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Exploring the Nexus among Green Banking, Risk Management, and Profitability: Implications for Environmental Performance

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Abstract

The financial system is now changing due to internal and external pressure of stakeholders towards environmentally responsible banking. The current study examined the nexus between green banking, risk management, and profitability on environmental performance for 2014-2023. The data was collected from the Fitch Solution databank in Malaysia using a non-probability purposive sampling method. The total observation was 210 of 21 samples. Prior to the regression analysis, this study conducted a diagnostic test. Hausman test was performed to select a model, either a fixed effect model or a random effect model. The findings revealed that liquidity, interest rate, and income diversification positively and significantly affect environmental performance. In contrast, the results showed that green banking (GBRNK) is the most integral factor when evaluating environmental performance. However, the results indicate that GBRNK significantly impacts environmental performance in the Bangladesh banking industry. Moreover, bank risks, such as credit and management efficiency, have a negative and significant relationship with environmental performance. On the contrary, profitability, such as ROA and ROE, has a positive and significant impact on environmental performance. These findings offer numerous insights into the banking strategy, regulatory policy, and future research directions to address the implementation of green banking practices. This study also verifies the use of institutional theory in the context of green banking.

Keywords: *Environmental Performance, Green Banking, Bank Risks, Profitability, Corporate Social Responsibility.*

Introduction

Environmental sustainability has become a pivotal concern worldwide for better living (Awewomom et al., 2024). It emphasizes on sustainable development practices that align with the United Nations Sustainable Development Goals (SDGs) and sustainability. The role of the financial sector in fostering ecological stewardship has increased as a result of the shift toward environmentally responsible behaviour practices in many industries (Islam et al., 2024a). However, banks play an important role among all market participants to enhance environmental sustainability (Amin & Oláh, 2024). In the service industry, the banking sector significantly affects the economy, and the growing concern about environmental issues also burdens this sector to take action in the green environment (Amin et al., 2019b). Thus, the banking industry can enhance environmental risks. Recently, commercial banks have drawn attention to implementing green banking practices in several fields. A study by (Kumar et al., 2024) revealed that green banking (GBRNK) has emerged as a key mechanism in fostering environmental responsibility, encouraging financial institutions

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to support sustainable projects, adopt eco-friendly practices, and reduce their carbon footprint. Consequently, to attain overall sustainability, banks must evaluate the way their clients or operations affect environmental issues to reduce costs. Moreover, green banking (GBRNK) focuses on protecting the environment and enhancing banks sustainability (Islam et al., 2023). Besides, green banking (GBRNK) addresses climate change, sustainable consumption, and production to promote SDG-12 and SDG-13 to mitigate carbon emissions (United Nations, 2023). Banks can reduce costs by mobile baking, online banking, digital banking, or e-payments. Recently, few banks and financial institutions in Bangladesh have provided e-wallet services which reduces environmental hazards. Whereas developed economies like Malaysia are already in the advanced stage of using e-wallets such as touch and go. Furthermore, banks allocate resources toward sustainable projects that could impact their financial stability in the long term.

Nevertheless, this study uses institutional theory, which integrates a valuable framework for understanding how green banking (GBRNK) influences environmental performance (Dimaggo & Powel, 1983). According to Park and Kim (2020), institutional pressures from regulators and environmental agencies to engage in practices that contribute positively to the environment in green banking. To illustrate, banks incorporate green policies to maintain legitimacy and comply with industry standards; they contribute as a key player to improved environmental performance (Haque & Ntim, 2018). However, effective risk management can mitigate environmental challenges by allowing institutions to balance profit (Sharfman & Fernando, 2008). The studies by Islam et al. (2024b) and Amin et al. (2024) suggested that organizational success can reinforce an institution's ability to invest in sustainable practices, creating a positive cycle that enhances environmental outcomes. The environmental progress is alarming in Bangladesh due to the degradation of natural resources, which eventually impacts human health (Raihan et al., 2024; Mollah et al., 2024c; Yu et al., 2024; Islam et al., 2018; Islam & Amin, 2011). So, assessment of green banking implementation is underexplored. Moreover, there is a lack of studies on how green banking, bank risk, and profitability affect environmental performance in the context of Bangladesh (Bose et al., 2021; Chen et al., 2022; Rahman et al., 2024; Mustafi et al., 2024). Therefore, understanding the relationships between green banking, risk management, and profitability is essential to comprehend their combined impact on environmental performance (Siddik et al., 2024). This study aims to investigate how green banking, risk management, and profitability impact environmental performance which did not examined combinedly, especially in the context of emerging economy like Bangladesh. By integrating institutional theory and addressing relevant SDGs, this research contributes to the growing body of literature on the financial sector's role in sustainable development. Therefore, policymakers, bank management, investors, and regulatory bodies may benefit from these empirical findings, which indicate sustainable development and environmental preservation.

Literature Review and Hypotheses Development:

Banks can measure environmental performance (ENVP) based on three main aspects; firstly, efficient utilization of internal resources, secondly, the benefits derived from investing in environmentally sustainable projects, and finally, minimizing risks from financing environmentally sensitive industries (Chen et al., 2022; Dey et al., 2021; Saha et al., 2016). So, ENVP cannot be ignored for a better life. According to Sharma et al. (2024), ENVP plays an active role in environmental initiatives in operations and engagements with customers and business partners (Tanchi et al., 2025; Uzir et al., 2025; Ismael et al., 2025; Kassim et al., 2024; Al Amin et al., 2024; Qing et al., 2023; Mahapatra et al., 2021; Shen et al., 2015). In the context of Bangladesh, this field is in the infancy stage (Rahaman et al., 2025; Islam et al., 2024a; Karim et al., 2024; Azad et al., 2023; Shahneaz et al., 2020; Hoque et al., 2015). So, it is high time to address this current issue. However, a study by Lu et al. (2021) revealed that environmental performance can be analysed through corporate social responsibility (CSR) initiatives by monitoring particular environmental actions and outcomes that fit with sustainability goals. Besides, scholars (for example, Ahmed et al., 2025; Prakash et al., 2023) identified that essential aspects encompass greenhouse gas emissions, energy efficiency, resource utilization, garbage reduction, and investment in eco-friendly projects. In addition, compliance with environmental regulations, contributions to biodiversity protection, and sustainable product lifecycle practices are major aspects (Niyommaneerat et al., 2023; Rahaman et al., 2023; Rabbi et al., 2024; Rabbi & Amin, 2024).

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However, these methods not only increase environmental performance but also ensure accountability and long-term sustainability (Wong et al., 2021). As a result, environmental performance can be categorized in the current study by measuring the spending on CSR activities (Gazi et al., 2024c; Mahmud et al., 2023;) such as reducing energy consumption and carbon emission, giving green training to employees (Gazi et al., 2024a; Amin & Salehin, 2021; Amin & Rubel, 2020; Amin et al., 2019a), and paper conservation from banking activities, all of which contribute to the economy's sustainable development (Mohaimen et al., 2025; Ullah et al., 2024; Yu et al., 2021). Green banking (GBRNK) is called sustainable banking, which stresses the relationship between environmental issues and the bank's social responsibility (Park & Kim, 2020). According to Zhou et al. (2021), the main objective of GBRNK is to provide quality services to protect against environmental hazards. Moreover, GBRNK provides a strong commitment to sustainable development by benefiting people, the environment, and culture. However, GBRNK emphasizes social and environmental issues and offers a financial model that encourages green investments to boost economic growth and preserve the environment. Moreover, GBRNK is now drawing the attention of researchers, scholars, academics, and practitioners all over the world, and Bangladesh is no exception (Zhang et al., 2022). As a result, it is now a key element of sustainable banking and plays a big part in promoting balanced market and economic growth. The Central Bank of Bangladesh (BB) has taken numerous initiatives and formulated guidelines in 2011. Later, it was implemented in three phases. Though GBRNK is in the infancy stage in Bangladesh, BB has made sustainability reporting mandatory for all listed banks since 2020 (BB, July, 2024). Therefore, GBRNK can be measured by green spending to protect the environment.

The variety of bank risks, which include credit, liquidity, interest rate, solvency, operational, innovation, and management efficiency risks, has a major impact on environmental performance (Anik et al., 2019; Arif & Batool, 2021; Ayoob, 2018; Gulzar et al., 2024; Nguyen et al., 2021). Bank risks need to assess for their sustainable performance (Park & Kim, 2020; Mollah et al., 2024a; Mollah et al., 2024b; Hosain et al., 2024; Karim et al., 2023a; Karim et al., 2023b). A study by Prakash et al. (2023) found that bank risks need to be addressed so that they can be reduced environmental risks. On the contrary, Ziolo (2023) revealed that banks can manage risks and adopt market conditions with sustainability goals. Considering all risks with creative fixes and active stakeholder participation improves environmental performance and guarantees long-term financial stability (Gazi et al., 2024b). This comprehensive strategy emphasizes how important risk management is to putting green banking concepts into practice.

Profitability is an integral part of banks adopting all financial innovations, such as green banking (GBRNK), which impact environmental performance (Ma et al., 2023). According to Park and Kim (2020), initially, GBRNK initiatives may have upfront expenses that lower short-term profitability; eventually, it enhances long-term profit for financial stability. Profitability can be measured by ROA, ROE, Tobin's Q ratio, and EBITDA. Profitable banks can invest more in environmentally friendly projects. Moreover, GBRNK aids lessen hazards related to ecologically hazardous projects. A recent study by Liu et al. (2024) revealed that climate-focused actions also decrease exposure to systematic risks, encouraging consistent performance. In summary, while GBRNK may jeopardize short-term profitability, its long-term benefits, including cost efficiency, increased market position, regulatory alignment, and risk mitigation-highlights its critical role in accomplishing financial and environmental sustainability (Zhang et al., 2022).

Theoretical frameworks on pro-environmental strategies have been examined in multiple research projects. To illustrate, some studies have applied stakeholder theory (Baah et al., 2021; Nguyen et al., 2021), others have utilized institutional theory (Farrukh et al., 2022; Hasan et al., 2024; Latif et al., 2020), and few have adopted the resource-based view (RBV) theory (Muafi et al.; Rehman Khan & Yu, 2021) to analyze pro-environmental adoption behaviour. However, the institutional theory is particularly relevant in this study investigates the linkage between GBRNK and ENVP. Besides, this theory offers a framework for understanding how green banking practices influence a bank's long-term ENVP. It posits that organizations strive for legitimacy, resources, and sustainability by aligning with the norms, values, and expectations of their institutional environment (DiMaggio & Powell, 1983). This theory explains why banks adopt eco-friendly practices within the green banking paradigm, driven by regulatory pressure, societal norms, and the pursuit of a competitive advantage (Bukhari et al., 2021). For instance, implementing green banking strategies and green banking helps banks comply with legal obligations, address public demands for

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environmental accountability, green culture, and differentiate themselves in a competitive market (Park & Kim, 2020; Gazi et al., 2024d). By integrating environmental sustainability into their operations, banks can improve their reputation, attract environmentally conscious clients, and strengthen their competitive position (Sun et al., 2020).

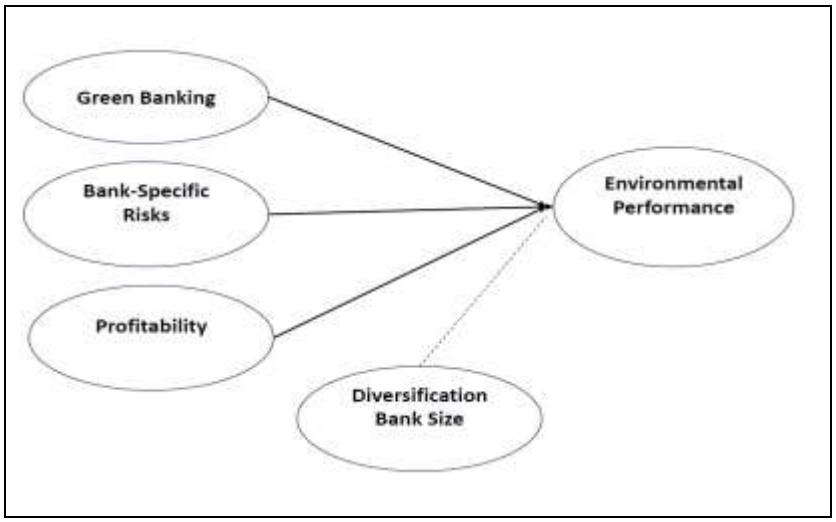

Figure 1. Conceptual Framework Developed by Author (2024)

Hypotheses Development

Green Banking and Environmental Performance

Environmental performance describes how a business's activities affect the environment (Azad et al., 2012; Amin et al., 2012). According to the prior research, there are several benefits to implementing green banking practices, such as increased corporate image, cost savings, operational efficiency, a company's sustainability, and better environmental results (Azad et al., 2022; Bukhari et al., 2022; Zhixia et al., 2018). This suggests that green banking practices can greatly aid improved environmental performance. Several studies emphasize implementing green initiatives reduces energy consumption, minimizing the production of pollutants, and limiting the use of hazardous materials (Hasan et al., 2023; Gazi et al., 2024f). In this context of green banking, the main goal is to reduce both internal and external carbon emissions, leading to improved environmental results. However, several studies consistently demonstrate that green banking practices positively influence environmental performance (Aslam & Jawaid, 2022; Bag et al., 2021; Zhang et al., 2022). Consequently, the literature suggests that green banking practices can be hypothesized to enhance environmental performance.

Hypothesis 01: GBRNK positively affects environmental performance

Bank Risks and Environmental Performance

The relationship between bank risks and environmental performance has drawn a lot of attention, showing how the exposure of banks to operational, credit, liquidity, interest rate, solvency, and management efficiency risks can affect sustainability results (Chiaramonte et al., 2024; Chupradit et al., 2021; Korzeb et al., 2024). The financial health of banks becomes danger due to increasing NPLs (Atichasari et al., 2023; Boussaada et al., 2023). A study by Birindelli et al. (2022), identified banks can reduce risks and improve their environmental performance by including sustainability factors. In contrast, banks can prevent bad investments by following sustainability goals and attain better environmental results to manage environmental risks (Sarfraz et al., 2018; Breitenstein et al., 2021; Gazi et al., 2025b; Gazi et al., 2024e). On the contrary, bank risks have a significant negative relationship with environmental performance (Cai et al.,

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2016; Ilinitch et al., 1998). Therefore, weak risk management strategies can accelerate reducing environmental performance as well. From the above analysis, it can be hypothesized as follows:

Hypothesis 02: Bank risks have a significant effect on environmental performance

Profitability and Environmental Performance

Profitability is the financial performance and efficiency of banks or the ability of a bank to generate earnings compared to its sales or other assets. It is a driver of environmental performance by implementing environmentally friendly policies (Zhang et al., 2022). ROA and ROE positively impact environmental performance. A study by Van Niekerk (2024) examined that banks have a substantial impact on environmental performance to attract stakeholders. Similarly, a study by Aggarwal and Garg (2022) found that profitability and environmental performance have a positive relationship by underscoring the importance of financial strength in driving sustainability (Baah et al., 2021). Another study by Torre Olmo et al. (2021) revealed that highly profitable banks are better positioned to absorb the cost of green investment and regulatory compliance. In contrast, less profitable banks may struggle to implement such practices, limiting their environmental performance (Bose et al., 2021). Thus, it can be hypothesized as follows:

Hypothesis 03: Profitability positively affects environmental performance

Methodology

Sample and Data Collection

The researchers collected the data from secondary sources through non-probability sampling, which meets the specific requirement (Alvi, 2016; Etikan & Bala, 2017). The current study employed panel data estimates focusing on Bangladesh, encompassing 21 PCBs between 2014 and 2023 of 55 commercial banks. The banking industry in Bangladesh is essential for sustainable development (Gazi et al., 2025a). The data was collected from different sources such as Fitch Solution, the e-annual report, the BB website, and the World Bank database. However, owing to data inaccessibility, this explanatory analysis concentrates on 21 PCBs registered in Bangladesh that were listed on the DSE before 2014, and 21 PCBs were selected based on asset structure. Islamic banks are not included in this analysis because of the different investment policies. Nonetheless, the study intends to investigate how green banking, bank risks, and profitability impact environmental performance between 2014 and 2023.

Model Development

Compared to previous studies, the current study's empirical findings may differ significantly due to the deductive research technique (Barratt et al., 2011; Chowdhury et al., 2024). The research philosophy is applied similarly to objectivism to see the reality of the banking sector from an ontological standpoint (Bisman, 2010). The panel data regression technique employed in this study provides more useful data with less variability but less collinearity, greatly reducing the problems brought on by missing variables. A synchronized organization of particular and individual variables comprising a study in the form of equations that are performed to create an outcome with the investigation's dependent variable is known as model specification.

Therefore, the general regression model is as follows;

$$Y_{it} = \alpha_0 + \beta X_{it} + \varepsilon_{it}$$

Where Y is the dependent variable, X is the independent variable, i is the sample of banks, t is the time dimension of the variables, β is the parameter of the explanatory variable, α is the intercepts and ε is the

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error terms. Considering that the model has more than one independent variable,therefore, we need to move from single-independent-variable regressions to equations with more than one independent variable.

Hence, the empirical model is stated below and denoted by Equation 1:

$$ENVP_{it} = \beta_0 + \beta_1 GBRNK_{it} + \beta_2 CRISK_{it} + \beta_3 LRISK_{it} + \beta_4 IRRISK_{it} + \beta_5 SRISK_{it} + \beta_6 INRISK_{it} + \beta_7 MERISK_{it} + \beta_8 OPRISK_{it} \beta_9 ROA_{it} + \beta_{10} ROE_{it} + \beta_{11} IDIV_{it} + \beta_{12} BNSIZE_{it} + \varepsilon_{it} \quad (1)$$

Where εit means idiosyncratic shocks, i mean n^{th} bank, t^{th} means t^{th} year, β is the parameter of the explanatory variable, and CRISK, LRISK, IRRISK, SRISK, INRISK, MERISK, OPRISK, ROA, ROE and GBRNK represent credit risk, liquidity risk, interest rate risk, solvency risk, innovation risk, management efficiency risk, operational risk, and green banking, respectively. The controlled variables, such as bank size and income diversification, are also included to control their effect on environmental performance.

Table 1. Definition of Measurement Variables

Variables	Acronyms	Proxy and Measurement	Expected Outcome
Environmental Performance	ENVP	% of CSR activities and total spending	Positive/Negative
Green Banking	GBRNK	Green banking is measured by green investment divided by total investment	Positive/Negative
Credit Risk	CRISK	The NPL ratio is calculated by impaired loans divided by gross loan	Positive/Negative
Liquidity Risk	LRISK	The liquid assets ratio is calculated by liquid assets divided by total assets	Positive/Negative
Interest Rate Risk	IRRISK	Net interest margin is measured by (net interest income divided by total average earning assets) x100	Positive/Negative
Solvency Risk	SRISK	Total regulatory risk is measured by weighted of (tier 1 capital + tier 2 capital)	Positive/Negative
Innovation Risk	INRISK	Standard deviation of return on total assets, σ (ROA)	Positive/Negative
Management Efficiency Risk	MERISK	Net operating Income/ No. of Full-time employee	Positive/Negative
Operational Risk	OPRISK	Cost to Income ratio	Positive/Negative
Profitability (ROA)	ROA	Return on equity is measured by net income divided by total assets	Positive/Negative
Profitability (ROE)	ROE	Return on equity is measured by net income divided by shareholder's equity	Positive/Negative
Income Diversification	IDIV	Income diversification is measured by the non-interest income ratio.	Positive/Negative
Bank Size	BNSIZE	It is calculated by taking the natural logarithm of the total asset	Positive/Negative

Results and Discussion

Descriptive Analysis

Table 2 presents the statistical data for the descriptive and correlation assessments for the study variables, which examines the impact of green banking, risk factors, and profitability on environmental performance

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(ENVP). The mean value highlights that green banking, risk factors, and profitability are the most essential determinants of environmental performance.

Table. 2 Descriptive Statistics

Variable	Obs.	Mean	Std. Deviation	Min	Max
ENVP	210	327.973	2175.071	3.030	22500
GBRNK	210	0.144	0.146	0.001	0.542
CRISK	210	0.048	0.018	0.012	0.094
LRISK	210	0.115	0.050	0.014	0.237
IRRISK	210	0.037	.0130	0.006	0.072
SRISK	210	0.133	0.018	0.088	0.177
INRISK	210	0.014	0.022	0.001	0.097
MERISK	210	4.580	1.614	0.478	8.235
OPRISK	210	0.494	0.078	0.286	0.693
IDIV	210	0.337	0.127	0.036	0.654
BNSIZE	210	5.454	0.216	5.024	7.127
ROA	210	0.065	0.225	-0.067	1.220
ROE	210	0.112	0.088	-0.702	0.295

Table 3 shows the Pearson correlation of the variables. The outcome indicates that all independent variables are significantly correlated with the environmental performance parameters.

Table 3. Pearson Matrix of Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) ENVP	1.000												
(2) GBRNK	-0.100	1.000											
(3) CRISK	-0.147	-0.009	1.000										
(4) LRISK	0.146	0.053	-0.011	1.000									
(5) IRRISK	0.153	0.087	0.081	0.127	1.000								
(6) SRISK	-0.159	-0.015	-0.050	0.209	-0.074	1.000							
(7) INRISK	0.352	-0.208	-0.003	0.052	0.135	-0.245	1.000						
(8) MERISK	-0.235	0.133	-0.173	-0.159	-0.278	0.120	-0.112	1.000					
(9) OPRISK	0.045	-0.122	-0.037	-0.108	0.146	0.127	0.008	-0.374	1.000				
(10) IDIV	0.173	0.083	-0.199	0.058	-0.293	-0.082	-0.056	0.177	-0.047	1.000			
(11) BNSIZE	0.073	0.022	-0.069	-0.137	-0.207	0.233	-0.045	0.139	0.032	-0.081	1.000		
(12) ROA	0.062	0.051	0.066	-0.243	0.038	-0.032	-0.057	0.188	0.043	0.035	-0.069	1.000	
(13) ROE	0.155	0.114	0.047	0.191	0.053	0.226	-0.183	-0.136	-0.068	0.065	-0.106	0.092	1.000

The multicollinearity issue is the primary concern in the static panel regression. As the data set of this research is the combination of 21 PCBs in Bangladesh with 10 years, it is important to test multicollinearity before conducting the regression. The test found that this data set is free from the multicollinearity issues which is reflected in Table 3. The next diagnostic test, such as the Wooldridge test, is conducted to validate no first-order autocorrelation and is found validated where the study shows F statistics of 427.833 with a p-value of 0.00, indicating a rejection of the null hypothesis. In addition, VIF is tested to detect multicollinearity and found mean VIF is 1.247, which is less than 10, and a mean of 1/VIF is 0.793, which is close to 1 and validates no multicollinearity (see Table 4). Xtscc test is conducted to account for cross-sectional dependency and heteroskedasticity (Driscoll & Kraay, 1998). Moreover, the Hausman test is conducted to model fitness between fixed effects and random effects, and the results show a selection of fixed-effect regression since the value was less than 0.05. Hence, the fixed effect was identified as the best regression estimator.

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Table 4. Variance Inflation Factor

Variables	VIF	1/VIF
MERISK	1.609	0.621
SRISK	1.425	0.702
OPRISK	1.377	0.726
LRISK	1.310	0.763
IRRISK	1.309	0.764
ROE	1.242	0.805
IDIV	1.241	0.806
BNSIZE	1.190	0.840
INRISK	1.181	0.846
ROA	1.177	0.850
GBRNK	1.130	0.885
CRISK	1.096	0.912
Mean VIF	1.274	0.793

Hausman Test		Wooldridge Test	
Chi-Square	70.726	F(1, 20)	427.833
P-Value	0.00	Prob>F	0.0000

Table 5. Regression Results with Driscoll-Kraay Standard Errors

ENVP	Coefficient	Drisc/Kraay std. Error	t	P>t	[95% conf. interval]	
GBRNK	-1015.107	517.926	-1.960	0.082	-2186.737	156.522
CRISK	-8087.709	3440.689	-2.350	0.043	-15871.09	-304.329
LRISK	4346.033	2359.646	1.840	0.099	-991.857	9683.922
IRRISK	82678.700	11360.150	7.280	0.000	56980.250	108377.20
SRISK	9135.013	7083.076	1.290	0.229	-6888.019	25158.050
INRISK	-47367.62	43107.780	-1.100	0.300	-144884.20	50148.950
MERISK	-518.322	114.948	-4.510	0.001	-778.352	-258.291
OPRISK	3198.835	1832.342	1.750	0.115	-946.210	7343.880
IDIV	5869.128	695.401	8.440	0.000	4296.021	7442.235
BNSIZE	3193.809	406.803	7.850	0.000	2273.557	4114.061
ROA	6915.819	1012.841	6.830	0.000	4624.614	9207.024
ROE	4485.439	760.462	5.900	0.000	2765.154	6205.724
_cons	-22789.18	2413.296	-9.440	0.000	-28248.44	-17329.93

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R-Squared	0.5029
F (12, 9)	584.68
Prob>F	0.0000
No. of Obs.	210

The regression results with Discroll-Kraay standard errors highlight key relationships between environmental performance (ENVP) and the independent variables. Among the significant predictors, interest rate risk (IRR) shows a strong positive effect (coefficient:82,678.70, p-value: 0.000) is supported by the study (Ali & Oudat, 2020), indicating that banks with varied income sources possess greater flexibility in allocating resources for environmental activities. The size of the bank (BNSIZE) is positive and significant, exhibiting a positive coefficient (3,193.81, p-value: 0.000), indicating that larger banks, owing to their resources and capabilities, are more adept at adopting environmentally sustainable practices. Profitability metrics, including return on assets (ROA) and return on equity (ROE), exhibit a positive and significant influence on ENVP (coefficient: 6,915.82 and 4,485.44, respectively; p-value: 0.000 for both), which is supported by (Zhang et al., 2022). This indicates that financially robust and productive banks are more inclined to invest in enhancements to environmental performance. Conversely, credit risk (CRR) has a significant negative effect on ENVP (coefficient: -8087.71. p-value: 0.043), indicating that higher credit risks can constrain a bank's ability to focus on environmental initiatives, likely due to financial pressures and limited resources. This statement is supported by (Hanweck & Kilcollin, 1984; Isran et al., 2021). Management efficiency risk (MER) also negatively impacts ENVP (coefficient: -518.32, p-value: 0.001), reflecting how inefficiencies in management hinder the ability to prioritize environmental sustainability (Bai et al., 2021). Some variables, while showing a directional relationship, are not statistically significant. For instance, green banking (GBNK) has a negative but significant effect (coefficient: -1015.11, p-value: 0.082), suggesting that its role in enhancing ENVP may not be fully capitalized in this context (Akhter et al., 2021). The probable reason may be green fund disbursement was in the wrong place or borrowers. Similarly, liquidity risk (LQR) has a marginally positive relationship (coefficient: 4346.03, p-value: 0.099), while operational risk (OPR) (Adusei, 2022), and solvency risk (SLR) also show positive but insignificant relationships (Chen et al., 2021), indicating these factors may not directly influence environmental outcomes. Lastly, innovation risk (INR) demonstrates a negative and insignificant effect (coefficient: -47367.62, p-value: 0.300), which could mean that high innovation risks deter banks from pursuing uncertain environmental investments (Huda et al., 2020). Overall, the regression model is significant (F-statistic: 584.68, p-value:0.000), with a within R-squared of 0.5029, indicating that approximately 50.3% of the variance in ENVP is explained by the model. These findings underscore the importance of profitability, size, and diversification in driving environmental performance, while inefficiencies and certain risk factors pose barriers. The results also highlight the nuanced roles of green banking and other risks, suggesting a need for further exploration to better understand their impacts.

Managerial Implication

These current findings illustrate the important outcome for bank managers in enhancing environmental performance and mitigating several risks in the banking industry in the context of emerging economies like Bangladesh. However, managers should emphasize improving the financial performance of the banks, such as ROA and ROE, that align with sustainability requirements. By improving environmental performance bank managers can reduce bank-specific risk like management inefficiency risk. Credit risk managers may use these findings to focus on credit risk by reducing NPLs in the context of Bangladesh. Moreover, managers can explore increasing green fund disbursement into their business operations. Nevertheless, the findings also provide real ideas and insights for the managers to link their bank's goals and sustainability objectives by promoting sustainable growth.

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Limitations of the Study and Future Research Directions

This study provides significant contributions, but several limitations should be acknowledged for future research. The current study was selected focusing on PCBs, but Islamic banks and NBFI were excluded due to different investment policies and risk appetite. Consequently, future studies could be expanded regarding generalizing all banks and NBFI of investigating the impact of green banking in determining environmental performance in the emerging economy. Furthermore, this study explored a negative relation between green banking and environmental performance in the context of Bangladesh. As a result, future investigations may address the reasons why this relationship is negative in the same context.

Conclusion & Recommendations

This is the first study in Bangladesh to examine the impact of green banking, bank risks, and profitability on environmental performance, which offers significant insights into sustainability. The empirical results suggest that green banking (GBRNK) and environmental performance have a significant relationship but are negatively significant, thus validating hypothesis 1. The impact of green banking on environmental performance is yet to be given a lack of academic attention, though few researchers only focused on the adoption of green banking and green finance areas. The study also revealed multiple negative relations between bank risks and environmental performance, which validates hypothesis 2. For instance, the assessment of risk variables revealed complex results where interest rate risk positively impacts environmental performance, suggesting that banks with exposure to IRRISK may prioritize sustainable investments as part of their risk mitigation strategy. Conversely, credit risk negatively affects environmental performance, suggesting that financial constraints impair sustainability efforts. In addition, management efficiency risk also has a harmful effect, stressing the importance of efficient operations to accomplish environmental goals. However, other risks, such as liquidity risk (LRISK), solvency risk (SRISK), operational risk (OPRISK), and innovation risk (INRISK), had limited direct impact on environmental performance, pointing to the intricacy of their roles in sustainability. Whereas return on assets (ROA) and return on equity (PRO) considerably boost environmental performance, indicating that financially stable and prosperous banks are better positioned to participate in sustainability programs. Similarly, bank size (BNSIZE) and income diversification (IDIV) increase environmental performance, indicating the importance of resource availability and various revenue streams in supporting green initiatives. Interestingly, green banking (GBRNK) revealed a limited impact on environmental performance in this investigation. While these findings do not dismiss the potential of green banking, they highlight the need for greater intentional integration of green banking practices into core banking operations to create demonstrable environmental outcomes. Overall, this study underscores the critical roles of profitability, effective management, and targeted risk management in encouraging environmental sustainability. The findings give a platform for banking institutions to combine their financial and operational objectives with sustainability goals, helping to fulfil global environmental targets.

Author Contribution

Conceptualization, M.A.K.A. (Mohammad Abul Kalam Azad), M.A.I (Md Aminul Islam), H.A.R (Hafizah Abul Rahim); Data curation, M.A.K.A and M.A.I; Formal analysis, M.A.K.A and M.A.I; Funding acquisition, E.D (Esayas Degago), Investigation, M.A.K.A, H.A.R; Methodology, M.A.K.A, M.A.I, and H.I (Hasina Imam); Project administration, M.A.K.A, M.A.I, E.M (Edina Molnar) and H.A.R; Resources, M.M.A (Mohammed Mahabubul Ahsan) and E.D; Software, M.A.K.A, H.I and M.A.I; Supervision, M.A.I and H.A.R; Validation, M.A.I, H.A.R, and H.I.; Visualization, M.A.K.A, H.A.R, and M.A.I; Writing-original draft, M.A.K.A; Writing-review & editing, M.A.K.A, H.A.R, M.A.I, H.I, MMA, and E.M. All authors have read and agreed to the published version of the manuscript.

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