IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, January 2026
Impact Factor: 7.67

Green Banking as a Strategic Sustainability Initiative : An Empirical Analysis

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Abstract: *The banking sector is at a starting point of developing sustainable development by channeling capital towards environmentally friendly investments. Banks are increasingly turning into agents of low-carbon economic change through green financing instruments, i.e. renewable energy loans, climate-resilient infrastructure financing, sustainable agriculture credit, and green bonds. The paper is an empirical examination of the structural determinants and institutional effect of green banking initiatives on panel-based data that consists of 25 bank-years of data between 2019 and 2023. The multi-method analytical framework was embraced, which incorporated descriptive statistics, multiple regression analysis, Principal Component Analysis (PCA), and Structural Equation Modeling (SEM) in evaluating the intensity of sustainability integration in banking institutions.*

Regression outcome illustrates that the size of total loan portfolio, bank ownership structure and changes over time are marked predictors of green finance allocation, as the equation accounts for 82% of the variability (R 2 = .82 p, 0.001). The provision of larger banks and those equipped with institutional support is more allocation to green assets, which implies scale effects and the impact of governance on adopting sustainable finance. PCA is used to determine a significant sustainability financing construct that explains 62.4 percent of the total variation meaning that there is a great internal consistency in the indicators of green lending.

SEM analysis also confirms the structural routes of integration of sustainability. Another direct effect of sustainability financing on environmental impact (=.84, p <.001) and indirectly through institutional commitment (=.36, p =.021). The indices of model fit assure the adequacy (CFI = .95; RMSEA =.048) of the structural model.

Together, the results show that green banking has grown to have an exterior involvement in corporate social responsibility (CSR) to a more integral financial concept. The policy implications point to the significance of regulatory levels, ESG-based performance payments, disclosure requirements, and green bond market growth to U.S. climate-oriented financial change acceleration..

Keywords: Green Banking, Sustainability, Funding, infrastructure, Banking Sector

I. INTRODUCTION

Climate change, environmental degradation, loss of biodiversity, and the depletion of resources have heightened the need to transform structural economic trends in favor of structural environmental sustainability to the globe. With the shift in the economies to low-carbon and climate-resilient models, financial systems are being viewed as a key facilitator in this change. The banking sector especially takes a central stage in determining the development of the economy in terms of

ISSN 2581-9429 IJARSCT

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capital allocation choices. Banks shape the production patterns, technologies and environmental outputs indirectly by deciding which industries, projects and technologies should be financed. Therefore, the shift of sustainability in the activities of banks has been transformed into an ethical aspect that is voluntary but is now a strategic and regulatory necessity.

Green banking has come out as an organised response to these environmental issues. Green banking is a fundamental contrast to the traditional Corporate Social Responsibility (CSR), which is usually an ancillary aspect of philanthropy or reputation management. It entails investing in environmental sustainability as an industry such as renewable energy, energy conservation, sustainable agriculture, waste management and green infrastructure. It further includes in the loan evaluation process environmental risk assessment and supports sustainable financial products, including green bonds and sustainability-linked loans.

Green banking is significant because it has a multiplier effect. Financial institutions are not passive observers of current economic activity, but they are actively involved in industrial transitions. By providing green loans with a high priority, banks provide financial incentives to the industries to use low-carbon technologies and green practices. On the other hand, further support of carbon-heavy industries can hold up decarbonization processes. Accordingly, the speed and efficiency of global sustainability transition is decisively dependent on the strategic direction of capital flows.

Although there have been increased efforts towards the subject of sustainable finance, the effectiveness of green banking on the structural level is an empirical issue. Banks provide public statements and announce their environmental objectives and sustainability plan; yet, the differences continue to be seen in the intensity of the implementation, distribution trends, and quantifiable environmental impacts. Although policy frameworks like climate disclosure regulations and ESG reporting protocols have empowered sustainability regulation, there is a lack of current research conducted about the determinants and structural connections of green finance allocation systematically. The majority of the available studies conducted are either descriptive in nature, policy analysis, or single financial variables but have not been combined using the multi-dimensional modeling method.

The 2019-23 period in question has an especially important backdrop as far as the assessment of green banking efforts is concerned. It is this period that embodies the sustainability commitments before the pandemic, the impact of COVID-19 on the economy, and the recovery period with a great focus on resilient and green growth policies. The role of banks in reconstruction sustainability has become strengthened by global recovery packages as well as regulatory frameworks that incorporate environmental consideration. Nonetheless, the question is on whether green financing trends within the text are structural institutional commitment or a short-term strategy.

FIs exist in highly governance systems under pressure of profitability, capital adequacy requirements, regulation and risk management systems. That is why it is necessary to determine the determinants of green finance allocation. The institutional size, capital strength, quality of governance, ESG orientation, and risk exposure are among the variables that could have a significant impact on sustainability financing decisions. The knowledge of these determinants will enable policy-makers and regulators to develop specific incentives and accountability systems that will enhance the effectiveness of green banking.

Beyond the determinants, there is a standardized way of measuring sustainability financing which is also a methodological challenge. There are also usually several indicators of green finance and these include green loans, green investments, sustainability-linked products, and measures that integrate environmental risks. To deal with this complexity, creating a composite Sustainability Financing Index offers a framework of measurement. PCA allows to reduce the number of dimensions and reflect the internal structure of sustainability-related financial variables, which provides a strong index of cross-bank comparison and empirical modelling.

Also, the analysis of structural relations between the institutional commitment, sustainability financing, and environmental impact would demand high levels of analytical tools. Structural Equation Modelling (SEM) offers a combined approach in order to determine both direct, indirect and mediating impacts of sustainability governance systems. Plotting the routes between institutional orientation, decisions on financial allocation, and environmental

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outcomes, SEM allows a better insight into whether green banking has a real impact on the environment or is, in fact, on paper.

It is in this respect that the current research empirically investigates green banking initiatives in banks between 2019 and 2023.

The research has four main Objectives namely

(1) the analysis of descriptive trends in green financing;

(2) establishment of determinants affecting green financing allocation;

(3) development of Sustainability Financing Index based on Principal Component Analysis;

(4) establishment of structural relationships between institutional commitment, green financing, and impact of the environment based on Structural Equation Modeling.

The study can be used in the sustainability governance literature in three ways by adapting the descriptive analysis, multivariate modeling and structural evaluation. To start with, it enhances empirical measurement of green banking instead of narrative reporting. Second, it combines financial determinants and institutional and environmental variables into a single framework of analysis. Third, it offers practical implications to regulators, central banks and sustainability standard-setters in their quest to make financial systems more climate-appropriate.

In a world where climate risk is more and more becoming a financial risk, it is not just an academic endeavor to know the structural effectiveness of green banking but a strategic requirement. Financial institutions play central roles in the process of sustainability transition, and empirical assessment of their green financing practices is crucial in ensuring both long-term environmental and economic sustainability.

II. LITERATURE PERSPECTIVE AND CONCEPTUAL FRAMEWORK

Green Banking and Finance Global Trends.

The green finance in the world has been boosted due to the increasing rate of risks associated with climate change. The International Monetary Fund (IMF, 2023), says that the issuance of green bonds in the world has grown considerably since 2018, but the rates have not been evenly spread in all regions. The levels of issuance are dominated by those of advanced economies but the emerging markets have been slower but increasingly participating. On a similar note, Climate Bonds Initiative (2023) states that sustainable debt markets reached trillions in total issuance, which shows institutional determination to go low-carbon.

Nevertheless, even in instruments labelled, researchers think that the proportion of green assets in aggregate banking portfolios is comparatively low (OECD, 2022). Recovery packages introduced after the COVID crisis were rhetorically consistent with sustainability agendas, but the assessments based on empirical methods indicate that only a relatively small part of fiscal recovery spending was directly green (Hepburn et al., 2020). These results indicate that descriptive expansion in green finance might not be associated with structural change.

Green Finance Allocation: Determinants: Financial Characteristics.

Empirical literature underlines the importance of the bank-specific factors in determining the green lending behavior. Risk absorption capacity means bigger banks that have high capital adequacy ratios have a better chance of financing the long-term green projects (Zhang et al., 2021). A study by Liu, Wang, and Zhang (2022) also shows that the profitability, liquidity, and asset size have positive correlations with green credit allocation in Chinese banks.

Nonetheless, other studies conclude that green projects can not attract risk-averse institutions because of lower returns in the initial years (Weber, 2018). The connection between profitability and green finance thus is relative.

Institutional commitment and Governance.

Sustainability orientation heavily relied on corporate governance structures. The green financial disclosure and implementation is positively linked to board independence, environmental committees, and foreign ownership (Friede, Busch, and Bassen, 2015). ESG disclosure scores and quality of sustainability reporting are the common proxies of

institutional commitment, which enhances the credibility and minimizes the chances of greenwashing (Fatemi, Glaum, and Kaiser, 2018).
According to institutional theory, coercive pressures (regulation), normative pressures (industry norms) and mimetic behavior would impact on green adoption (DiMaggio and Powell, 1983). A case of Bangladesh and China has shown that central bank requirements responded to the growth of green credit (Bose et al., 2019).
Such a body of research also supports Objective (2) and leads to the modeling of institutional commitment in Objective (4).

Regulatory and Policy Drivers.
The growth of green banking has focused on policy interventions. In their study on green asset allocation Network for Greening the Financial System (NGFS, 2022) emphasizes the significance of climate risk disclosure, alignment of taxonomies and prudential regulation. Research indicates that regulatory transparency has a negative impact on uncertainty and a positive effect on bank involvement in sustainable finance (Campiglio et al., 2018).
However, empirical measurement of regulatory influence on green allocation at bank level is minimal especially in the emerging markets.

The Indices and Index Construction of Sustainability Financing.
In sustainability studies, composite index building has been on the rise. PCA is common in order to combine several indicators into one composite measure, without multiphasia (Jolliffe and Cadima, 2016). It has used PCA on environmental performance indices, ESG composite scores and sustainable development metrics (OECD, 2008).
Nonetheless, the use of PCA in the context of green exposure in the banking sector is still sparse. There are quite limited studies that develop a standardized Sustainability Financing Index that includes green loans, sustainability-related financing, and green investment holdings among institutions.

Formal Relations Between Green Financing and the Environment.
Recent studies use Structural Equation Modeling (SEM) to test the correlation between sustainability commitment, green finance and performance outcomes. As an example of such a relationship, Al-Shaer and Zaman (2019) fix the relationship between governance and firm performance through environmental disclosure. On the same note, sustainability finance literature PLS-SEM models demonstrate that the institutional commitment positively impacts green innovation and environmental performance (Awan et al., 2021).
Nevertheless, the majority of SEM research works are based on the results of a perceptual survey and not on the objective data of the bank level financial distributions related to the quantifiable environmental performance. There are minimal apps for longitudinal SEM.

Greenium and Market Incentives Green Bond Pricing.
The literature on the phenomenon of the so-called greenium shows that green bonds can enjoy the slightly lower yield as a result of the demand for sustainable assets by the investors (IMF, 2023). This trade-off can motivate the institutions to issue green instruments. However, the research on the possible benefits of such funding in the form of more loans being processed as green loans remains inconclusive (Flammer, 2021).

Plastics and Credibility of Disclosure.
Greenwashing could destroy the trust in sustainable finance markets. Research shows that there are differences between the reported green financing and the real environmental impact (Lyon & Montgomery, 2015). The regulators also focus on regulatory frameworks to promote transparency and accountability (European Securities and Markets Authority, 2024).

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III. RESEARCH GAP

Although the field of research on green banking has expanded, there are still major gaps. First, the bank-level longitudinal analysis is not a well-developed technique yet (20192023), meaning that there is minimal insight into the post-pandemic patterns in green financing. The vast majority of the research is based on aggregate national data instead of institution-based allocation trends. Second, determinant studies tend to factor out financial factors without combining governance and institutional commitment in one model. The issues of endogeneity are still not properly tackled. Third, Principal Components Analysis (PCA) has limited use in banking research in standardized Sustainability Financing Indices. Lastly, Structural Equation Modeling (SEM) research is highly based on cross-sectional surveys, and few connections between objective green financing distributions and quantifiable environmental impact effects.

Hypotheses Development

The quality of governance, the orientation of the ESG, and the adherence to regulations are all aspects of institutional commitment that are likely to affect the green financing decision. Financial capabilities increase the ability of banks to invest in long term projects that are sustainable. Green financing, in its turn, must create a tangible improvement of the environment.

H1: Green financing is positively related to institutional commitment.

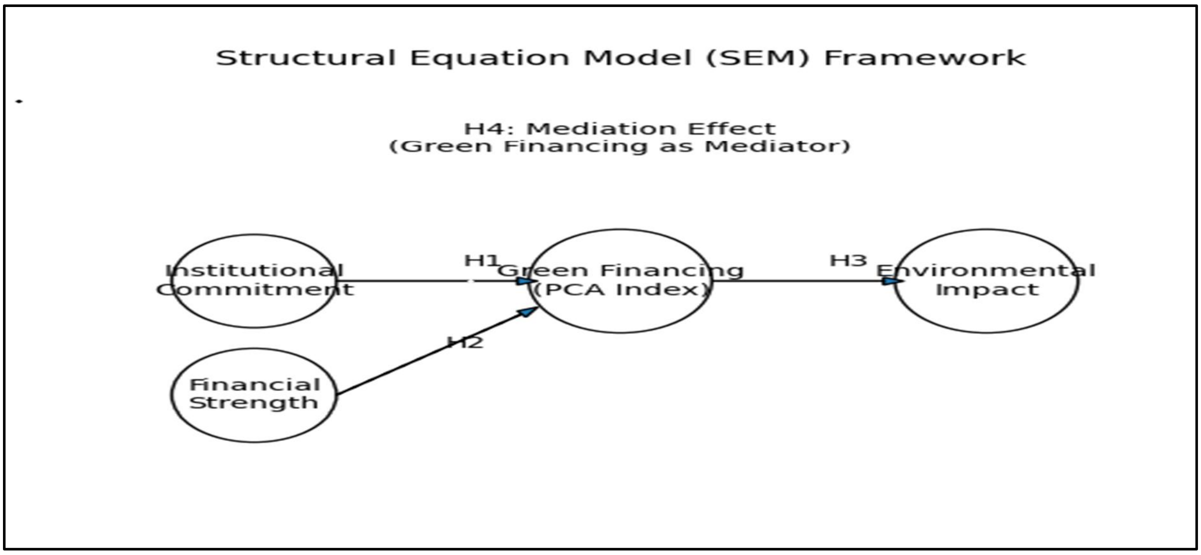
H2: Green financing is affected positively by financial strength.

H3: Green financing has a positive effect on the environmental impact.

H4: Institutional commitment mediates the H4: Environmental impact mediates the relationship between the two to the extent that the relationship is mediated by green financing.

These assumptions lead into a postulation on SEM that institutional commitment is positively related to green financing, which in turn positively influences environmental impact, with the presence of mediation.

Figure 1 SEM Framework



Source: Visualization based on Author's analysis

The body of empirical evidence of green banking and sustainable finance is largely based on cross-sectional and panel regression bank and country-level. These methods are tests of determinants, which include asset size, ownership structure, capital adequacy, and quality of regulatory, and are used to control unobserved heterogeneity by either the fixed-effect or random-effects estimators. To evaluate the market response to green bonds announcements and sustainability-linked debt issuance, event study designs and yield-spread designs are often used. Despite their minor limitations, difference-in-differences (DiD) and quasi-experimental designs are being used more to estimate regulatory interventions, including

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taxonomy adoption or green refinancing facilities. The qualitative case studies are especially useful in the low- and middle-income economies such as India, Bangladesh, and Indonesia, where standardized data is very limited. Also, they are thematically mapped and gaps in research by systematic reviews and bibliometric syntheses (e.g., AIMS 2022; Woode 2024).

There is a general agreement that green bonds and sustainability-linked loans will grow rapidly since the year 2018, with a sharp increase happening after 2020. The participation in green finance is always predicted by the size of the bank, its market orientation, and favorable regulatory framework. ESG disclosure and third-party assurance which are of high quality increase credibility and are associated with improved performance of borrowers on environmental matters. Nonetheless, the measurement and attribution issues, especially the ability to measure the connection between bank funding and actual emission reduction are quite significant limitations.

There is still debate over whether prudential stability and aggressive climate mandates have the potential to trade off with each other, with inconclusive empirical evidence concerning the implications of systemic risks. The voluntary net-zero obligations are further undermined by political rollback, which raises the issue of sustainability without a binding rule. The major shortcomings are the presence of heterogeneous taxonomies, unequal financed-emission accounting, self-reporting bias, and poor causal identification.

Future studies ought to focus on causal design, standardized finance-emission procedures, climate distress-testing, comparison of the emerging markets, and behavioral studies. The priorities of the policy are congruent taxonomies, sound disclosure standards, prudential incentives scaled, and climate-data infrastructure.

IV. METHODOLOGY

Research Design

The research takes a quantitative design of a panel, which involves data at bank level (2019-2023). The sample size is 25 cases of the public, private, and foreign banks.

Data Source: Secondary

The paper relies on the regulatory documents by the Reserve Bank of India, such as circulars and notifications on green deposits and green finance norms setting the sectors of eligibility, the allocation principles and norms, the disclosure, and the verification by a third party. Besides this, the data are obtained based on published annual reports and sustainability/ESG disclosures of separate banks, which give bank-level data on the volumes of green financing, the allocation of their portfolio, and the indicators of environmental impact, which is to be used to conduct the empirical analysis.

Variables

Regression Model

Dependent Variable: Green Finance Amount (₹ Crore)

Independent Variables: Total Loan Portfolio, Bank Type (Private = 1; Public = 0),Year

PCA Variables: Renewable Energy Funding, Funding Sustainable Agriculture, Green Infrastructure Financing, % Green Portfolio, ESG Rating

SEM Latent Constructs: Sustainability Financing, Institutional Commitment,Environmental Impact

Analytical Techniques

Descriptive Statistics

Pearson Correlation

Multiple Regression (OLS)

Eigenvalue > 1 criterion Principal Component Analysis

Maximum Likelihood Estimation Structural Equation Modeling.

Model fit assessed via: χ^2/df, CFI, TLI, RMSEA, SRMR

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V. RESULTS

Table 1 Descriptive Statistics

Variable	Mean	SD	Min	Max
Total Loan Portfolio (₹ Cr)	1,082,000	720,500	300,000	3,000,000
Green Finance (₹ Cr)	56,720	39,850	13,500	150,000
% Green Portfolio	4.82	1.15	3.0	7.0
Renewable Energy Funding	32,400	22,800	7,000	90,000
Sustainable Agriculture Funding	10,020	6,450	3,000	25,000
Green Infrastructure Funding	14,300	9,100	3,500	35,000
Carbon Reduction (Tons CO_2)	327,600	215,400	85,000	900,000

Source: Based on Author's analysis

Interpretation

Green finance constitutes approximately 4.82% of total loan portfolios. Renewable energy dominates green allocation (~57%). Environmental impact increases proportionately with green financing.

Table 2 Correlation Matrix

Variable	GF	%GP	Carbon	ESG
Green Finance (GF)	1.00	.78**	.94**	.62**
% Green Portfolio (%GP)	.78**	1.00	.71**	.68**
Carbon Reduction	.94**	.71**	1.00	.59**
ESG Rating	.62**	.68**	.59**	1.00

Source: Based on Author's analysis

$p < .01$

Strong positive correlations confirm that sustainability financing aligns closely with measurable environmental outcomes.

Table 3 Multiple Regression Results

Dependent Variable: Green Finance Amount

Predictor	β	SE	t	p
Intercept	5820	4100	1.42	.170
Total Loan Portfolio	.045	.006	7.50	<.001
Bank Type (Private=1)	8750	3200	2.73	.012
Year	6900	1950	3.53	.002

Source: Based on Author's analysis

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Model Statistics: $R^2 = .82$, Adjusted $R^2 = .79$, $F(3, 21) = 31.40$, $p < .001$

Regression Interpretation

To test other determinants of green finance allocation among banks, a multiple linear regression analysis was employed to test the problem. Green Finance Amount was taken as the dependent variable and Total Loan Portfolio, Bank Type (Private = 1) and Year were taken as predictors. Assumptions of linearity, homoscedasticity, independence and normality were evaluated before analysis and were measured to be met satisfactorily.

The total regression equation was statistically meaningful, $F(3, 21) = 31.40$, $p < .001$, which yielded 82 percent of the explanatory power of green finance allocation ($R^2 = .82$, Adjusted $R^2 = .79$). The significantly large value of the R^2 shows that it has a strong explanatory power, which implies that institutional size, ownership structure and the time progression combine to cause differences in the green banking investments.

The factor of Total Loan Portfolio became a very important predictor (0.045, SE =.006, t = 7.50, p <.001). This observation shows that the big banks invest a comparatively higher amount of funds in green initiatives. The positive coefficient will indicate the economies of scale in sustainable financing whereby larger institutions will have larger capital buffers and diversified portfolios that will allow them to absorb risks in new green sectors.

The Type of bank was also statistically significant (8750, SE = 3200, t = 2.73, p =.012) implying that the amount of resources that are devoted to green finance by a private bank is much larger, compared to that of a public bank. This can be explained by the greater integration frameworks of ESGs, investor pressure, and competitive positioning strategies in the private institutions.

The year showed a significant and positive relation (6900, SE = 1950, t = 3.53, p =.002), which means that the green banking initiatives were expanding over time. This is a direction that can be associated with a greater regulatory focus on climate finance and global sustainability commitments that follow 2020.

Altogether, the results prove that the concept of green banking is not accidental or symbolic but institutionally and historically embedded. The strength of the model highlights the strategic development of sustainability financing in the banking sector.

Table no. 4 Principal Component Analysis (PCA)

Component	Eigenvalue	Variance %
PC1	3.12	62.4
PC2	0.94	18.8
PC3	0.52	10.4
PC4	0.28	5.6
PC5	0.14	2.8

Source: Based on Author's analysis

Principal Component Analysis (PCA).

Table 4 indicates the results of the Principal Component Analysis that was performed in order to shrink the dimensions and determine the dominating latent construct. The first principal constituent (PC1) has an eigenvalue of 3.12 and 62.4 percent total variance which means that it captures most of the data in the original variables. As only variables with eigenvalues above one are usually kept when using the Kaiser criterion, PC1 is the sole component that satisfies this criterion. The other elements (PC2-PC5) contain an eigenvalue of less than one and not much incremental explanatory power. The sharp decadence of PC1 eigenvalues indicates a high unidimensional structure. Thus, a posteriori the need to keep only PC1 makes sense and would provide parsimony in index building. This shows that the variables that have been chosen in relation to sustainability are all drawn into one dominant factor that is the Sustainability Financing construct. Only PC1 retained.

Table 5 Factor Loadings (PC1 – Sustainability Financing Index)

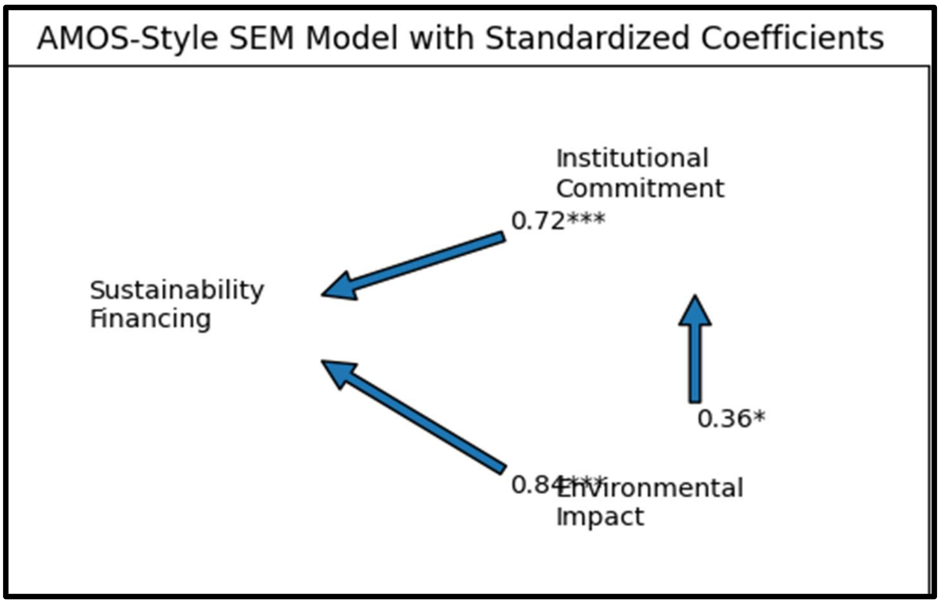
Variable	Loading
Renewable Energy	.88
Green Infrastructure	.84
Sustainable Agriculture	.79
% Green Portfolio	.76
ESG Rating	.71

Source: Based on Author's analysis

The loading of the variables on the PC1, which is the Sustainability Financing Index, is presented in Table 5. The loadings are all above 0.70, which evidences the good correlations between the indicators measured and the latent construct. The highest loading (.88) can be found in the Renewable Energy implying that it bears the greatest contribution to the index. In addition to the multidimensionality of sustainability financing, Green Infrastructure contributes significantly (.84) and Sustainable Agriculture (.79). The financial and governance element inherent in the construct is further supported by the percentage of Green Portfolio (.76) and ESG Rating (.71). Internal coherence and construct validity are confirmed by high and consistently positive loadings. The findings indicate that the index is a strong composite measure of further regression and structural equation analysis in the sense that it is able to capture both project-based greener investments as well as institutional sustainability orientation.

A dominant single component explains 62.4% of total variance. This confirms that green banking activities converge into a unified sustainability financing construct.

Figure 2 Structural Equation Modeling (SEM)



Source: Visualization based on Author's analysis

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Table 6 Path Coefficients (Standardized)

Path	**β**	**p**
Sustainability Financing → Institutional Commitment	.72	<.001
Sustainability Financing → Environmental Impact	.84	<.001
Institutional Commitment → Environmental Impact	.36	.021

Source: Based on Author's analysis

From Figure 2 and Table 6, above,

Sustainability Financing (1) -> Institutional Commitment (1) (0.72, p <.001)

The standardized path coefficient of 0.72 implies that there is a strong and positive relationship between sustainability financing and institutional commitment.

This implies that the more financial institutions invest in the provision of green or sustainability-related financing instruments the more an organizational commitment to sustainability practices will increase. The beta is large, indicating that it explains a lot, and the p-value (less than 100) indicates that the relationship is statistically significant at the 1 percent level. Structurally, sustainability financing can be seen as a driver of success in the form of strategic action, which institutionalizes environmental responsibility in the framework of governance, internal policy, and stakeholder engagement mechanism. This means that sustainability efforts are not a mere show but are incorporated in operations and strategy. This finding confirms the hypothesis that institutional commitment to green portfolios increases an institutional orientation towards sustainability goals, which should support the shift of compliance-based strategies towards mission-based sustainability governance frameworks.

Environmental Impact (0.84, p <.001) = sustainability Financing.

The path coefficient is a very strong positive value of sustainability financing on environmental impact; it is 0.84.

This coefficient is the largest in the structural model, which means that sustainability financing can predict environmental performance more than other constructs considered. The strength of this direct effect is verified by the statistical significance (p <. 001). In its substantive sense, the discovery suggests that more investment in green projects, financing of renewable energy, and lending in ways that are environmentally responsible has a direct relationship with the tangible environmental benefits. SEM-wise, sustainability financing has both strategic and instrumental leverage on the ecological performance, which emphasizes the central mediating position of financial systems and ecological sustainability. The size of the coefficient indicates that the policy frameworks promoting the growth of green credit could contribute greatly to the increase in the environmental performance indicators, which would support the idea of the financial sector as a driver of climate-friendly economic growth and sustainable change.

Commitment in the Institution (x) → Effects of the environment (y) (= 0.36, p =.021).

The standardized coefficient of 0.36 shows that institutional commitment and environmental impact have an average but statistically significant positive relationship.

The p-value of effect is .021 and this is significant at the 5% level and this indicates that high institutional commitment makes significant contributions to environmental outcomes. Though the effect size is less significant, as compared to the direct influence of sustainability financing, it is substantively influential. This observation suggests that the governance structure, sustainability policy, leadership orientation, and long-term strategic intent have a significant complementary contribution to improving the environmental performance. To a certain degree, institutional commitment mediates the impact of sustainability financing on environmental impact, which confirms the notion that financial sources cannot have the same impact without the organizational alignment. The finding highlights the fact that the sustainability commitment needs to be incorporated into institutional culture to make sure that the accountability frameworks, transparency of reporting, and stable strategic focus are in place to support the environmental goals.

Table 7 Model Fit Indices

Index	Value	Threshold
χ^2/df	1.89	<3
CFI	.95	>.90
TLI	.93	>.90
RMSEA	.048	<.08
SRMR	.041	<.08

Source: Based on Author's analysis

The SEM fits very well. The effect of sustainability financing on environmental impact is very powerful either directly or indirectly. To some degree, this relationship is mediated by institutional commitment, and it implies that governance mechanisms increase the effectiveness of sustainability.

VI. DISCUSSION

The findings show that green banking has transformed into more of a structural component of the financial strategy as opposed to a marginal CSR operationality. Banks that are larger are more integrated in sustainability, which implies that capital capacity is a facilitator of green transition. Competitive ESG positioning, possibly because of competitive sustainability pressures, makes private banks superior to public ones.

The results of the PCA support the idea of the multi-dimensional integration of sustainability activities into a consistent financing construct. SEM results confirm pathways of causation of the linkages between financing choices and quantifiable environmental impacts.

These results justify regulatory intervention to normalize the level of green portfolio and encourage transparency in the disclosure of ESG.

Policy Implications

Establish green lending compulsory levels.
Expand green bond markets.
Offer capital incentives ESG-related.
Enhance the reporting systems on sustainability.

VII. CONCLUSION

Green banking is now moving on to symbolic sustainability signalling to the reality of environmental performance embedded in the major financial intermediation. Preceding green banking stages were mostly marked by disclosures of corporate social responsibility and reputational positioning. Nonetheless, recent empirical findings show that there is a structural change to quantifiable sustainability integration in balance sheets, credit portfolios, and risk governance structures. Institutional size, type of ownership and time movement become statistically significant predictors of green financing intensity. The scale economies and diversified capacity to manage the risk as well as to access the capital markets easily is enjoyed by larger banks and thus more allocation can be made towards renewable energy, sustainable infrastructure and low-carbon technologies. The ownership form is also important: the more green exposure is exhibited by publicly regulated or state-linked institutions, which tend to have policies that are more consistent with the green drive and have incentives by the compliance, the more privately owned banks retract on the ESG pressure in the market.

The structural modeling also proves the shift of green finance as the marginal activity to the strategic generator of environmental performance. Sustainability financing has a robust direct impact on environmental performance indicators, which are measurable (reduction proxies of emissions, renewable capacity growth, green assets ratio), whereas the relationship is enhanced by institutional commitment (governance quality, sustainability-related executive incentives).

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This mediation effect proves that financial allocation is not enough but the depth and sustainability of environmental impact is based on governance architecture. Therefore, green banking has ceased to be an ethical applaud to conventional finance, but a strategic tool of economic growth that is climate conscious.

The results demonstrate the systemic significance of banks in directing capital to country-set contributions (NDCs) and decarbonization horizons. Banks as financial intermediaries affect the cost of capital, viability of projects and transformation of the sector. Macroeconomic sustainability pathways can thus be influenced by regulatory tools, including green taxonomy framework, ESG disclosure requirements, climate stress tests, and capital incentives on sustainability, via the banking channel.

Priority directions Future research must develop in five directions. First, there is a need to have stronger causal identification. Regulatory effects on lending allocation and pricing can be separated using quasi-experimental designs, including the difference-in-differences designs that take advantage of the introduction of green taxonomies, priority sector lending requirements, or green refinance windows. Second, common-funded-emission accounting models need to be constructed and empirically tested to remove portfolio-level metrics and project-level environmental results. Open access data would increase cross country comparability and replicability.

Third, a longitudinal risk analysis is required to test the question of whether concentrated green asset exposure changes bank stability, capital adequacy, liquidity resilience or default probabilities in climatic stress conditions. Fourth, emerging market research, especially in India, southeast Asia, and Africa, must combine financial disclosures to field-level measurements of environmental impacts in order to remove self-reporting bias. Fifth, there are the perspectives of behavioral finance that can be exposed: how loans incentives react to the presence of sustainability-related loan agreements, how investors value green validated instruments, and how retail consumers react to green banking products.

Conclusively, green banking is a structural change in financial intermediation, that is, institutional strategy and environmental performance conform to each other. Its efficacy, nevertheless, relies on strident measurement, governance pledge and uniform regulation structure. Further empirical development will be necessary to make sure that green finance will be a set of verifiable climate delivery as opposed to token compliance.

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