, and sustainable growth. According to KBE theory, organizations that effectively create, share, and apply knowledge are better positioned to adapt to environmental challenges and implement sustainability-oriented strategies [28, 30, 53]. In the context of green banking, this perspective suggests that regulatory knowledge, financial technology, and organizational learning are essential enablers for integrating environmental, social, and governance (ESG) principles into banking operations. Building on prior works that have linked knowledge resources to corporate sustainability [31, 33, 53], this study extends the theory by examining how knowledge-driven factors, such as legal frameworks, awareness of sustainable consumption, and technological adoption, interact to promote green financial practices in an emerging economy. By adopting the KBE perspective, the research transcends descriptive approaches and offers a theoretically grounded explanation of how intangible resources can drive both green banking adoption and broader sustainable development outcomes.

Moreover, green banks act as a financial driver to promote sustainability goals, and sustainability trends and goals motivate green banking development. Optimizing this relationship will protect the environment and promote comprehensive and sustainable socio-economic development. Thus, the authors presented the model in Figure 1. To improve clarity and coherence, the hypotheses have been grouped into two categories: (1) Push factors based on these include external pressures such as regulatory frameworks, investor demand, and market competition, which compel banks to adopt green banking practices. (2) Pull factors based on these encompass internal drivers such as corporate sustainability initiatives, knowledge diffusion, and financial technology adoption, which encourage banks to proactively pursue green banking strategies. By structuring the hypotheses in this way, the study provides a clearer conceptual understanding of the external constraints and internal motivations shaping the adoption of green banking practices in Figure 1.
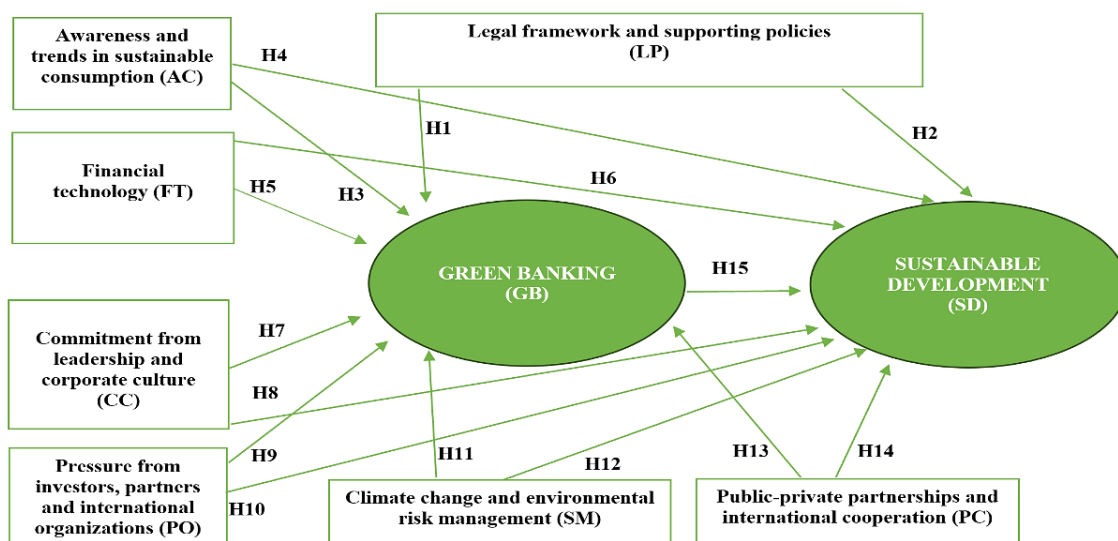

Figure 1. The model proposed for key factors affecting green banking and sustainable development

Figure 1 presents seven independent factors influencing green banking and sustainable development in Vietnam: (1) Legal framework and supporting policies (LP), (2) Awareness and trends in sustainable consumption (AC), (3) Financial technology (FT), (4) Commitment from leadership and corporate culture (CC), (5) Pressure from investors, partners and international organizations (PO), (6) Climate change and environmental risk management (SM), and (7) Public-private partnerships and international cooperation (PC). Figure 1 also shows that green banking and sustainable development are dependent factors.

3- Methods of Research

Before commencing the study, ethical approval must be obtained for all respondents who agree to participate, having been fully informed about the research objectives, procedures, and potential implications. Consent to participate was obtained in written forms. Written consent was obtained by having participants sign a consent form that detailed the study's purpose, their rights as participants, and assurances of confidentiality. All respondents agreed to participate and answer the author's questions, as listed in "Appendix I: Table A1". This study is divided into three phases: (1) qualitative research, (2) preliminary quantitative research, and (3) formal quantitative research. Based on three stages, the authors completed the six steps in this research process through an in-depth interview to create the scales and research hypotheses shown in Figure 2.
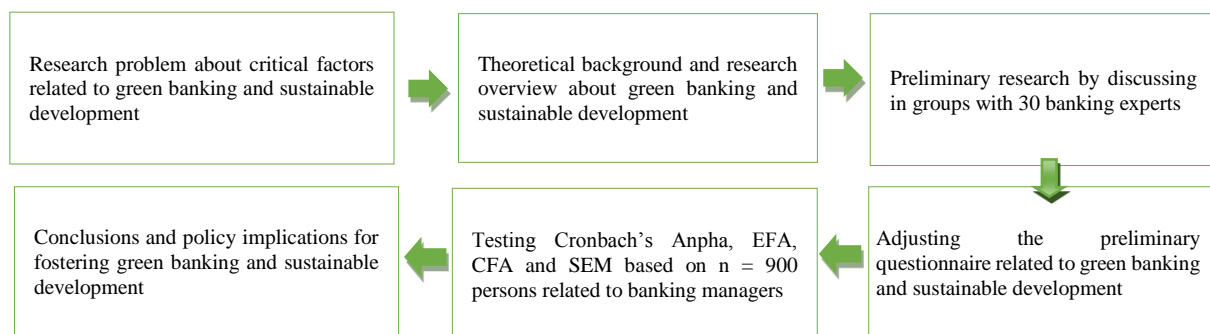

Figure 2. A research process for critical factors affecting green banking and sustainable development

To evaluate research idea measuring scales and enhance the questionnaire, preliminary quantitative research employs direct interview techniques based on the essential elements impacting green banking and sustainable development. This study is a descriptive one. Formal quantitative analysis checks the validity and reliability of the scale used to assess the theoretical model and its assumptions in Figure 1 [54]. To do research and development for the ranking, the following six steps were detailed in the article:

Step 1: The authors identified the research problem and developed theoretical foundations. The research begins by defining a core problem based on the elements influencing green banking and sustainable development in Southeast Vietnam. The authors perform an extensive literature review to ensure academic rigor, concentrating on theoretical frameworks and worldwide studies on green credit, green banking, and sustainable development. The theoretical framework is based on fundamental studies on sustainable development and banking, offering a firm platform for proposing an appropriate research model. Furthermore, the authors must establish an environmentally sustainable green banking theory to underpin the conceptual framework and research challenge. The initial phase of the inquiry encompassed doing three analyses: (1) Develop a theoretical framework for the examination of green banking and sustainable development concepts; (2) Analyze the interrelations among the concepts within the research model; (3) Formulate an initial scale for the concepts under investigation, specifically the scale of factors influencing green banking and sustainable development.

Step 2: The authors applied research design and development of measurement tools; the research design includes the following steps by adopting a mixed methods approach based on combining qualitative and quantitative methodologies to leverage the strengths of both techniques, developing a preliminary research model based on the theoretical model is proposed, including potential factors such as (1) Legal framework and supporting policies, (2) Awareness and trends in sustainable consumption, (3) Financial technology, (4) Commitment from leadership and corporate culture, (5) Pressure from investors, partners, and international organizations, (6) Climate change and environmental risk management, and (7) Public-private partnerships and international cooperation. The survey questionnaire will be designed based on the measurement scales adapted from established studies and tailored to the research context in Vietnam. The questionnaire comprises two main parts based on the respondents' basic information and quantitative questions measuring the impact of factors on green banking and sustainable development. Moreover, the authors conducted empirical research and focus groups with 30 banking experts from different provinces and cities in Vietnam to develop conceptual measurements for green banking and sustainable development. At the same time, to get suggestions about the scope of green banking and

sustainable development [54]. At this stage, the authors had revised two things: (1) Create a set of variables on a new scale to incorporate into the model. (2) Adjust and improve the scale of scaled concepts. The initial study will modify and enhance the original scales through focus group discussions. A study was conducted using focus group interviews. Interviews were conducted with different groups. The absolute scale, now called the variable scale, is modified at this step [54].

Step 3: The authors conducted the qualitative research. Basic quantitative research involved conducting interviews with 30 Vietnamese banking specialists. The questionnaire created following step 2 analyzes green banking and sustainable development, making it suitable for this study's banking management survey, which was based on 30 professionals sampled in the provinces as mentioned above. Moreover, the qualitative phase is conducted through in-depth interviews with 15 senior managers at commercial banks in the Southeast region. Objectives are based on exploring additional potential factors not mentioned in the theoretical framework. Evaluate the comprehensiveness, clarity, and suitability of the quantitative survey questionnaire. Data collection methods by interviews are conducted either in person or online, lasting 45 to 60 minutes per session. The interview content focuses on managers' perceptions of green banking, existing policies, and challenges in sustainable development. Results based on the insights from this phase are used to refine and finalize the questionnaire and identify new factors, if any.

Step 4: The authors applied the conducting quantitative research. The quantitative survey is implemented on a large scale, with a sample of 900 commercial bank managers based on "Appendix I: Table A1", with only 845 votes processed. Data collection strategy based on the sampling method by stratifying random sampling across provinces to ensure representativeness for commercial banks in the Southeast region, including Ho Chi Minh City and Dong Nai Province. The data collection mode is based on online and offline surveys. Questionnaires are distributed via email or directly during industry conferences. The data collection period is from January 2024 to June 2024. After that, exploratory factor analysis (EFA) and the reliability coefficient of Cronbach's alpha were applied to the data collected in Step 4 to conduct a preliminary scale assessment. The sample comprises 900 commercial bank managers from multiple Vietnam's Southeast region banks. To enhance transparency and robustness, the sample distribution includes: (1) Number of banks surveyed through 25 commercial banks. (2) Average number of managers per bank through 36 regional representations. (3) Aggregate bank loan and deposit totals through the sampled banks account for approximately 70% of total loans and 65% of total deposits in the region.

The two primary methods for calibrating the scales are (1) exploratory factor analysis (EFA) and (2) Cronbach's alpha, which is used to assess reliability. Researchers conducted a Cronbach Alpha coefficient study to establish the scale's reliability. When the coefficient exceeds 0.6, the scale is regarded as reliable. The correlation coefficient is the fundamental variable, averaged across all variables on the same scale. A higher coefficient suggests that the variable is more strongly associated with other group variables. The variable and total must have a correlation of at least 0.3. We discard and delete from the scale any variables with a total correlation coefficient less than 0.3 [54].

The authors utilized exploratory factor analysis (EFA) to test whether the conceptual scale is valid. Following the identification of EFA, the authors conducted confirmatory factor analysis (CFA) and structural equation modeling (SEM) tests; therefore, it is critical to analyze the scale structure and differences between factors. As a result, the writers conducted an exploratory factor analysis with the following success criteria. When factoring along the principal axis, promax rotation is used. The second requirement states that each variable must have a maximum coefficient load factor of 0.4. Factor loading is the most crucial factor for each variable [54]. The load factor should equal or exceed 0.3 to ensure factor difference. Half of the overall variation was removed. When KMO > 0.5, the Bartlett test is statistically significant ($p < 0.05$). Structural Equation Modeling (SEM) was chosen for its ability to simultaneously analyze complex relationships among multiple variables, a critical feature when investigating green banking's multidimensional influences. Although SEM has been debated for its sensitivity to model specification, it remains an essential tool for examining latent constructs in financial research.

Step 5: The authors had data processing and analysis. The collected data are processed and analyzed using advanced analytical methods with SPSS 20.0 and Amos software. Detailed data processing steps based on the reliability analysis by Cronbach's Alpha are applied to eliminate variables with low item-total correlations (< 0.3). Exploratory factor analysis (EFA) based on the principal component analysis extraction method with Varimax rotation is used to identify latent factors. For conditions based on the eigenvalue > 1, the total variance was explained to be> 50%. Confirmatory factor analysis (CFA) based on the model is tested for unidimensionality, composite reliability (CR), and convergent validity. Model fit indices such as Chi-square/df, CFI, GFI, and RMSEA are evaluated. Structural Equation Modeling (SEM) based on the relationships among factors affecting green banking and sustainable development are examined. Research hypotheses are tested with a statistical significance level of 5%.

Step 6: The authors provide practical and academically rigorous conclusions based on the data analysis results. Research conclusions based on the degree of influence of each factor on green banking and sustainable development are identified. A new theoretical framework is proposed, tailored to the context of commercial banks in Vietnam, particularly in the Southeast region. Policy recommendations are based on enhancing green credit management capacity by training

personnel on managing environmental and social risks. Applying modern banking technologies by promoting digitization and integrating big data analytics tools to improve green credit operations. Developing comprehensive support policies based on the Government should introduce financial incentives and appropriate legal frameworks to foster green banking development. Raising awareness on sustainable development based on the launch of community education campaigns to increase awareness of the banking sector's role in sustainable development. Additionally, the authors address research limitations, such as the restricted survey scope and time frame, and propose future research directions for broader generalizability and deeper exploration.

4- Results and Discussion

4-1- Analysis of the Situation for Vietnam's Green Banking Development Situation During 2022-2024

The situation for the growth of green banking was gradually improved by the legislative framework. The banking industry has been an intermediary in promoting environmentally friendly and long-term economic prosperity. Commercial banks were ordered by the Governor of the State Bank of Vietnam (SBV) to provide green financing for projects with specific environmental objectives. Therefore, Vietnam aims to raise environmental consciousness and social responsibility within the banking sector concerning climate change response and protection. This will be achieved through the following measures: the gradual implementation of green banking practices; the use of direct credit flows to fund environmentally friendly projects; the promotion of green production, services, and consumption; the use of clean and renewable energy sources; the active promotion of green growth and sustainable development; and the goal of having interns at 100% of construction banks by the year 2025.

According to the Vietnam Banking Association, credit institutions are increasingly showing great interest in the responsibility of developing green credit, building preferential credit policies for customers with production and business plans, and projects that meet green growth targets in the context of increasing demand for green products and products that meet environmental protection standards. As a result, commercial banks have consistently developed preferential lending schemes to allow corporate and individual customers to borrow funds to implement "green" projects. The banks have long recognized the importance of sustainability in driving growth, and providing loans for green projects is one of the bank's essential roles. Vietcombank aims to increase green financing for the economy, particularly for renewable energy, green agriculture, and environmental treatment projects. By the end of the first quarter of 2024, the bank's outstanding green credit had increased, accounting for 3.7% of the bank's total outstanding loans. In terms of green capital-funded programs, Vietcombank actively implemented a program in 2023 to re-lend green projects from loans from the Japan Bank for International Cooperation (JBIC) to finance green and renewable energy projects to protect the environment, totaling USD 300 million.

In recent years, Agribank has been concentrating on some essential areas, including the following: prioritizing capital sources; effectively expanding lending to projects and programs for production and business development; contributing to the promotion of green credit growth; managing environmental and social risks in credit; and, of particular importance, programs and projects that create added value, clean energy, and high-tech agriculture. For instance, in 2023, Agribank served 42,883 clients with green sector loans totaling VND 28,277 billion. With a projected $3 billion in assets by 2023, the bank has surpassed all others in green project funding. In addition, it is the first bank to provide green bonds to support enterprises. The banks offer a preferred loan package with lower interest rates than usual, particularly for enterprises that fulfill international green criteria.

The green credit scale is expanding; according to the World Bank, Vietnam must invest an extra capital of around 6.8% of GDP each year for resilience and zero net emissions roadmaps through 2040. The banking sector plays an essential role in delivering this type of capital. According to data from the State Bank of Vietnam, the system's outstanding credit for green industries grew at an average rate of more than 23% per year between 2022 and 2023. At the end of the first quarter of 2024, exceptional green credit in Vietnam had reached almost 637,000 billion VND at 47 credit institutions, accounting for approximately 4.5% of the total outstanding loan balance in the economy. Outstanding loans assessed for environmental and social risks were approximately VND 2.9 million billion, accounting for more than 21% of the total outstanding loans in the credit institution system and increasing by more than 20% over the same period in 2023. Difficulties and challenges based on the commercial banks in both the private and public sectors showed that the development of green banking in Vietnam still faces problems and barriers such as: (i) While the government and the state bank have released broad principles for green banking development, specific regulations regarding the implementation roadmap are lacking and insufficient detail rules are available. (ii) Banks encounter challenges during the implementation phase of green projects or products due to a lack of coordination or assistance from state management authorities, international organizations, and other stakeholders involved in adopting green banking. (iii) Sponsoring banks face risks due to the low efficiency and relatively extended payback period of green investment projects. (iv) Problems with commercial banks' ability to function due to green banking initiatives. (v) Following the COVID-19 epidemic, the economy has been hit hard, delaying initiatives to promote green finance.

The development of green banking activities at Vietnamese credit institutions continues to face numerous difficulties and challenges, such as the need for significant resources for implementation; the knowledge and experience of bank officers performing credit appraisal and approval related to social and environmental issues is generally limited. Lack of structures and policies to assist credit institutions in accessing long-term, preferential capital sources, particularly mobilizing international resources to give long-term, preferential interest rate financing to green industries/sectors.

Additionally, since most Vietnamese banks are state-owned or state-influenced, compliance with green banking regulations may broadly reflect alignment with state policies rather than independent institutional commitments. The regulatory environment, therefore, serves as both a framework for guiding green banking adoption and a mechanism for reinforcing state-driven sustainability initiatives in the banking sector. To ensure the sustainable development of digital transformation, the banking industry needs to focus on upgrading and developing modern information technology infrastructure. Investing in electronic payment systems, national financial switching systems, and credit databases is crucial for enhancing transaction efficiency and security. In addition, the banking industry also needs to develop technology infrastructure platforms to support integration between banks, credit institutions, and other sectors within the digital ecosystem, facilitating the provision of multi-utility services to the public.

4-2- Examining Determinants Influencing Green Banking and Sustainable Development Through Descriptive Statistics and Cronbach's Alpha

Table 1 presents the analysis of descriptive statistics and Cronbach's alpha for green banking and sustainable development as follows:

(1) Table 1 was analyzed using descriptive statistics and Cronbach's Alpha to determine green banking and sustainable development. Cronbach's alpha values evaluate the internal consistency of each factor's measurement scale; higher values indicate better reliability. The generally accepted thresholds are based on excellent reliability > 0.90, good reliability is 0.80 - 0.90, and acceptable reliability is 0.70 - 0.80. Therefore, all factors exhibit high reliability, with Cronbach's alpha values ranging from 0.846 to 0.943. Financial technology (FT) demonstrates the highest internal consistency (0.943), reflecting a well-constructed and cohesive scale. Sustainable development (SD) has the lowest alpha (0.846), which is still within the acceptable range but may suggest room for further refinement of its scale items.

(2) The mean scores indicate respondents' agreement levels with each factor on a scale likely ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Higher means reflect more substantial agreement or higher perceived importance of a factor. The highest mean score is observed for green banking (3.307), followed closely by public-private partnerships and international cooperation (3.297). Besides, awareness and trends in sustainable consumption are also critical (3.382). This suggests that respondents perceive these factors as particularly important or well-implemented in the context of green banking. The lowest mean scores are for sustainable development (2.374) and climate change and environmental risk management (2.418), which may indicate perceived challenges or insufficient implementation in these areas. The mean for Pressure from investors, partners, and international organizations (2.494) is also relatively low, suggesting limited influence or lower emphasis from external stakeholders in driving green banking practices. The standard deviation reflects the variability in responses. A higher standard deviation indicates more diverse perceptions, while a lower value suggests greater consensus. Climate change and environmental risk management (0.674) and sustainable development (0.654) show the lowest standard deviations, indicating relatively consistent perceptions among respondents. Factors such as commitment from leadership and corporate culture (1.012) and legal framework and supporting policies (1.009) exhibit higher standard deviations, suggesting more varied opinions.

(4) Factor-specific analysis indicates strengths and development areas that can improve green banking and sustainable development: Legal framework and supporting policies (LP) with a strong Cronbach's alpha (0.932), mean score (3.023), and significant standard deviation (1.009) show mixed viewpoints on its effectiveness and implementation. Uniform enforcement or regional discrepancies may be present with a high mean (3.382) and solid reliability (0.860), indicating universal agreement that customer awareness drives green banking. However, the moderate standard deviation (0.948) suggests that demographic or regional groupings may perceive things differently. With the most excellent Cronbach's alpha (0.943) and a mean of 3.036, Fintech appears to enable green banking. The moderate standard deviation (0.981) suggests fintech adoption or impact perceptions vary by location or institution. Leadership commitment and corporate culture (CC) have a high alpha (0.942), indicating good internal consistency, but the relatively average mean (3.045) and large standard deviation (1.012) indicate significant variation among firms. Based on the low mean (2.494) but excellent dependability (0.933), pressure from investors, partners, and international organizations (PO) appears to have little perceived influence, suggesting a gap in external stakeholder engagement. Climate change and environmental risk management (SM) have a low mean (2.418) and moderate alpha (0.884), suggesting financial solutions could improve environmental risk management. The high mean (3.297) and excellent alpha (0.920) imply that respondents consider public-private partnerships and international cooperation (PC) as successful green banking promotion methods. Green banking (GB)'s continuously high mean (3.307) and excellent dependability (0.914) demonstrate the sector's recognition of green banking initiatives. Sustainable development (SD), with the lowest mean (2.374) and alpha (0.846), needs industry-wide focus to improve implementation and perception.

Table 1. Statistic testing and Cronbach's alpha for critical factors influencing green banking and sustainable development

Items	Cronbach's alpha	Mean	Std. Deviation
1. Legal framework and supporting policies (LP: LP1, LP2, LP3, LP4)	0.932	3.023	1.009
2. Awareness and trends in sustainable consumption (AC: AC1, AC2, AC3, AC4)	0.860	3.382	0.948
3. Financial technology (FT: FT1, FT2, FT3, FT4)	0.943	3.036	0.981
4. Commitment from leadership and corporate culture (CC: CC1, CC2, CC3, CC4)	0.942	3.045	1.012
5. Pressure from investors, partners and international organizations (PO: PO1, PO2, PO3, PO4)	0.933	2.494	0.807
6. Climate change and environmental risk management (SM: SM1, SM2, SM3, SM4)	0.884	2.418	0.674
7. Public-private partnerships and international cooperation (PC: PC1, PC2, PC3)	0.920	3.297	0.984
8. Green banking (GB: GB1, GB2, GB3)	0.914	3.307	0.985
9. Sustainable development (SD: SD1, SD2, SD3)	0.846	2.374	0.654

Table 2 examines the essential aspects affecting green banking and sustainable development as follows:

(1) Legal framework and supporting policies (LP) based on the SRC is 0.581, and significance is highly significant based on $P < 0.001$. Moreover, LP is the most influential factor in green banking, underscoring the critical role of legal and regulatory frameworks in driving green banking practices. This highlights the importance of robust policies, transparent regulations, and enforcement mechanisms in promoting green initiatives within financial institutions. Besides, legal framework and supporting policies (LP) are the most critical factors for sustainable development, with a SRC of 0.332 and $P < 0.001$, highlighting the foundational role of regulations in sustainability. One of the key factors in promoting green transformation in the banking sector is to establish and refine a clear and coherent legal framework and policy system. It is necessary to continue reviewing, amending, and supplementing legal regulations related to green banking activities, electronic payments, and customer information security, thereby creating a favorable legal corridor for technology development in banking. At the same time, it is necessary to develop management regulations for new business models, such as fintech and digital banking, which will help credit institutions develop technology without violating current regulations.

(2) Awareness and trends in sustainable consumption (AC), with a SRC of 0.151, is a highly significant factor influencing green banking ($P < 0.001$). Although its influence is moderate compared to LP, it emphasizes the growing role of consumer awareness and behavior in driving green banking practices. Institutions can leverage this trend through targeted awareness campaigns and by offering financial products that align with sustainable consumption preferences. Besides awareness and trends in sustainable consumption with an estimate of 0.096 ($P = 0.003$), AC emphasizes the role of consumer behavior in shaping sustainability outcomes.

(3) Financial technology (FT) exhibits a SRC of 0.097, with significance at $P = 0.001$, making it a notable contributor to green banking. This reflects the role of digital tools and innovations in enabling environmentally friendly banking operations. Technologies like blockchain, AI-driven risk assessments, and paperless banking systems are pivotal in reducing operational inefficiencies and enhancing the sustainability of financial practices. Besides, financial technology, with a SRC of 0.094 and $P = 0.003$, reflects the role of technological advancements in sustainable development.

(4) Commitment from leadership and corporate culture (CC) has a SRC of 0.105, which is highly significant ($P < 0.001$). This underscores the importance of organizational leadership and an ingrained corporate culture in embedding green banking practices. Strong leadership that prioritizes sustainability can inspire employees, align strategic goals, and foster a robust organizational commitment to green initiatives. Besides, commitment from leadership and corporate culture with a modest influence (0.079, $P = 0.012$) indicates the need for organizational alignment with sustainability goals.

(5) Pressure from investors, partners, and international organizations (PO) is a significant factor influencing green banking, with a SRC of 0.054 and $P = 0.022$. Although its influence is relatively modest, it highlights the importance of external stakeholder expectations. Strengthening alignment with investor priorities and international standards can enhance the adoption of green banking practices. Besides, pressure from investors, partners, and international organizations, with an estimated 0.091 ($P < 0.001$), highlights the importance of stakeholder-driven sustainability initiatives.

(6) Climate change and environmental risk management (SM) has a SRC of 0.079 and is significant at $P = 0.003$. This indicates that institutions that effectively manage environmental risks and address climate change are more likely to implement green banking practices. Expanding capabilities in climate risk assessment and mitigation can further bolster this relationship. Besides, climate change and environmental risk management, with an estimate of 0.064 and $P = 0.023$, signifies that environmental risk management remains an essential but more minor contributor to sustainable development.

(7) Public-private partnerships and international cooperation (PC), with a SRC of 0.058 and P = 0.021, play a more minor but significant role in green banking. This suggests that while partnerships can enhance green banking, their impact is less pronounced than other factors. Improving collaboration and aligning efforts between public and private sectors can amplify their contributions to green banking. Besides, public-private partnerships and international cooperation play the least influential role (0.056, P = 0.038), suggesting that more robust collaborative frameworks are needed to maximize their impact on sustainable development.

(8) Green banking (GB) based on the significant contributions to sustainable development (0.329, P < 0.001), reinforcing its role as a driver of sustainable development. Green banking is a banking operating model aimed at protecting the environment, promoting sustainable development, and ensuring social responsibility. These activities include financing renewable energy projects, sustainable financial management, and minimizing the environmental impact of internal operations. Green banks not only act as financial intermediaries but also as driving forces for sustainable development. By supporting environmentally friendly projects, green banks protect ecosystems, improve quality of life, and ensure long-term sustainable development. Green banking has a multidimensional impact on sustainable development, including environmental, economic, and regulatory components. Green banking is essential to long-term economic and environmental sustainability because it directs financial resources toward sustainable activities, enforces policy alignment, promotes financial inclusiveness, and improves risk management. Empirical data from Vietnam corroborate the favorable association between green banking adoption and national sustainability outcomes, emphasizing the urgency for ongoing financial sector reforms toward a greener economy.

Table 2. Critical factors affecting green banking and sustainable development based on testing structural equation modeling

Relationships			Standardized regression coefficient (SRC)	S.E	C.R	P value	Result
AC	→	GB	0.151	0.030	4.850	***	Accepted H3
PC	→	GB	0.058	0.032	2.305	0.021	Accepted H13
LP	→	GB	0.581	0.031	16.986	***	Accepted H1
FT	→	GB	0.097	0.026	3.239	0.001	Accepted H5
CC	→	GB	0.105	0.024	3.545	***	Accepted H7
PO	→	GB	0.054	0.034	2.291	0.022	Accepted H9
SM	→	GB	0.079	0.050	3.007	0.003	Accepted H11
LP	→	SD	0.332	0.024	7.903	***	Accepted H2
FT	→	SD	0.094	0.018	2.943	0.003	Accepted H6
CC	→	SD	0.079	0.016	2.514	0.012	Accepted H8
PO	→	SD	0.091	0.023	3.572	***	Accepted H10
SM	→	SD	0.064	0.033	2.271	0.023	Accepted H12
AC	→	SD	0.096	0.019	2.946	0.003	Accepted H4
PC	→	SD	0.056	0.021	2.072	0.038	Accepted H14
GB	→	SD	0.329	0.027	7.575	***	Accepted H15

*** is significance 0.01.

Notably, the variable 'legal framework and supporting policies' records the highest mean, highlighting the central role of government regulations and institutional support in promoting green banking in Vietnam. This aligns with previous studies that emphasize the regulatory environment as the most potent enabler of sustainability transitions in emerging markets [41, 43]. Conversely, financial technology has a comparatively lower mean, which may suggest that while fintech is recognized as an enabler, its practical application in Vietnam's banking sector is still in the process of evolving. This finding resonates with earlier research in Southeast Asia, where limited digital infrastructure constrained the immediate benefits of fintech for sustainability [44].

The relatively high values for leadership commitment and corporate culture also indicate that internal organizational orientation toward sustainability is a critical factor. This confirms prior literature that organizational leadership has a significant impact on the adoption of environmental and social responsibility practices [45, 46]. Meanwhile, the considerable variation in responses regarding investor and international pressure suggests that not all banks are equally exposed to global sustainability demands, which may result in an uneven pace of green banking adoption across institutions.

Overall, the descriptive results in Table 2 provide initial evidence in support of the hypothesized relationships. They suggest that external institutional drivers, such as international regulation and pressure, and internal enablers, such as

leadership, culture, and technology, jointly influence the advancement of green banking practices. These findings not only reinforce the theoretical framework grounded in the knowledge-based economy perspective but also reveal specific contextual insights into Vietnam's transition toward sustainable development.

ESG alignment fosters innovation and product diversification, as banks develop green credit products, sustainability-linked loans, and green bonds that meet the demands of international investors. This not only expands product portfolios but also situates Vietnamese banks as credible players in the global sustainable finance value chain. In this sense, international ESG alignment serves as both a constraint that imposes higher compliance requirements and an opportunity to strengthen competitiveness, access international capital, and foster long-term growth. For Vietnam, proactive adaptation will be critical to ensure that its banking sector can transition from reactive compliance to strategic leadership in sustainable development.

Figure 3 displayed the results of the evaluation of the critical aspects impacting green banking and sustainable development, which are: CMIN/DF = 3.995 (<5.0), GFI = 0.888 (>0.800), TLI = 0.932 (>0.900), CFI = 0.943 (> 0.900), and RMSEA = 0.060 (<0.08). The article aims to determine the seven factors affecting green banking and sustainable development in Vietnam, especially the legal framework and supporting policies (LP), based on the SRC of 0.581, and the significance is highly significant based on P < 0.001. Moreover, banks are financial intermediaries essential in promoting sustainable development in all three economic, social, and environmental aspects. The bank is a critical driver in building a sustainable future by financing green projects, supporting communities, and integrating ESG standards into operations. Moreover, empirical findings from Vietnam further validate the positive correlation between green banking adoption and national sustainability outcomes, supporting the imperative for continued financial sector reforms toward a greener economy.
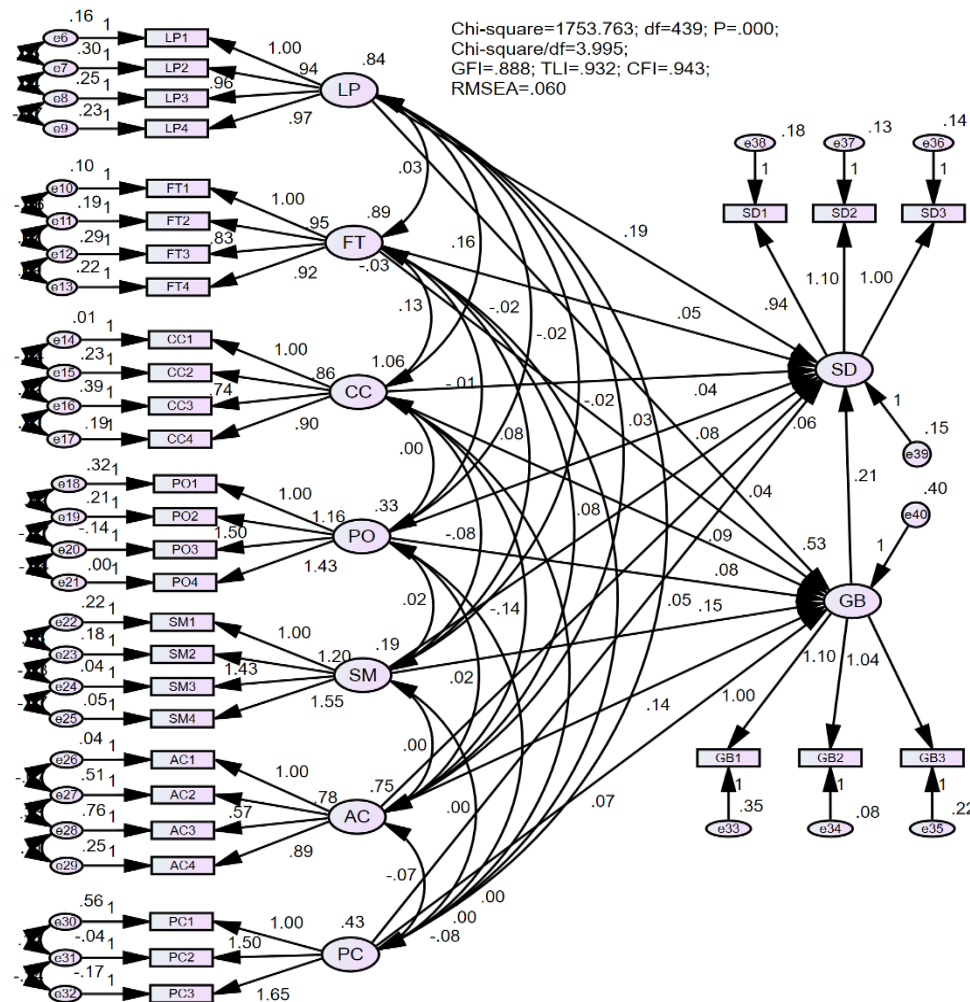

Figure 3. Testing for critical factors influencing green banking and sustainable development

Table 3 presents all aspects are classified as "Good" demonstrating strong construct validity following: (1) Composite reliability based on values measure the internal consistency of the constructs, with thresholds acceptable > 0.7, and all constructs have CR values ranging from 0.846 to 0.959, reflecting excellent reliability. Besides, pressure from investors, partners, and international organizations (0.959) and Public-Private partnerships and international cooperation (0.956)

exhibit the highest CR, indicating highly cohesive scales. (2) Average variance extracted (AVE) based on values measures the proportion of variance explained by the construct's indicators, with a threshold of 0.5 or higher for adequate convergent validity. All constructs exceed the AVE threshold, ranging from 0.593 (AC) to 0.884 (PC). Public-Private partnerships and international cooperation have the highest AVE (0.884), demonstrating that their indicators effectively capture the construct's variance. Awareness and trends in sustainable consumption (AC) have the lowest AVE (0.593) but still meet the validity criterion.

Table 3. Factors affecting green banking and sustainable development based on testing average variance extracted

Code	CR	AVE	MSV	Results
PC	0.956	0.884	0.018	Very good
LP	0.931	0.770	0.367	Very good
FT	0.937	0.789	0.018	Very good
CC	0.939	0.796	0.033	Very good
PO	0.959	0.856	0.010	Very good
SM	0.910	0.721	0.029	Very good
AC	0.846	0.593	0.026	Very good
GB	0.916	0.784	0.367	Very good
SD	0.846	0.647	0.334	Very good

Table 4 presents the variables influencing green banking and sustainable development were investigated through Bootstrap testing with 5.000 samples, with a significant level of 0.05 (C.R < 1.96). This outcome is in complete harmony with the principles of sustainable development and applied green banking in Vietnam. This finding provides scientific evidence that policymakers can utilize to inform their predictions.

Table 4. Testing Bootstrap for 5.000 samples of green banking and sustainable development

Parameter			SE	SE-SE	Mean	Bias	SE-Bias	C.R	Results
AC	→	GB	0.036	0.001	0.142	0.002	0.003	0.67	Not rejected H3
PC	→	GB	0.036	0.001	0.065	0.003	0.002	1.50	Not rejected H13
LP	→	GB	0.039	0.001	0.524	0.003	0.003	1.00	Not rejected H1
FT	→	GB	0.027	0.001	0.078	0.007	0.004	1.75	Not rejected H5
CC	→	GB	0.023	0.001	0.080	0.004	0.003	1.33	Not rejected H7
PO	→	GB	0.042	0.001	0.073	0.004	0.004	1.00	Not rejected H9
SM	→	GB	0.078	0.002	0.097	0.003	0.002	1.50	Not rejected H11
LP	→	SD	0.026	0.001	0.186	0.002	0.003	0.67	Not rejected H2
FT	→	SD	0.025	0.001	0.051	0.001	0.001	1.00	Not rejected H6
CC	→	SD	0.024	0.001	0.039	0.001	0.001	1.00	Not rejected H8
PO	→	SD	0.031	0.001	0.077	0.006	0.004	1.50	Not rejected H10
SM	→	SD	0.068	0.002	0.089	0.004	0.003	1.33	Not rejected H12
AC	→	SD	0.021	0.001	0.052	0.005	0.004	1.25	Not rejected H4
PC	→	SD	0.024	0.001	0.034	0.001	0.001	1.00	Not rejected H14
GB	→	SD	0.029	0.001	0.207	0.001	0.001	1.00	Not rejected H15

4-3- Discussion of Findings

The findings in Table 2 highlight the relationships between critical factors and their influence on green banking (GB) and sustainable development (SD) through SRCs and significance levels:

(1) Legal framework and supporting policies (LP) based on the most influential factor for green banking with SRC 0.581, P < 0.001 (see table 2), this study's findings are consistent with those of other research [7, 14, 55]. This result underscores the foundational role of robust regulatory frameworks in driving green banking adoption. Clearly defined policies, effective enforcement, and alignment with global sustainability standards like the equator principles can significantly encourage financial institutions to prioritize green initiatives. Besides, legal framework and supporting

policies (LP) based on the most influential factor for sustainable development with a SRC of 0.332, P < 0.001 (see table 2). The critical role of legal frameworks in enabling sustainable development is evident. Comprehensive policies addressing environmental challenges and incentivizing sustainable practices are fundamental for progress.

(2) Awareness and trends in sustainable consumption (AC) based on a moderate influence on green banking with SRC 0.151, P < 0.001 (see Table 2), this study's findings are consistent with those of other research [13, 18, 56]. Consumer behavior and demand for eco-friendly products play a significant role in encouraging banks to adopt sustainable practices. Public education and awareness campaigns are essential to amplify this impact, especially in regions where awareness is still developing. Besides, awareness and trends in sustainable consumption (AC) moderately influence sustainable development with a SRC of 0.096, P = 0.003 (see Table 2). Sustainable consumption trends drive broader sustainability efforts based on increasing consumer awareness, which can further enhance the alignment between financial products and SDGs.

(3) Commitment from leadership and corporate culture (CC) moderately influences green banking with a SRC of 0.105, P < 0.001 (see Table 2); this study's findings are consistent with those of other research [15, 24, 57]. Leadership vision and an aligned corporate culture are crucial for embedding sustainability into organizational strategies. Strong leadership commitment ensures the integration of green banking initiatives at all operational levels. Besides, commitment from leadership and corporate culture (CC) based on a moderate influence on sustainable development with a SRC of 0.079, P = 0.012 (see table 2). Leadership commitment ensures that sustainability remains a strategic priority. A corporate culture emphasizing environmental responsibility is essential for long-term sustainability success.

(4) Financial technology (FT) contributes positively to green banking with a SRC of 0.097, P = 0.001 (see Table 2); this study's findings are consistent with those of other research [19, 23, 58]. This highlights the role of technology in facilitating green banking. Digital innovations like blockchain for carbon credits or AI for risk management enable efficient and scalable green banking operations. Besides, financial technology (FT) positively affects sustainable development with a SRC of 0.094, P = 0.003 (see Table 2). The role of fintech in supporting sustainable development is notable, as digital tools reduce resource consumption, improve efficiency, and facilitate innovative solutions for sustainable financing.

(5) Climate change and environmental risk management (SM) based on a more minor but significant impact on green banking with a SRC of 0.079, P = 0.003 (see Table 2), this study's findings are consistent with those of other research [33, 36, 59]. Effective environmental risk management is vital for financial institutions to mitigate exposure to climate risks. This emphasizes the need for advanced tools and frameworks to evaluate and address these risks. Besides, climate change and environmental risk management (SM) are based on a more negligible influence on sustainable development with a SRC of 0.064, P = 0.023 (see Table 2). Integrating climate risk management into sustainability strategies is vital for mitigating long-term environmental challenges.

(6) Public-Private partnerships and international cooperation (PC) based on a weaker but significant influence on green banking with a SRC of 0.058, P = 0.021 (see Table 2), this study's findings are consistent with those of other research [41, 45, 60]. Collaborative efforts between the public and private sectors contribute to green banking but require more robust integration and alignment to maximize impact. Besides, public-private partnerships and international cooperation (PC) based on the least influential factor for sustainable development with a SRC of 0.056, P = 0.038 (see Table 2). While still significant, the relatively low impact of PC suggests that more vital collaboration and alignment between public and private entities are needed to amplify its role in sustainable development.

(7) Pressure from investors, partners, and international organizations (PO) has the least influence on green banking, with a SRC of 0.054, P = 0.022 (see Table 2); this study's findings are consistent with those of other research [46, 49, 61]. Although significant, the relatively low impact suggests that financial institutions may not fully integrate stakeholder-driven sustainability demands. Greater alignment with ESG principles and increased stakeholder pressure could amplify this factor's role. Besides, pressure from investors, partners, and international organizations (PO) significantly impacts sustainable development with a SRC of 0.091, P < 0.001 (see Table 2). External pressures from investors and partners are crucial in driving sustainable development. Transparency in reporting and alignment with international standards are critical to strengthening this factor.

(8) Green banking (GB) significantly impacts sustainable development with a SRC of 0.329, P < 0.001 (see Table 2); this study's findings are consistent with those of other research [50, 62, 63]. The close relationship between green banking and sustainable development highlights that adopting green banking practices directly contributes to achieving sustainable development goals (SDGs), such as climate action and responsible consumption.

Inclusion, legal framework, supporting policies (LP), and green banking as central drivers are emerging as the most influential factors for sustainable development, highlighting the need for robust policies and sustainable financial practices. Moreover, the interconnectedness of factors based on the significant impact of multiple factors emphasizes that achieving sustainable development requires a multifaceted approach, integrating technology, consumer awareness,

leadership, and collaboration. Though substantial, it shows weaker impacts, suggesting areas for further enhancement through policy alignment, stakeholder engagement, and climate risk integration. These findings offer actionable insights for policymakers, financial institutions, and stakeholders to enhance green banking and contribute effectively to sustainable development. This study's findings reinforce the role of knowledge creation, diffusion, and application in shaping Vietnam's green banking landscape. The seven identified factors highlight how financial institutions generate and apply knowledge for sustainability innovation. Key takeaways include: (1) Policy knowledge as a catalyst based on the legal framework and supporting policies (LP) emerged as the most influential factor, demonstrating that knowledge-intensive regulatory environments drive sustainable banking adoption. (2) Financial technology and knowledge diffusion: FinTech innovations facilitate the diffusion of sustainability knowledge, enhancing banking transparency and efficiency. (3) Leadership and organizational learning through a commitment from leadership and corporate culture (CC) indicates that organizations embedding sustainability knowledge into corporate strategies outperform competitors in green banking adoption.

While the empirical results of this study are context-specific to Vietnam, the theoretical framework and methodological approach hold broader applicability to emerging economies with comparable financial and institutional structures. Vietnam shares several structural similarities with other Southeast Asian countries, such as Indonesia, Thailand, and the Philippines, where commercial banks dominate financial intermediation, regulatory systems for green finance are still evolving, and pressures from international organizations and investors are increasingly shaping domestic sustainability agendas. In these contexts, the seven knowledge-driven factors identified in this study, including legal frameworks, consumer awareness, financial technology, leadership and culture, international pressure, environmental risk management, and public-private partnerships, are also relevant enablers of green banking adoption.

However, the degree of influence of each factor may vary depending on national priorities and institutional maturity. For instance, while legal frameworks emerged as the strongest driver in Vietnam, fintech adoption might be more pronounced in countries like Singapore or Malaysia, where digital financial ecosystems are more advanced. Similarly, public-private partnerships could play a relatively greater role in Indonesia due to its large-scale infrastructure investment needs. Thus, the framework developed in this study can serve as a comparative lens for cross-country analyses within Southeast Asia, but empirical validation in each national context remains necessary.

By situating the findings within the broader Southeast Asian landscape, this research contributes not only to Vietnam-specific policymaking but also to the regional discourse on sustainable finance, offering a transferable conceptual model for other emerging economies undergoing green transitions.

5- Conclusions and Policy Recommendations

5-1- Conclusions

Based on the survey, 900 managers related to the banking activities of commercial banks in the two aforementioned provinces. The data survey is from January 2024 to June 2024 to evaluate the modified scale. The sample size was 900 banking managers, with only 845 votes processed. The analysis showed seven key factors affecting green banking and sustainable development include: (1) Legal framework and supporting policies (LP) are the most influential factors for green banking and sustainable development. Comprehensive and enforceable policies provide the foundation for promoting sustainability in the financial sector. (2) green banking significantly contributes to sustainable development, highlighting its role as a strategic tool for achieving sustainability goals. The interconnectedness between regulatory support, banking practices, and environmental considerations underscores its importance. (3) Financial technology and awareness and trends in sustainable consumption have notable impacts on green banking and sustainable development, emphasizing the importance of technological innovation and consumer behavior in fostering sustainability. (4) Commitment from leadership and corporate culture (CC) and Public-private partnerships and international cooperation (PC) play supporting roles, indicating the need for enhanced corporate alignment with sustainability goals and stronger collaborations between sectors. Finally, pressure from investors, partners and international organizations (PO) and climate change and environmental risk management (SM) are significant; their relatively minor influence suggests untapped potential for leveraging stakeholder engagement and improving climate risk management.

This study underscores the pivotal role of knowledge in shaping green banking and sustainable development. The findings illustrate how financial institutions act as knowledge intermediaries, facilitating the creation, diffusion, and application of sustainability practices. Moreover, integrating policy knowledge, technological knowledge, and organizational learning accelerates the transition toward a green economy. This research demonstrated how knowledge-based policies and innovations contribute to economic transformation. Financial institutions are crucial in bridging policy knowledge gaps, enhancing knowledge diffusion through technology, and fostering knowledge-driven sustainability practices.

5-2- Policy Recommendations

Based on the abovementioned analysis, green banking can serve as a transformative force for sustainable development by addressing legal, technological, and consumer-driven dimensions and fostering collaboration and leadership. Policymakers, financial institutions, and stakeholders must collaborate to prioritize regulatory reform, technological innovation, and public engagement to achieve a more sustainable future. The authors had policy recommendations based on factor impact through SRCs below:

(1) Improve the legal framework and supporting policies (LP) based on the most influential factor for green banking with SRC 0.581, $P < 0.001$ and 0.332, $P < 0.001$ (see Table 2). Among the seven identified factors, the most realistic entry point for Vietnamese policymakers is the legal framework and supporting policies. Unlike technological infrastructure or shifts in corporate culture, which require long-term investments and organizational change, regulatory reform can be enacted more directly through legislative and administrative channels. Strengthening environmental regulations, mandating green credit ratios, and introducing tax incentives for sustainable finance are policy measures that fall within the immediate authority of the government and the State Bank of Vietnam. These actions are also consistent with Vietnam's existing commitments under international agreements such as the Paris Climate Accord and COP26 pledges. In the short term, policymakers should focus on creating a robust and transparent legal and regulatory framework, as well as enhancing public awareness, since these are both politically achievable and economically less constrained. Together, these foundational steps can create enabling conditions that subsequently accelerate fintech adoption, organizational cultural change, and cross-sector partnerships in the medium term. Therefore, Vietnam should continue strengthening legal and regulatory frameworks based on developing clear, enforceable regulations that mandate sustainability reporting and adherence to green banking principles. Introduce tax incentives, subsidies, or preferential loan rates for financial institutions adopting sustainable practices. Align national policies with international standards, such as the Equator Principles and SDGs. In addition to the efforts of credit institutions to promote ESG practices in the banking industry, there needs to be synchronous participation of relevant ministries and branches, especially in perfecting the legal framework of ESG. It will issue a national green project list so that credit institutions have a legal basis to identify projects and project items that meet green credit conditions and have policies to promote carbon market development. The Government plays a crucial role in guiding the successful implementation of green banking and green credit activities. This role is demonstrated through: (i) Issuing policies and documents on national green criteria, a list of green economic sectors integrated into the Vietnamese economic sector system, similar or gradually approaching Vietnam's green criteria with international ones; support policies on taxes, product outputs, etc.; (ii) Coordinating the participation of relevant parties to soon issue regulations on green finance for all financial institutions. (iii) Strengthening cooperation and mobilizing green financial resources from international financial and banking organizations and institutions. Long-term development orientations and supporting policies from the Government will be necessary conditions for policies to promote green transformation and green banking to be effective.

(2) Improve the awareness and trends in sustainable consumption (AC) based on a moderate influence on green banking with SRC 0.151, $P < 0.001$ and 0.096, $P = 0.003$ (see Table 2). Therefore, the Government should continue raising public awareness and consumer engagement by launching campaigns emphasizing the benefits of green banking and sustainable consumption. Collaborate with educational institutions to include sustainability in curricula, fostering long-term awareness. Use influencers and social media platforms to connect with diverse demographics about the importance of sustainable finance. Finally, it enhances the understanding and social responsibility of the banking system towards environmental protection, combating climate change, gradually greening banking activities, and directing credit flows into financing environmentally friendly projects, green consumption, clean energy, and renewable energy. It is essential to identify and select a green banking development model that is suitable for the country's socio-economic conditions. Green banks can exist within the conventional banking model, associated with social responsibility and sustainable development goals, by transforming the mindset to provide green products, services, internal processes, infrastructure, and information technology that better support the reduction of negative environmental impacts, such as those found in the green banking model.

(3) Improve the commitment from leadership and corporate culture (CC) moderately influences green banking with a SRC of 0.105, $P < 0.001$ and 0.079, $P = 0.012$ (see Table 2). Therefore, commercial banks continue enhancing leadership commitment and corporate culture by establishing sustainability training programs for organizational leaders to strengthen their role in driving green banking. Integrate sustainability metrics into corporate key performance indicators (KPIs). Foster a corporate culture that incentivizes employees to participate in green initiatives. Finally, closer coordination is needed from the Board of Directors of each bank. Strengthening the commitment of senior management must be considered a prerequisite because green banking can only be implemented effectively when the strategic vision and action plan are clearly defined by the Board of Directors. At the same time, it is necessary to improve staff capacity in the departments to implement green banking policies. The banking managers needs to continue improving the legal document system and supplement existing mechanisms, encouraging and promoting member banks to develop green credit and green banking activities. Specifically: (i) Issuing guidelines on green banking activities; (ii) Completing the environmental and social risk management system in relevant legal documents, approaching international standards; (iii) Conducting financial risk assessments related to the environment, integrating these risks into the macro risk management framework of the monetary market; (iv) Coordinating with relevant ministries and branches to develop a data information system to serve the forecasting, warning and management of environmental risks and climate change.

(4) Improve the financial technology (FT), which contributes positively to green banking with a SRC of 0.097, P = 0.001 and 0.094, P = 0.003 (see Table 2). Therefore, commercial banks continue investing in digital banking solutions to reduce resource consumption and enhance operational efficiency. Promote fintech innovation for sustainability, such as AI for climate risk assessment and blockchain for green finance tracking. Ensure equitable access to green banking services through mobile and digital platforms. Finally, continue to have policies to encourage commercial banks to provide preferential credit in terms of limits and interest rates to businesses investing in energy-saving projects, green technology, etc.; set specific targets suitable to Vietnam's conditions on the ratio of green credit in total outstanding credit. The process of implementing green banking activities requires significant adaptation and transformation in banking management, encompassing the development and implementation of banking business strategies, as well as the application of sustainable banking principles. Along with this is creating green financial potential, promoting digital transformation, innovation, and making breakthroughs in the operations of the entire bank. This includes training human resources during the whole cycle, from orientation and design to development, acceptance, and deployment of products and services for both external customers and internal users. Develop digital financial services and improve customer experience. The banking industry needs to focus on developing digital financial services that ensure convenience and easy access for customers, particularly in rural, remote, and isolated areas. The digitalization of banking services, such as opening accounts, depositing money, borrowing capital, and making payments, needs to be promoted, creating conditions for customers to conduct transactions via digital platforms conveniently and safely. At the same time, banks need to continue improving service quality, focusing on personalizing the customer experience, thereby increasing customer satisfaction and loyalty to banking products and services.

(5) Improve the climate change and environmental risk management (SM) based on a more minor but significant impact on green banking with SRCs 0.079, P = 0.003 and 0.064, P = 0.023 (see Table 2). Therefore, commercial banks continue enhancing climate risk management by developing advanced tools, such as AI-powered models, for assessing climate risk. Offer financial products tailored to climate resilience, such as disaster insurance or green infrastructure loans. Implement carbon offset programs and energy efficiency measures within financial institutions. Finally, strengthen the assessment of the impact of projects on the environment and society, such as Appraising the environmental and social security risks of the project before granting credit, excluding or limiting credit granting for projects that are likely to have a severe and significant impact on the social environment; periodically checking and monitoring the management of environmental and social risks for the credit granted to customers. The banking industry needs to compete to raise awareness, make breakthroughs in innovation of thinking, digital transformation, scientific and technological development, innovation in leadership and management methods, and operating models, and management from "traditional" to digital space based on digital data. Link propaganda, goals, and tasks of scientific and technological development, innovation, and digital transformation with action programs, goals, and functions of each unit in the banking system.

(6) Improve the public-private partnerships and international cooperation (PC) based on a weaker but significant influence on green banking with a SRC of 0.058, P = 0.021 and 0.056, P = 0.038 (see Table 2). Therefore, commercial banks continue strengthening public-private partnerships by developing co-financed projects in renewable energy, waste management, and other sustainable sectors. Provide grants or tax benefits to private entities contributing to government-led sustainability initiatives. Establish platforms for knowledge sharing between the public and private sectors. Finally, many credit institutions must proactively cooperate to receive green capital sources and technical support from international financial organizations to build internal regulations to implement environmental and social risk management for a country's number of credit extension activities for customers. The banking industry needs to effectively implement digital technology applications, develop digital banking models, strengthen integration, and connect its infrastructure and systems with those of other industries and fields to expand and grow the digital ecosystem. Continue to invest in infrastructure, machinery, and equipment for information technology; apply new technology to internal management processes and supply of financial and banking products and services, develop modern payment services, ensure the security and safety of information technology and banking payment activities.

(7) Improve the pressure from investors, partners, and international organizations (PO) has the least influence on green banking, with a SRC of 0.054, P = 0.022 and 0.091, P < 0.001 (see Table 2). Therefore, commercial banks continue leveraging stakeholder pressure by encouraging financial institutions to align with ESG standards to attract sustainability-focused investors. Require transparency in reporting sustainability initiatives to stakeholders. Engage international organizations to provide funding and technical expertise for green banking. Finally, commercial banks need to improve the capacity of department employees in the process of implementing policies related to green banking. Strengthening coordination between functional departments within the bank also needs to be focused on in implementing green banking products and services. To accomplish the above, there needs to be a specific roadmap at all levels, from the macro level of the economy to the banking system and within each commercial bank. Building a digital banking ecosystem connected to other industries. To promote the digital transformation process, the banking industry needs to develop a digital banking ecosystem that is connected to different industries and sectors within the economy. Banks need to cooperate with commercial enterprises, financial institutions, and technology companies to provide diverse and flexible financial services that are deeply integrated into the customer's digital journey. The development of digital banking services must ensure seamless connectivity between parties and deliver superior customer experiences.

(8) Improve green banking (GB) significantly impacts sustainable development with a SRC of 0.329, P < 0.001 (see Table 2). Therefore, commercial banks continue expanding green banking practices by encouraging financial institutions

to diversify their products, including green loans, bonds, and eco-savings accounts. Provide financial incentives for businesses adopting environmentally friendly practices, such as lower interest rates. Promote education and marketing campaigns to increase consumer adoption of green banking services. Finally, commercial banks map green banking activities directly to specific SDG targets to ensure strategic alignment. Regularly evaluate green banking initiatives' social, environmental, and economic impacts. Support community projects, such as reforestation or renewable energy, to amplify the impact of sustainability efforts. The government needs to establish a national digital infrastructure that connects banks with data from insurance, tax, real estate, and health sectors through the account green tick model, enabling all individuals to access authentic public financial services and borrow capital seamlessly and transparently.

The recommendations of this study can be operationalized more effectively when responsibilities are clearly assigned to relevant institutions: (1) State Bank of Vietnam (SBV) should take the lead in establishing regulatory frameworks, such as mandatory green credit quotas, disclosure requirements on ESG performance, and risk-weight adjustments favoring sustainable investments. SBV can also issue guidelines for integrating environmental risk assessment into credit appraisal procedures. (2) Ministry of Finance (MoF) is best positioned to design fiscal incentives, including tax reductions for green projects, subsidies for renewable energy financing, and preferential treatment for green bonds. The MoF can also collaborate with SBV to align financial regulations with Vietnam's commitments under COP26 and the Paris Agreement. (3) Commercial Banks are responsible for operationalizing green banking practices at the institutional level. This includes embedding sustainability into corporate strategies, adopting fintech tools for efficient ESG reporting, and investing in staff training programs that build awareness and capacity for sustainable finance. (4) Ministry of Natural Resources and Environment should coordinate environmental data collection and risk assessment, providing banks with reliable climate and environmental risk indicators. Such information can help financial institutions evaluate project-level environmental impacts more accurately. (5) Public - Private Partnerships can be facilitated by the Ministry of Planning and Investment, creating channels for collaboration between the government, banks, and international investors. This would encourage capital mobilization for large-scale sustainable infrastructure projects. By clarifying institutional responsibilities, these recommendations not only become more actionable but also reduce coordination gaps that often slow down policy implementation in emerging economies.

5-3- Limitations and Further Research

Besides the results achieved, this article also has certain limitations: (1) The study primarily focuses on a specific region or a subset of financial institutions, limiting the generalizability of the findings to other contexts or areas. Regulatory and cultural differences across countries may result in variations in the impact of green banking and sustainable development factors. (2) The data used in the analysis may reflect conditions and trends at a specific time, which may not account for evolving technologies, policies, or environmental challenges. Rapid advancements in financial technology, e.g., blockchain, AI and shifts in global sustainability standards could outpace the study's findings. (3) The study primarily focuses on the perspective of financial institutions and policymakers, with limited input from customers, NGOs, or other stakeholders. Broader inclusion of stakeholder perspectives could provide a more comprehensive understanding of green banking adoption and its barriers.

To develop green banking, minor adjustments bring great significance to sustainable development, so future research needs to complete the following suggestions: (1) Future research directions by expanding regional and cross-cultural comparisons based on conducting comparative studies across regions or countries to identify variations in the effectiveness of green banking strategies. (2) Examine cultural, economic, and political factors' role in shaping green banking practices' adoption. Longitudinal studies are based on the implementation of longitudinal research to track the evolution of green banking initiatives and their impact on sustainable development over time. Assess how emerging technologies and evolving regulatory landscapes influence the effectiveness of green banking. (3) Focus on emerging technologies by investigating the role of cutting-edge technologies, such as blockchain, machine learning, and the Internet of Things, in advancing green banking and sustainable development. (4) Future research should explore dividing latent variables into corporate and financial intermediary categories to examine their distinct influences and interactions. This method may yield more profound insights. Future research could address this limitation by employing stratified or multi-stage sampling techniques that deliberately include diverse types of banks, such as joint-stock rural banks, cooperative credit institutions, or fintech-driven microfinance organizations. Comparative analyses across regions and bank sizes would not only enhance representativeness but also provide a more nuanced understanding of how institutional context moderates the adoption of green banking practices.

6- Declarations

6-1- Author Contributions

6-2- Data Availability Statement

The data presented in this study are available in the article.

6-3- Funding and Acknowledgements

6-4- Institutional Review Board Statement

Not applicable.

6-5- Informed Consent Statement

Not applicable.

6-6- Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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Appendix I: Questionnaire

Table A1. Research questionnaires

Factors Affecting Green Banking and Sustainable Development	5-point Likert scale				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
LP1: The government has established legal frameworks to encourage green banking projects	(1)	(2)	(3)	(4)	(5)
LP2: The region actively enforces policies that promote green banking	(1)	(2)	(3)	(4)	(5)
LP3: Current regulations encourage financial organizations to implement sustainable practices	(1)	(2)	(3)	(4)	(5)
LP4: Legal frameworks effectively mitigate environmental risks in financial operations	(1)	(2)	(3)	(4)	(5)
AC1: Consumers are increasingly valuing environmentally friendly financial goods	(1)	(2)	(3)	(4)	(5)
AC2: Green banking awareness programs can help promote sustainable consumption	(1)	(2)	(3)	(4)	(5)
AC3: The organization promotes sustainable consumption through financial offerings	(1)	(2)	(3)	(4)	(5)
AC4: Customers are willing to pay more for sustainable banking services	(1)	(2)	(3)	(4)	(5)
FT1: Advanced financial technology helps to implement green banking practices	(1)	(2)	(3)	(4)	(5)
FT2: Digital banking systems have reduced the need for paper in financial transactions	(1)	(2)	(3)	(4)	(5)
FT3: The organization's sustainability initiatives have increased due to fintech investments.	(1)	(2)	(3)	(4)	(5)
FT4: The organization uses financial technologies to encourage green financing	(1)	(2)	(3)	(4)	(5)
CC1: The leadership of your organization actively promotes sustainable banking activities	(1)	(2)	(3)	(4)	(5)
CC2: A strong business culture promotes green banking practices	(1)	(2)	(3)	(4)	(5)
CC3: The organization's strategic objectives include sustainability aims	(1)	(2)	(3)	(4)	(5)
CC4: Employees know the significance of green banking in their jobs	(1)	(2)	(3)	(4)	(5)
PO1: Sustainability is a top priority for investors regarding financial institutions.	(1)	(2)	(3)	(4)	(5)
PO2: Collaboration with international groups propels sustainable banking activities	(1)	(2)	(3)	(4)	(5)
PO3: External stakeholder pressure influences green banking practices.	(1)	(2)	(3)	(4)	(5)
PO4: The organization meets international sustainable banking standards	(1)	(2)	(3)	(4)	(5)
SM1: The organization's finance strategy takes into account climate change concerns	(1)	(2)	(3)	(4)	(5)
SM2: The organization takes appropriate steps to manage environmental concerns	(1)	(2)	(3)	(4)	(5)
SM3: Environmental factors influence loan approval and investment decisions	(1)	(2)	(3)	(4)	(5)
SM4: Climate risk management helps to ensure financial operations' long-term viability	(1)	(2)	(3)	(4)	(5)
PC1: Public-private partnerships are critical to encouraging sustainable banking practices	(1)	(2)	(3)	(4)	(5)
PC2: International cooperation has aided the adoption of green banking policies	(1)	(2)	(3)	(4)	(5)
PC3: Collaborative projects with government bodies improve sustainable development activities	(1)	(2)	(3)	(4)	(5)
GB1: The company provides green financial solutions like eco-loans or bonds	(1)	(2)	(3)	(4)	(5)
GB2: Green banking has helped your organization's reputation	(1)	(2)	(3)	(4)	(5)
GB3: Customers choose banks that prioritize green banking practices	(1)	(2)	(3)	(4)	(5)
SD1: Green banking makes a substantial contribution to sustainable development goals	(1)	(2)	(3)	(4)	(5)
SD2: The company actively integrates its operations with sustainable ideals.	(1)	(2)	(3)	(4)	(5)
SD3: Sustainable development strategies have enhanced long-term financial success	(1)	(2)	(3)	(4)	(5)