The Effect of Green Banking and Risk Management on Profitability with ESG Disclosure as a Moderation

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ABSTRACT

The increasing importance of sustainable finance and the growing role of environmental, social, and governance practices in shaping banking performance. This study examines the impact of green banking, risk management, and ESG disclosure on bank profitability, with ESG disclosure also tested as a moderating variable. A quantitative approach with a causal associative design is applied using data from banking companies listed on the Indonesia Stock Exchange during 2023–2025. Multiple regression analysis is employed to test both direct and moderating effects. The findings show that green banking and ESG disclosure have a positive and significant effect on profitability, while risk management, proxied by non-performing loans, has a significant negative effect. Furthermore, ESG disclosure strengthens the relationship between green banking and profitability and moderates the effect of risk management by reducing the adverse impact of credit risk on financial performance. The results indicate that sustainability-oriented practices combined with effective risk management play a crucial role in improving banking profitability. The study concludes that integrating green banking initiatives with strong ESG disclosure practices enhances financial outcomes, while proper risk control remains essential for maintaining stability and long-term performance in the banking sector.

Keywords: *Banking, ESG Disclosure, Green Banking, Profitability, Risk Management.*

INTRODUCTION

Climate change and environmental challenges have become major concerns for the global financial system due to their impact on economic stability and long-term business sustainability. Consequently, banks are evaluated not only by their financial performance but also by their contribution to sustainable development through environmentally responsible financing (Geo et al., 2023). As financial intermediaries, banks play a strategic role in allocating capital, making their financing decisions crucial to achieving sustainability goals (Kontesa et al., 2023). In Indonesia, this commitment is reflected in the Sustainable Finance Roadmap introduced by the Financial Services Authority (*Otoritas Jasa Keuangan*/OJK), which encourages the integration of environmental, social, and governance considerations into banking activities. As a result, sustainability practices have become a strategic necessity rather than merely a regulatory requirement (Asfahaliza & Anggraeni, 2022).

Green banking has become one of the most widely adopted approaches to supporting sustainable finance by reducing environmental impacts through service digitalization, energy efficiency, and financing environmentally friendly sectors (Ningsih et al., 2020). Theoretically, green banking can improve a bank's reputation, strengthen customer

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loyalty, and reduce financing risks related to future environmental regulations (Fadilah, 2024). However, its implementation often requires significant investments in technology, environmental certification, and operational adjustments, which may increase short-term costs and reduce profitability (Nurmalia, 2021). Consequently, the relationship between green banking and financial performance remains an important area for further investigation.

Risk management is also a key determinant of banking performance, particularly through indicators such as Non-Performing Loans (NPL) and Capital Adequacy Ratio (CAR), which support operational stability and profitability (Pratiwi & Kurniawan, 2018). Effective risk management enables banks to mitigate credit, market, and other financial risks (Ansori & Safira, 2018). Moreover, environmental risks, including physical risks from natural disasters and transition risks driven by environmental policy changes, can weaken borrowers' repayment capacity, increase credit risk, and ultimately reduce profitability (Eng, 2013). Therefore, integrating environmental considerations into risk management has become increasingly important for sustaining long-term banking performance.

At the same time, Environmental, Social, and Governance (ESG) disclosure has gained considerable attention as a transparency mechanism that helps reduce information asymmetry between firms and stakeholders. According to stakeholder theory, companies are expected to disclose non-financial information to obtain social legitimacy and strengthen stakeholder trust (Wahyudi, 2023). ESG disclosure reflects a firm's commitment to sound governance, social responsibility, and environmental stewardship (Yudha & Rahman, 2024). Greater transparency through ESG reporting is believed to enhance corporate reputation, improve investor confidence, and lower the cost of capital, ultimately contributing to better financial performance (Fitra & Rahman, 2024).

Despite the growing interest in sustainable finance, previous studies have reported inconsistent findings regarding its impact on banking performance. Ningsih et al. (2020) found that green banking positively affects profitability by improving operational efficiency and corporate reputation. In contrast, Mahardika and Fitanto (2023) reported a negative effect, arguing that the high costs associated with green banking implementation may outweigh its short-term benefits. Similar inconsistencies are found in studies on risk management. Putri and Dewi (2025) concluded that effective management of NPL and CAR contributes positively to profitability, whereas Harahap et al. (2025) argued that conventional risk management alone is insufficient unless it is integrated with environmental risk mitigation strategies. These conflicting findings reveal a significant research gap that requires further empirical examination.

To address this gap, this study introduces ESG disclosure as a moderating variable in the relationship between green banking, risk management, and financial performance. Unlike previous studies that focused primarily on direct effects, this study proposes that ESG disclosure strengthens these relationships by enhancing transparency, reducing information asymmetry, and increasing stakeholder confidence. ESG disclosure is therefore considered a strategic mechanism for explaining inconsistent findings in prior research. The study aims to examine the effects of green banking and risk management on financial performance and investigate the moderating role of ESG disclosure. The findings are expected to extend stakeholder theory and sustainable finance literature while providing practical insights for bank managers, regulators, and investors in developing sustainability strategies that enhance financial performance and long-term competitiveness in an increasingly sustainability-oriented banking environment.

LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

The Influence on Profitability

Profitability reflects a bank's ability to generate earnings from its operational activities and serves as an important indicator of managerial effectiveness and financial performance (Adyani & Sampurno, 2011; Priatna, 2016; Nirawati et al., 2022). In the context of sustainable finance, green banking has emerged as a strategic approach that integrates environmental objectives with financial goals (Böttcher, 2020). Green banking encourages financial institutions to reduce environmental impacts through environmentally responsible business practices, service digitalization, and financing support for sustainable sectors (Bhardwaj & Malhotra, 2013; Setyoko & Wijayanti, 2022). These initiatives can improve operational efficiency, strengthen corporate reputation, and attract environmentally conscious customers, which may contribute to higher profitability. Furthermore, by financing environmentally friendly projects and reducing exposure to environmentally harmful industries, banks can minimize future credit risks and enhance long-term financial performance. Therefore, the implementation of green banking is expected to create both economic and reputational benefits that positively influence profitability.

Besides green banking, effective risk management is essential for maintaining stable financial performance. According to Mardiana (2018), risk management functions as an early warning system that helps organizations anticipate potential losses and operational disruptions. In the banking sector, risk management is commonly measured using the Non-Performing Loan (NPL) ratio, which reflects the proportion of problematic loans in a bank's credit portfolio. A higher NPL ratio indicates deteriorating loan quality, reducing banks' opportunities to generate interest income from lending activities and increasing the potential for credit losses. This relationship is supported by Alnabulsi et al. (2023), who found that non-performing loans have a significant negative effect on bank profitability.

In addition, ESG disclosure serves as an important communication mechanism between companies and stakeholders by providing transparent information regarding environmental, social, and governance practices (Saripah et al., 2024). Through ESG reporting frameworks such as the Global Reporting Initiative (GRI), banks can enhance stakeholder trust, strengthen corporate legitimacy, and improve market confidence (Chen & Xie, 2022; Gutama & Sisdianto, 2024). Increased transparency and stakeholder confidence may lead to greater business opportunities and improved financial performance.

H1: Green banking has a positive effect on profitability.
H2: Risk management has a negative effect on profitability.
H3: ESG disclosure has a positive effect on profitability.

The Influence of ESG Disclosure as a Moderator Variable

ESG disclosure is increasingly recognized as a strategic mechanism that enhances the effectiveness of sustainable business practices. As a form of communication between companies and stakeholders, ESG disclosure provides information regarding environmental, social, and governance performance that may influence stakeholder perceptions and decision-making (Saripah et al., 2024). The use of internationally recognized reporting standards such as the Global Reporting Initiative (GRI) increases the credibility and comparability of sustainability information disclosed by companies (Chen & Xie, 2022; Gutama & Sisdianto, 2024). In the context of green banking, ESG disclosure can strengthen the positive impact of environmentally friendly banking initiatives on profitability. Green banking activities often require substantial investments and may not immediately generate financial benefits. However, transparent ESG reporting allows stakeholders to better understand the long-term value of these initiatives, thereby enhancing investor confidence, customer trust, and corporate reputation. As a result, the positive contribution of green banking to profitability may become stronger when supported by high-quality ESG disclosure.

Similarly, ESG disclosure may strengthen the relationship between risk management and profitability. Effective risk management aims to identify and control potential risks that could threaten organizational performance (Ferry, 2008; Fahmi, 2010). Through transparent ESG reporting, banks can communicate their risk management policies and sustainability commitments more effectively to stakeholders. This transparency reduces information asymmetry and demonstrates the bank's capability to manage both financial and non-financial risks (Darmawi, 2022; Fitria & Mariana, 2025). Consequently, stakeholders may perceive the bank as more reliable and resilient, leading to stronger market confidence and improved financial outcomes. In this regard, ESG disclosure not only functions as a reporting mechanism but also as a strategic tool that amplifies the benefits of risk management practices.

H4: ESG disclosure moderates the effect of green banking on profitability.
H5: ESG disclosure moderates the effect of risk management on profitability.

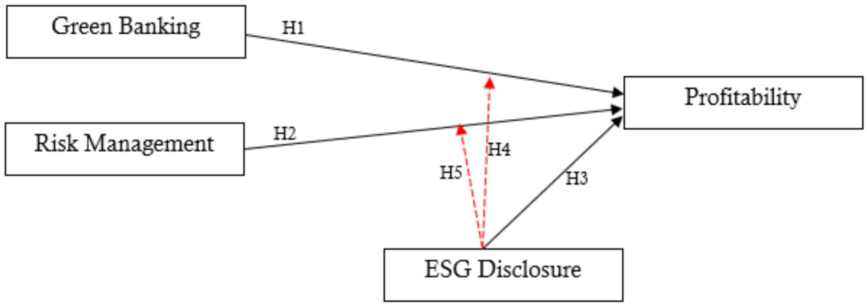

Figure 1. Conceptual Framework

Figure 1 presents the conceptual framework of the study. Green banking and risk management are proposed as independent variables that directly influence bank profitability (H1 and H2), while ESG disclosure is hypothesized to have a direct effect on profitability (H3). In addition, ESG disclosure serves as a moderating variable, strengthening the relationships between green banking and profitability (H4) and between risk management and profitability (H5). This framework suggests that effective ESG disclosure enhances the contribution of sustainable banking practices and risk management to improving banks' financial performance.

RESEARCH METHODS

This study employs a quantitative method with a causal associative approach to examine the effects of green banking and risk management on profitability, with ESG disclosure serving as a moderating variable. A quantitative approach is considered appropriate because the study aims to provide empirical evidence regarding the impact of green banking implementation and risk management practices on banking profitability, as well as to assess whether ESG disclosure strengthens or weakens these relationships. The population consists of banking companies listed on the Indonesia Stock Exchange (IDX) during the 2023–2025 period. The research sample is selected using a purposive sampling technique. The sampling criteria include banks that were consistently listed on the IDX throughout the observation period, published annual reports and sustainability reports, and provided complete data related to green banking, risk management, profitability, and ESG disclosure. The 2023–2025 period was chosen because it reflects the most recent developments in sustainability practices and ESG reporting within the Indonesian banking sector.

This study relies on secondary data obtained from annual reports, sustainability reports, and financial statements published on the official websites of banking companies and the IDX. Data collection is conducted through a documentation method, which involves gathering and reviewing relevant documents related to the research variables. Profitability serves as the dependent variable and is measured using Return on Assets (ROA), as this ratio reflects a bank's ability to generate earnings from its asset utilization. The independent variables are green banking and risk management. Green banking is measured using a green banking disclosure index derived from information presented in annual and sustainability reports. Risk management is measured using the Non-Performing Loan (NPL) ratio, which represents the level of credit risk faced by a bank. ESG disclosure functions as the moderating variable and is measured using an ESG disclosure index that captures the extent to which banks disclose environmental, social, and governance-related information.

Hypothesis testing is conducted using multiple regression analysis. The t-test is employed to examine the partial effect of each independent variable on profitability, while the F-test is used to assess the simultaneous effects of the independent variables on profitability. The coefficient of determination (R^2) is applied to evaluate the explanatory power of the model. Furthermore, the moderating role of ESG disclosure is examined through interaction terms between green banking and ESG disclosure, as well as between risk management and ESG disclosure. The significance of these interaction effects indicates whether ESG disclosure moderates the relationship between the independent variables and profitability. Through this approach, the study is expected to provide empirical evidence on the effectiveness of green banking and risk management in enhancing profitability and to offer further insights into the role of ESG disclosure in strengthening sustainable banking performance during the 2023–2025 period.

RESULTS

The following table presents the descriptive statistical results of the variables used in this study. These results are intended to provide an initial overview of the data distribution before conducting further empirical analysis. Descriptive statistics help to illustrate the general characteristics of profitability, green banking, risk management, and ESG disclosure.

Table 1. Descriptive Test Results

Variables	N	Minimum	Maximum	Mean	Standard Deviation
Profitability	90	0.21	4.86	2.147	1.021
Green Banking	90	0.45	0.92	0.721	0.118
Risk Management	90	0.38	4.25	2.014	0.935
ESG Disclosure	90	0.40	0.95	0.697	0.124

Table 1 presents the descriptive statistics for the four key variables used in the study: profitability, green banking, risk management, and ESG disclosure, each observed across 90 samples. The data show noticeable variation both within and between variables. Profitability exhibits the widest range, with values spanning from 0.21 to 4.86 and a relatively high standard deviation of 1.021. This indicates that the level of profitability among the observed entities is quite heterogeneous, suggesting substantial differences in financial performance. The mean value of 2.147 implies a moderate level of profitability on average, although the dispersion shows that several observations deviate significantly from this central tendency.

In contrast, the sustainability and governance-related variables, green banking, and ESG disclosure show more constrained distributions. Green banking has a mean of 0.721 with a relatively low standard deviation of 0.118, while ESG disclosures have a mean of 0.697 and a standard deviation of 0.124. These figures suggest that both variables are fairly consistent across observations, with limited variability compared to profitability and risk management. Risk management itself displays moderate variability, with values ranging from 0.38 to 4.25 and a standard deviation of 0.935, indicating differing levels of implementation or effectiveness among the sampled entities. Taken together, these descriptive results highlight that while financial performance is highly dispersed, sustainability-related practices tend to be more uniform, albeit still showing room for differentiation across observations.

Table 2 represents normality tests, Jarque-Bera statistic value of 1.847, with a probability of 0.397, is obtained. The probability value is greater than the level of significance 0.05 (0.397 > 0.05). Hence, it can be concluded that the residuals in the model are normally distributed. This means that no deviation exists in the distribution of data, hence the normality assumption in the regression model is met. The normality assumption implies that the data set used in the study has a distribution pattern that approximates the normal distribution and is suitable for conducting a regression analysis. Moreover, it can be observed that this condition means that the values obtained from the model estimation are reliable and can be used to conduct hypothesis testing.

Table 2. Normality Test Results

Information	Mark
Jarque-Bera	1.847
Probability	0.397

Based on the results of the multicollinearity test shown in Table 3, the VIF values of green banking variables are 1.865, the VIF value of the risk management variable is 1.422, the VIF value of the ESG disclosure variable is 1.957, whereas the VIF values of the green banking × ESG disclosure and risk management × ESG disclosure interaction variables are 2.418 and 2.163, respectively. It means that all variables have a VIF value below the maximum value of 10. In other words, the result shows that there is no high correlation between independent variables and variable moderation in the research model. Because the relative VIF values are quite low, this indicates that each variable can explain the effect of its influence on bank performance without any interference from the strong relationship with other variables. As a result, the variables green banking, risk management, ESG disclosure, and interaction variables can be used in a simultaneous manner in the regression model.

Table 3. Multicollinearity Test

Variables	VIF	Information
Green Banking	1.865	Not occur Multicollinearity
Risk Management	1.422	Not occur Multicollinearity
ESG Disclosure	1.957	Not occur Multicollinearity
Green Banking × ESG Disclosure	2.418	Not occur Multicollinearity
Risk Management × ESG Disclosure	2.163	Not occur Multicollinearity

The results of the heteroscedasticity test according to Breusch-Pagan, with a probability level of 0.284. This value is higher than the significance level used in the research, which is 0.05 (0.284> 0.05). Therefore, it can be said that the regression model does not experience symptoms of heteroscedasticity. This proves that the variance of the errors in the regression model used has a constant nature or is homogeneous throughout the level of observations. So, the error distribution in the regression model No is influenced by the variation of the independent variables, which are green banking and risk management, as well as the moderator variable ESG disclosure. Absence of heteroscedasticity means that the regression model applied meets one of the classic assumptions that must be met in regression analysis. Thus, the coefficient estimation of the regression model can be considered efficient, unbiased, and equitable for testing hypotheses in the next process.

Table 4. Analysis Test Results Regression Moderation

Variable	Coefficient	t- statistic	Sig.
Constant	0.842	2.341	0.022
Green Banking →Profitability	1.586	3.812	0.000
Risk Management → Profitability	-0.472	-4.285	0.000
ESG Disclosure →Profitability	0.965	2.978	0.004
Green Banking × ESG Disclosure →Profitability	1.128	2.684	0.009
Risk Management × ESG Disclosure →Profitability	-0.685	-2.219	0.029

Table 4 shows that the constant value of 0.842 (sig. 0.022) reflects the baseline level of profitability when all independent variables are held constant. Green banking has a positive and significant effect on profitability with a coefficient of 1.586 (sig. 0.000), indicating that better implementation of green banking is associated with higher profitability. In contrast, risk management proxied by NPL has a significant negative effect with a coefficient of -0.472 (sig. 0.000), meaning that higher non-performing loans reduce profitability. ESG disclosure also has a positive and significant impact on profitability, with a coefficient of 0.965 (sig. 0.004), suggesting that more extensive ESG disclosure tends to go hand in hand with better financial performance.

For the interaction effects, green banking × ESG disclosure shows a positive coefficient of 1.128 (sig. 0.009), indicating that ESG disclosure strengthens the positive impact of green banking on profitability. Meanwhile, risk management × ESG disclosure has a negative coefficient of -0.685 (sig. 0.029), which suggests that ESG disclosure also plays a role in shaping how risk management relates to profitability, particularly in reducing the adverse impact of NPL on bank performance. Main variables and interaction terms are statistically significant, confirming their relevance in explaining profitability.

Table 6. F Test & Coefficient of Determination (R^2)

Information	**Mark**
F- statistic	21.783
Prob(F-statistic)	0.000
R^2	0.628
Adjusted R^2	0.604

Table 6 shows that the model is statistically significant overall, as indicated by the F-statistic value of 21.783 with a probability of 0.000, meaning that green banking, risk management, ESG disclosure, and their interaction terms jointly have a significant effect on profitability. The coefficient of determination (R^2) of 0.628 indicates that 62.8% of the variation in profitability can be explained by the variables included in the model, while the remaining 37.2% is influenced by other factors outside the model. Meanwhile, the adjusted R^2 of 0.604 suggests that the model still maintains a fairly strong explanatory power even after adjusting for the number of predictors, confirming that the model is reasonably good in explaining changes in profitability.

DISCUSSION

The results indicate that green banking has a positive effect on profitability. This finding suggests that a higher level of green banking implementation is associated with higher profitability in the banking sector. Green banking reflects banks' commitment to sustainable practices through various initiatives such as green financing, energy efficiency, digital banking services, and reducing paper usage in operations. This result is consistent with stakeholder theory, which argues that organizations that are able to meet stakeholder expectations tend to receive stronger support from them (Tia et al., 2023; Amalia & Bertuah, 2025). Green banking not only contributes to environmental sustainability but also enhances corporate reputation, strengthens customer trust, and attracts investors who are increasingly concerned with sustainability issues. These factors ultimately contribute to a broader customer base, market expansion, and improved profitability. This finding is also in line with the studies conducted by Noman et al. (2015) and Hossain et al. (2020), which report that green banking practices positively influence banks' financial performance and profitability.

Furthermore, risk management proxied by NPL has a significant negative effect on profitability. This is indicated by a regression coefficient of -0.472 with a significance level of 0.000. The result suggests that higher levels of credit risk are associated with lower profitability, as increasing non-performing loans directly weakens financial performance. This finding aligns with management theory, which emphasizes that effective risk management is essential for maintaining firm performance stability. When banks are able to manage credit risk effectively, potential losses from defaults can be minimized, thereby preserving profitability. Conversely, higher NPL levels increase operational costs and reduce asset management efficiency. This result is also consistent with the findings of Kingu et al. (2018) and Anik et al. (2019), who found that non-performing loans negatively affect profitability in developing economies.

In addition, ESG disclosure has a positive and significant effect on profitability. This is shown by a regression coefficient of 0.965 with a significance level of 0.004. The finding indicates that greater disclosure of environmental, social, and governance information is associated with higher profitability. High-quality ESG disclosure reflects transparency and a strong commitment to responsible and sustainable business practices. This result is also consistent with the previous findings by Aydoğmuş et al. (2022), Azkiya et al. (2024), and Ali et al. (2025), which show that both green banking and risk management significantly influence profitability, highlighting that sustainability-related practices and risk control mechanisms jointly play an important role in shaping financial performance.

The moderation test results show that ESG disclosure plays an important role in both strengthening and shaping the relationship between independent variables and profitability. The interaction between green banking and ESG disclosure has a positive coefficient of 1.128 with a significance level of 0.009, indicating that ESG disclosure strengthens the effect of green banking on profitability. In other words, the impact of green banking on improving profitability becomes more pronounced when it is accompanied by a higher level of ESG disclosure, as transparency enhances stakeholder trust and credibility in the bank's sustainability practices. This finding is consistent with the study conducted by Alfalih (2023) and Simatupang et al. (2025), which suggests that ESG transparency strengthens the financial benefits of sustainability-oriented practices.

Meanwhile, the interaction between risk management and ESG disclosure shows a negative coefficient of -0.685 with a significance value of 0.029, indicating that ESG disclosure also moderates the relationship between risk management and profitability. In this context, ESG disclosure enhances the effectiveness of risk management in reducing the negative impact of NPL on profitability. This suggests that better ESG disclosure improves how risk management contributes to financial stability, particularly in mitigating credit risk exposure. This result is in line with findings from Albitar et al. (2020) and Yeye and Egbunike (2023), who report that ESG disclosure strengthens risk management effectiveness and contributes to improved financial performance in the banking sector.

CONCLUSION

This study finds that green banking, risk management, and ESG disclosure significantly influence bank profitability, both directly and through moderating effects. Green banking and ESG disclosure have a positive impact on profitability, while risk management, proxied by non-performing loans, negatively affects profitability. In addition, ESG disclosure strengthens the relationship between green banking and profitability, while also shaping the effect of risk management by mitigating the adverse impact of credit risk. These results confirm that sustainability-oriented practices and effective risk control are key determinants of banking performance in a competitive financial environment.

The findings imply that banks should integrate green banking initiatives with strong ESG disclosure practices to maximize financial outcomes, as transparency enhances stakeholder trust and reinforces the benefits of sustainable operations. Effective risk management remains essential in maintaining financial stability, particularly in reducing the negative consequences of non-performing loans. However, this study is limited to a specific set of variables and may not capture other factors influencing profitability, such as macroeconomic conditions or internal governance structures. Future research is encouraged to incorporate broader samples, additional financial indicators, and cross-country comparisons to provide a more comprehensive understanding of how sustainability and risk management interact in shaping bank performance.

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