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Corporate Governance and Board Gender Diversity as Moderators of Environmental Innovation on Financial Performance in Indonesia

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ABSTRACT

Purpose: Focusing on environmental strategic practices, this study examines whether Environmental Performance and carbon emission disclosure generate financial value and whether such value is contingent upon gender diversity and corporate governance mechanisms. The study responds to inconsistencies in prior sustainability research by emphasizing the strategic role of internal governance mechanisms in optimizing financial returns from environmental initiatives, especially in Indonesia, where regulatory and environmental pressures are intensifying.

Method: Using a quantitative approach, this study uses secondary data from annual and sustainability reports of firms listed on the Indonesia Stock Exchange for 2023–2024. Environmental innovation was measured using Environmental Disclosure Index based on environmental information disclosed. Carbon emission disclosure was assessed based on GRI 305 indicators, financial performance was proxied by Return on Assets (ROA), gender diversity was measured by the proportion of female directors/commissioners, and corporate governance was proxied by the proportion of independent commissioners. Using purposive sampling, the study obtained 354 firm-year observations from 177 firms. The hypotheses were tested using Partial Least Squares Structural Equation Modelling (PLS-SEM).

Findings: Model estimation results show that both environmental innovation and carbon transparency are associated with improved profitability. Importantly, this relationship intensifies in the presence of heterogeneous board representation and effective governance controls, underscoring the conditional nature of sustainability-driven financial gains.

Implications: The findings provide practical implications for corporate managers in strengthening sustainability-oriented governance strategies, for investors in evaluating firms' long-term sustainability performance, and for regulators and policymakers in encouraging stronger environmental disclosure and board diversity practices in emerging markets such as Indonesia.

Novelty/Value: Unlike prior studies in Indonesia that primarily examine the direct effect of environmental practices on financial performance, this study develops an integrated framework by investigating the simultaneous moderating roles of gender diversity and corporate governance in the relationship between environmental strategies and financial performance. The study extends stakeholder and contingency perspectives within the context of emerging markets.

Keywords: Environmental Performance, Carbon Disclosure, Board Gender Diversity, Corporate Governance, Financial Performance

INTRODUCTION

Environmental degradation and climate instability have become major global challenges, prompting firms to integrate sustainability principles into their corporate strategies. In line with the Sustainable Development Goals (SDGs) and Indonesian environmental policies, companies are increasingly expected to support sustainable development through environmental accountability (Yuniarti et al., 2022). In this context, Environmental Performance and carbon emission disclosure have emerged as important corporate sustainability practices. Environmental Performance reflects firms' efforts to develop environmentally friendly products, technologies, and operational processes to reduce ecological impact while maintaining efficiency (Ruan et al., 2024; Tjahjadi et al., 2023). Meanwhile, carbon emission disclosure represents corporate transparency regarding emissions, environmental risks, and mitigation strategies communicated to stakeholders (Wahyuningrum et al., 2024; Yusuf & Setiawan, 2023). These initiatives are viewed not only as regulatory compliance but also as strategic instruments for strengthening reputation, stakeholder confidence, and long-term economic performance.

Indonesia provides a unique setting for examining the relationship between sustainability initiatives and financial outcomes. As one of the largest carbon-emitting countries in Southeast Asia, Indonesia continues to face environmental pressures driven by industrial expansion, fossil fuel dependency, land-use transformation, and urbanization (Wahyudi et al., 2024). The Indonesian government has responded by strengthening environmental governance through sustainability reporting requirements and environmental disclosure initiatives. These developments create increasing pressure for listed companies to improve environmental accountability while maintaining financial competitiveness.

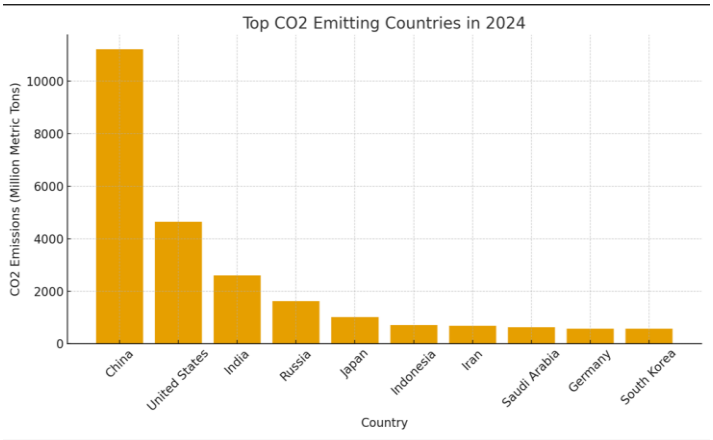

Figure 1. Countries by CO_2 Emissions

Figure 1 presents countries with significant CO_2 emissions and highlights Indonesia's environmental challenges in the global context. The figure demonstrates the urgency for firms operating in carbon-intensive environments to adopt environmentally responsible practices, including Environmental Performance and transparent carbon reporting. Consequently, governance quality and board effectiveness become increasingly important in ensuring that sustainability initiatives generate long-term economic value rather than merely fulfilling symbolic compliance requirements. Carbon transparency has also been associated with improved profitability through enhanced stakeholder trust and stronger corporate legitimacy (Kouaib et al., 2024). Transparent reporting may strengthen corporate legitimacy and improve access to sustainability-oriented financing.

Prior empirical studies examining the financial consequences of sustainability practices have produced inconsistent findings. Several studies report that Environmental Performance improves operational efficiency, enhances corporate reputation, and positively affects profitability (Tjahjadi et al., 2023; Yuniarti et al., 2022). Similarly, carbon disclosure has been linked to greater stakeholder confidence, improved transparency, and stronger firm value (Gabr & ElBannan, 2025; Kouaib et al., 2024; Lu et al., 2021). These findings support the argument that environmentally responsible practices can strengthen competitive advantage and long-term business sustainability.

However, other studies present contradictory evidence. Environmental Performance often requires substantial investment in technology development, environmental adaptation, and research activities, which may reduce short-term profitability and increase operational cost (Chen & Yang, 2023; Misra et al., 2023). Likewise, disclosure practices implemented primarily to satisfy regulatory pressure may not generate meaningful economic benefits when unsupported by substantive environmental actions (Jiang & Li, 2023; Liu & Yaacob, 2026). These inconsistencies indicate that the financial effectiveness of sustainability practices may depend on governance quality and organizational conditions.

Stakeholder theory explains that firms must respond to the expectations of various stakeholders, including investors, regulators, communities, and environmental groups, in order to maintain legitimacy and long-term survival (Donaldson & Preston, 1995; Freeman, 1984). Companies demonstrating credible environmental commitment through transparent reporting and sustainable innovation are more likely to obtain stakeholder support and reputational advantages. Meanwhile, contingency theory argues that organizational effectiveness depends on the alignment between managerial strategies and internal organizational characteristics (Otley, 1980). Therefore, governance mechanisms may determine whether sustainability initiatives successfully create financial value.

Despite the growing literature on corporate sustainability, prior studies predominantly focus on the direct effects of Environmental Performance and carbon disclosure on firm performance. Limited attention has been given to governance-related contingency factors, particularly governance structure and board gender diversity, within emerging-market settings such as Indonesia (Luo et al., 2024; Yue et al., 2025). This limitation highlights the need to examine whether governance mechanisms strengthen the financial effectiveness of sustainability practices in emerging markets.

Board gender diversity and corporate governance represent important internal governance mechanisms supporting corporate sustainability. Gender diverse boards contribute broader perspectives, stronger ethical awareness, and more effective sustainability oversight (Đặng et al., 2023; L. Jiang et al., 2025), while effective governance structures enhance managerial accountability and ensure environmental programs are aligned with long-term strategic objectives rather than symbolic compliance (Agnese et al., 2026; Dohrmann et al., 2024). However, empirical evidence regarding their moderating role remains limited and inconclusive in Indonesia. Therefore, this study examines the effect of Environmental Performance and carbon emission disclosure on financial performance, as well as the moderating role of corporate governance and board gender diversity in firms listed on the Indonesia Stock Exchange. By integrating stakeholder theory and contingency theory, this study explains how governance mechanisms influence the economic effectiveness of sustainability practices in an emerging-market context.

LITERATURE REVIEW

Environmental Performance and Financial Performance

Environmental Performance reflects firms' strategic efforts to redesign products, processes, and technologies to reduce environmental impact while maintaining economic sustainability (Tjahjadi et al., 2023; Yusuf & Setiawan, 2023). From the perspective of Stakeholder Theory, environmentally responsible practices may enhance legitimacy, stakeholder confidence, and corporate competitiveness through improved environmental accountability (Donaldson & Preston, 1995; Freeman, 1984). Prior studies generally indicate that Environmental Performance improves operational efficiency, market competitiveness, and profitability through cost efficiency, reputational benefits, and stronger sustainability orientation (Kraus et al., 2023; Zhang & Li, 2023). In emerging markets, environmentally innovative firms are also viewed more favorably by investors because of their long-term growth potential (Gabr & ElBannan, 2025).

However, empirical findings remain inconsistent. Several studies argue that Environmental Performance requires substantial investment in environmentally friendly technologies and organizational transformation, which may increase operational costs and reduce short-term profitability

(Chen & Yang, 2023; Misra et al., 2023). In contrast, long-term benefits may emerge through stronger reputation, operational efficiency, improved stakeholder confidence, and broader access to sustainable financing (Agnese et al., 2026; Anmiao, 2025). These inconsistencies indicate that the financial effectiveness of Environmental Performance depends on governance effectiveness, organizational readiness, and strategic alignment. Consistent with Stakeholder Theory and Contingency Theory, firms implementing Environmental Performance are more likely to achieve superior financial performance when supported by effective governance and organizational capabilities. Therefore, the following hypothesis is proposed.

H_1: Environmental Performance positively influences financial performance.

Carbon Emission Disclosure and Financial Performance

Carbon emission disclosure (CED) reflects the extent to which firms communicate information regarding carbon emissions, mitigation initiatives, environmental risks, and climate-related commitments in sustainability reporting (Andriadi et al., 2023; Yusuf & Setiawan, 2023). Based on Stakeholder Theory, transparent disclosure reduces information asymmetry and strengthens corporate legitimacy among investors, regulators, and society (Donaldson & Preston, 1995; Freeman, 1984). v (Wahyuningrum et al., 2025; Zhang & Li, 2025). Previous studies report mixed evidence. Several studies find that comprehensive disclosure improves investor confidence, corporate reputation, access to sustainable financing, profitability, and firm value (Gabr & ElBannan, 2025; Lu et al., 2021; Zhang & Li, 2023). Indonesian evidence also suggests that firms with greater environmental transparency tend to achieve better financial performance (Lina & Adelia, 2024; Maryanti & Zulfah, 2025).

However, other studies argue that disclosure does not always produce economic benefits because many firms engage in symbolic rather than substantive disclosure (Han et al., 2023; Isaboke et al., 2025). Substantive disclosure reflects genuine environmental commitment through verifiable emission reduction efforts and transparent reporting quality, whereas symbolic disclosure primarily serves legitimacy and compliance purposes without significant environmental improvement (Fahmi et al., 2025; Liu & Yaacob, 2026). Consequently, investors increasingly evaluate not only the existence of disclosure but also its credibility and consistency with actual environmental practices (Nguyen et al., 2025; Setiawan et al., 2025). These inconsistencies suggest that the effectiveness of carbon disclosure depends on governance effectiveness, board monitoring, and organizational accountability. Firms with stronger governance structures are more likely to transform carbon disclosure into strategic value creation rather than symbolic compliance (Luo et al., 2024; Sobhan et al., 2025). Although disclosure activities may increase reporting costs in the short term, substantive carbon disclosure can improve reputation, reduce financing constraints, and strengthen long-term competitiveness (Dohrmann et al., 2024; Khatib et al., 2023). Based on these arguments, the following hypothesis is formulated:

H_2: Carbon emission disclosure is expected to be positively associated with corporate financial performance.

The Moderating Role of Board Gender Diversity in the Relationship between Environmental Performance and Financial Performance

Board gender diversity reflects heterogeneity in perspectives, cognitive approaches, and strategic decision-making within corporate governance structures. Beyond demographic representation, gender-diverse boards contribute broader perspectives, stronger ethical awareness, and more effective environmental oversight (Agnese et al., 2026; Kouaib et al., 2024). Female directors are frequently associated with stronger concern for sustainability, long-term responsibility, and risk management, which are important in evaluating Environmental Performance and carbon disclosure strategies (Đặng et al., 2023). From a Contingency Theory perspective, the effectiveness of sustainability initiatives depends on governance conditions that support strategic implementation (Otley, 1980). Environmental Performance and carbon disclosure involve trade-offs between environmental investment costs, reputational benefits, regulatory compliance, and long-term value creation.

Gender-diverse boards may improve firms' ability to evaluate these trade-offs by reducing groupthink, broadening strategic perspectives, and strengthening monitoring effectiveness (Jiang et al., 2025). Empirical studies further demonstrate that gender diversity strengthens the relationship between sustainability practices and financial performance. Yue et al. (2025) found that board gender diversity positively moderates the relationship between environmental innovation and corporate outcomes through stronger governance effectiveness and strategic monitoring. Similarly, women on boards

improve carbon disclosure quality and strengthen firm value through greater environmental accountability and transparency (Ma'wa & Setiawan, 2025; Monica et al., 2021). Luo & Tang (2021) also emphasized that gender-diverse governance structures support sustainability performance and innovation-oriented strategic decisions (Satrio, 2026). Thus, firms with higher female board representation are more likely to transform Environmental Performance and carbon transparency initiatives into tangible financial benefits. Accordingly, the following hypotheses are proposed.

H_3: Gender diversity strengthens the positive effect of Environmental Performance on financial performance.

H_4: Gender diversity strengthens the positive effect of carbon emission disclosure on financial performance

The Moderating Role of Corporate Governance in the Relationship between Environmental Performance and Financial Performance

Corporate governance refers to the mechanisms used to direct, monitor, and control corporate activities to align managerial decisions with long-term shareholder and stakeholder interests (Jiang & Li, 2023; Zhang & Li, 2023). In this study, corporate governance is operationalized through board independence and monitoring effectiveness, which are considered essential in supporting environmental accountability and strategic decision-making. Effective governance enables firms to integrate Environmental Performance and carbon disclosure into long-term business strategies rather than symbolic compliance practices (Agnese et al., 2026; Hamoudah et al., 2024).

Consistent with Contingency Theory, governance quality determines whether sustainability practices generate financial value because Environmental Performance and carbon disclosure require effective oversight, risk control, and performance evaluation (Otley, 2016; Otley, 1980). Firms with stronger governance structures are more capable of managing environmental risks, improving reporting credibility, and strengthening stakeholder confidence (Luo et al., 2024; Sobhan et al., 2025). Prior studies also confirm that governance effectiveness enhances the positive effect of environmental innovation and carbon disclosure on financial performance (Babiker et al., 2025; Dohrmann et al., 2024; Fahmi et al., 2025). In Indonesia, differences in board independence, monitoring intensity, and regulatory compliance indicate that governance effectiveness may determine whether sustainability initiatives produce measurable financial benefits. Based on these arguments, the following hypotheses are proposed.

H_5: Corporate governance strengthens the positive effect of Environmental Performance on financial performance.

H_6: Corporate governance strengthens the positive effect of carbon emission disclosure on financial performance.

Conceptual Framework

This study develops an integrated conceptual framework by combining Stakeholder Theory and Contingency Theory to explain how environmental strategies influence financial performance. Stakeholder Theory suggests that firms enhance legitimacy, stakeholder trust, and organizational performance through sustainability initiatives such as Environmental Performance and carbon emission disclosure (Donaldson & Preston, 1995; Freeman, 1984), although prior studies show inconsistent financial impacts across firms and industries (Chen & Yang, 2023; Han et al., 2023; Lu et al., 2021). To explain these inconsistencies, Contingency Theory argues that sustainability strategies generate value only when aligned with internal organizational conditions and governance structures (Otley, 2016; Otley, 1980). Accordingly, corporate governance and board gender diversity function as moderating mechanisms that strengthen the effectiveness of Environmental Performance and carbon emission disclosure in improving financial performance through stronger monitoring quality, environmental accountability, and sustainability-oriented decision making (Agnese et al., 2026; Đặng et al., 2023; Dohrmann et al., 2024; Yue et al., 2025). Therefore, the framework emphasizes that the financial benefits of environmental initiatives depend not only on stakeholder legitimacy but also on

governance quality and organizational alignment. Figure 2 illustrates the direct and moderating relationships among the study variables.

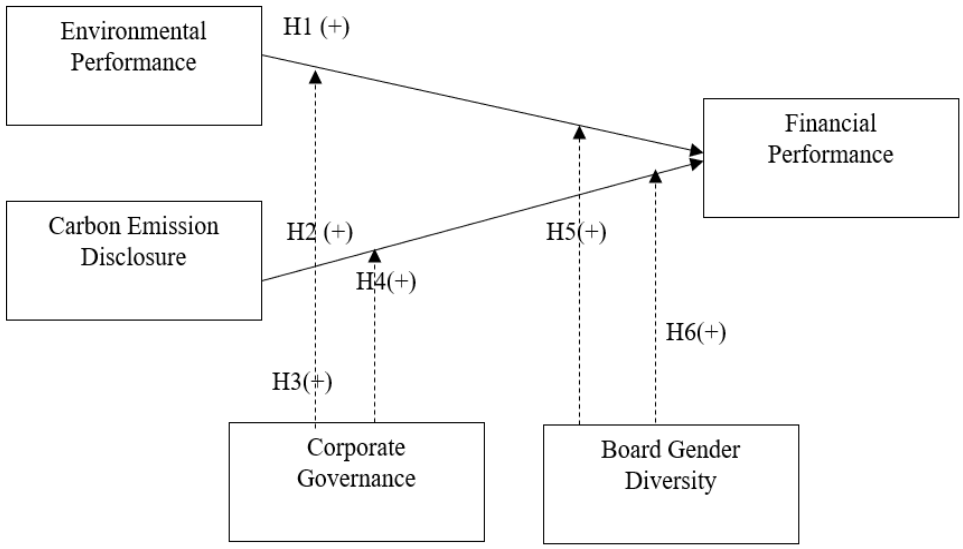

Figure 2. Research Model

RESEARCH METHOD

Research Design

This study employs a quantitative explanatory approach to examine the relationships between Environmental Performance, carbon emission disclosure, corporate governance, gender diversity, and financial performance among companies listed on the Indonesia Stock Exchange (IDX). The research is grounded in stakeholder and contingency theories, emphasizing that sustainability strategies generate financial value when supported by effective governance mechanisms (Freeman, 1984;Otley, 2016; Otley, 1980). Secondary archival data were collected from annual reports, sustainability reports, and governance disclosures during 2023–2024. Sample selection used purposive sampling based on several criteria, including continuous IDX listing status, availability of complete sustainability and governance disclosures, and completeness of financial data. A total of 177 firms met these requirements, resulting in 354 firm-year observations.

Variable Definitions and Measurements

Table 1 presents the operationalization of the variables used in this study, covering aspects of the environment, corporate governance, and financial performance. The Environmental Performance variable is measured using an environmental disclosure index that assesses the extent to which companies implement eco-friendly technologies, energy efficiency measures, and sustainable practices. Furthermore, Carbon Emission Disclosure is proxied by the GRI 305 indicator, which emphasizes corporate transparency regarding carbon emission management and mitigation strategies. Regarding governance, Board Gender Diversity and Corporate Governance are used to evaluate female representation on the board as well as the effectiveness of oversight and accountability mechanisms.

These variables were selected because prior literature indicates that board diversity and independence can influence the quality of environmental and social disclosures. Meanwhile, Financial Performance is measured using Return on Assets (ROA) to reflect a company's ability to generate profit from its assets. Through this combination of variables, the study aims to provide a comprehensive overview of the relationship between sustainability practices, corporate governance, and financial performance.

Table 1. Variable Definitions and Measurements

Variable	Definition	Measurement	Scale	Source
Environmental Performance	The implementation of environmentally friendly technologies, eco-efficient processes, and sustainability-oriented environmental practices aimed at reducing environmental impacts and improving resource efficiency.	Environmental Performance is proxied by an Environmental Disclosure Index based on disclosures in annual or sustainability reports related to energy efficiency, waste reduction, renewable energy utilization, and green technology initiatives. A score of 1 is assigned if an item is disclosed and 0 otherwise. Environmental Disclosure Index = Σ disclosed items / total disclosure items.	Ratio	(Anmiao, 2025; Chen & Yang, 2023; Ruan et al., 2024)
Carbon Emission Disclosure	The extent to which firms disclose information related to carbon emissions, mitigation strategies, and environmental management policies.	Carbon Emission Disclosure (CED) Index based on GRI 305 indicators (305-1 to 305-7). Score 1 if the disclosure item is reported; 0 otherwise. Disclosure index = Σ disclosed items / total disclosure items.	Ratio	(Andriadi et al., 2023; Wahyuningrum et al., 2024; Yusuf & Setiawan, 2023)
Board Gender Diversity	The representation and participation of women within the board of directors and commissioners in corporate decision-making processes.	Proportion of female board members relative to total board members: $\text{BGD} = \frac{\text{Number of Female Board Members}}{\text{Total Board Members}}$	Ratio	(Đặng et al., 2023; Kouaib et al., 2024; Ma'wa & Setiawan, 2025; Yue et al., 2025)
Corporate Governance	The effectiveness of governance mechanisms reflected in board independence, oversight quality, accountability, and monitoring functions in safeguarding stakeholder interests and environmental responsibility.	Proportion of independent commissioners relative to total board commissioners. Governance effectiveness is also conceptually linked to board monitoring and environmental oversight practices.	Ratio	(Agnese et al., 2026; Luo et al., 2021; Mansour et al., 2025; Sobhan et al., 2025)
Financial Performance	The company's ability to generate earnings from its operational and asset utilization activities.	$\text{ROA} = \frac{\text{Net Income}}{\text{Total Asset}}$	Ratio	(Gabr & ElBannan, 2025; Liu & Yaacob, 2026; Lu et al., 2021)
Leverage	The extent to which a company finances its assets through debt relative to equity or total assets, reflecting the firm's financial risk and long-term solvency. Higher leverage indicates greater dependence on external financing and may influence managerial decisions regarding environmental investments and sustainability disclosure.	$\text{DAR} = \frac{\text{Total Liabilities}}{\text{Total Asset}}$	Ratio	(Gabr & ElBannan, 2025; Liu & Yaacob, 2026)
Firm Size	The overall scale of a company's operations, representing its economic capacity, resource availability, and market presence. Larger firms generally possess greater financial resources and are more likely to engage in environmental initiatives and sustainability reporting.	Firm Size = ln (Total Assets)	Ratio	(Kouaib et al., 2024; Mansour et al., 2025; Liu & Yaacob, 2026)

Source: As stated in the Table

Hypothesis Testing

The study incorporates important control variables, namely firm size, leverage, and industry classification, to improve model robustness and reduce omitted variable bias, consistent with prior sustainability and governance research (Bedi & Singh, 2024; Lina & Adelia, 2024; Meiryani et al., 2023). The regression model used in the analysis can be expressed as follows:

$$Y = \alpha + \beta_1 EP + \beta_2 CED + \beta_3 EI*BGD + \beta_4 CED*BGD + \beta_5 EI*CG + \beta_6 CED*CG + \varepsilon \quad \text{..... (1)}$$

Where:

Y = Financial Performance
α = Constant Value
β_1-β_6 = Regression Coefficient
EP = Environmental Performance
CED = Carbon Emission Disclosure
BGD = Board Gender Diversity
CG = Corporate Governance
ε = Error term

The empirical analysis was conducted using Partial Least Squares–Structural Equation Modeling (PLS-SEM) with WarpPLS 7.0. Although the study relies on observable archival indicators, PLS-SEM was selected because the model focuses on predictive relationships, simultaneous estimation of direct and moderating effects, and interaction analysis involving governance variables (Hair et al., 2017; Ghozali & Latan, 2014). The analysis included evaluation of measurement followed by structural model testing using path coefficients, R^2, Q^2, and moderation effect estimation. Board Gender diversity and corporate governance were specifically tested as moderating variables influencing the relationships between environmental strategies and financial performance, consistent with recent sustainability studies (Dohrmann et al., 2024; Hamoudah et al., 2024; Yue et al., 2025). To reduce potential endogeneity concerns, the study incorporated control variables, applied consistent sampling criteria, and relied on audited secondary disclosures to improve data reliability and minimize measurement bias. Nevertheless, the study acknowledges that the relatively short observation period may limit the ability to capture long-term sustainability impacts. Future studies are therefore encouraged to employ longer panel data periods and advanced econometric approaches to provide more robust causal inference

RESULTS AND DISCUSSION

Results

Statistics Descriptive

The descriptive statistics in Table 2 reveal that Environmental Performance, measured using an environmental disclosure index, shows an average value of 0.73 with moderate variability (SD = 0.30). This indicates that most firms demonstrate relatively strong environmental performance, although differences in sustainability practices remain evident across companies. Carbon Emission Disclosure (CED), measured using the GRI 305 disclosure index, records an average disclosure level of 0.64 with moderate variability (SD = 0.21).

Table 2. Description of Variables

Variable	N	Min	Max	Mean	Standard Deviation
Environmental Performance	354	0	1	0.73	0.30
Carbon Emission Disclosure	354	0	1	0.64	0.21
Board Gender Diversity	354	0	1	0.80	0.32
Corporate Governance	354	0.2	1	0.43	0.23
Financial Performance	354	-1.77	0.48	0.04	0.14
Firm Size	354	24.12	34.85	29.76	1.82
Leverage	354	0.05	2.11	0.56	0.41

Sources: Data Processed (2025)

While a substantial proportion of firms disclose carbon-related information, the extent of disclosure differs considerably, reflecting uneven transparency practices. Board Gender Diversity presents an average proportion of 0.32 with moderate dispersion (SD = 0.19), indicating that women occupy approximately one-third of board positions on average. Corporate Governance records a mean value of 0.43 with relatively low variability (SD = 0.23), suggesting that governance effectiveness among Indonesian listed firms remains moderately distributed. Financial Performance, proxied by Return on Assets (ROA), shows a small positive average value (mean = 0.04) with moderate dispersion (SD = 0.14), indicating variation in firms' profitability performance during the observation period. The control variables also demonstrate variation across firms. Firm Size, measured using the natural logarithm of total assets, records an average value of 29.76 with moderate dispersion (SD = 1.82), indicating differences in organizational scale and resource capacity among firms. Leverage presents an average value of 0.56 (SD = 0.41), reflecting varying levels of financial risk and dependence on external financing.

In addition, industry classification was incorporated as a categorical control variable to account for sectoral differences in environmental sensitivity, regulatory pressure, and sustainability reporting practices. The inclusion of firm size, leverage, and industry classification as control variables improves model robustness and minimizes omitted variable bias. These variables help ensure that the relationships between Environmental Performance, Carbon Emission Disclosure, Corporate Governance, Board Gender Diversity, and Financial Performance are not substantially influenced by firm-specific structural characteristics.

Structural Model Evaluation

Because the study employs observable archival indicators and single-item constructs, the analysis focused primarily on structural model evaluation rather than reflective outer-model assessment. Consequently, outer loading, Average Variance Extracted (AVE), composite reliability, and discriminant validity tests were not emphasized, as these measures are less appropriate for single-item observable variables and interaction terms in archival-data models (Hair et al., 2017). Accordingly, the study prioritizes structural relationship assessment rather than reflective construct validation. This approach helps avoid model misspecification and unrealistic validity statistics frequently associated with treating observable indicators as reflective latent constructs. The robustness of the proposed theoretical relationships was evaluated using adjusted R^2 and predictive relevance (Q^2) values**.**

Table 3. Inner Model Results

Variable	Adjusted R^2	Q^2
Financial Performance	0.388	0.312

Sources: Data Processed (2025)

The adjusted R^2 value of 0.388 indicates that Environmental Performance, carbon emission disclosure, corporate governance, gender diversity, and the interaction variables explain 38.8% of the variation in financial performance. This result suggests moderate explanatory power, indicating that additional factors outside the model may also influence corporate profitability. Furthermore, the Q^2 value above zero confirms the predictive relevance of the structural model.

Model Fit Assessment

Model fit was evaluated using four key indicators: Average Path Coefficient (APC), Average R-Squared (ARS), Average Adjusted R-Squared (AARS), and Average Block Variance Inflation Factor (AVIF). The APC, ARS, and AARS indicators are considered satisfactory when their p-values are ≤ 0.05, while AVIF values below 3.3 indicate the absence of multicollinearity issues (Ghozali & Latan, 2014). Table 4 shows these results. Overall, the findings suggest that the structural specification satisfies established model fit standards and shows no indication of problematic collinearity among constructs.

Table 4. Model Fit Test Results

APC	0.128, p value: 0.004
ARS	0.198, p value: 0.016
AARS	0.182, p value: 0.030
AVIF	1.181 ≤ 3.3

Sources: Data Processed (2025)

Hypothesis Testing

The hypothesis testing results in Table 5 indicate that Environmental Performance positively influences financial performance, supporting H1. Carbon Emission Disclosure also demonstrates a positive and significant effect on financial performance, supporting H2. These findings suggest that firms with stronger environmental accountability and greater transparency regarding carbon-related activities tend to achieve better profitability performance.

Table 5. Hypothesis Test Results

Variable	Path Coefficient	ρ value	Conclusion
Direct Effect			
Environmental Performance → Financial Performance	0.182	<0.001	H1 Accepted
Carbon Emission Disclosure → Financial Performance	0.240	<0.001	H2 Accepted
Indirect Effect			
Gender Diversity × Environmental Performance → Financial Performance	0.100	0.03	H3 Accepted
Gender Diversity × Carbon Emission Disclosure → Financial Performance	0.244	<0.001	H4 Accepted
Corporate Governance × Environmental Performance → Financial Performance	0.183	<0.001	H5 Accepted
Corporate Governance × Carbon Emission Disclosure → Financial Performance	0.182	<0.001	H6 Accepted

Sources: Data Processed (2025)

The moderating analysis further demonstrates that Board Gender Diversity strengthens the positive relationship between Environmental Performance and financial performance, as well as the relationship between Carbon Emission Disclosure and financial performance, supporting H3 and H4. Similarly, Corporate Governance significantly strengthens the positive effects of Environmental Performance and Carbon Emission Disclosure on financial performance, supporting H5 and H6. These findings confirm the importance of governance effectiveness and board diversity in enhancing the financial benefits of sustainability-oriented strategies.

Control Variable Effects

Based on Table 6, The control variable analysis indicates that Firm Size positively influences Financial Performance, suggesting that larger firms tend to possess stronger resource capacity, operational efficiency, and sustainability implementation capabilities. Meanwhile, Leverage demonstrates a negative relationship with Financial Performance, indicating that higher financial risk and greater dependence on external financing may reduce corporate profitability. Overall, these findings strengthen the robustness of the empirical model and confirm that the observed sustainability performance relationships remain significant after controlling for firm-specific characteristics.

Table 6. Control Variable Effects

Variable	Path Coefficient	ρ value	Conclusion
Firm Size → Financial Performance	0.154	0.012	Significant
Leverage → Financial Performance	-0.118	0.041	Significant

Sources: Data Processed (2025)

Discussion

Environmental Performance and Financial Performance

The findings indicate that Environmental Performance positively influences financial performance, suggesting that environmental initiatives function not merely as compliance mechanisms but as strategic capabilities that improve operational efficiency, corporate reputation, and long-term competitiveness. This result supports Stakeholder Theory, which emphasizes that firms responding effectively to stakeholder expectations regarding environmental responsibility are more likely to obtain legitimacy and sustainable economic benefits. The findings are consistent with prior international studies showing that environmentally responsible firms tend to achieve stronger profitability and investor confidence through improved sustainability orientation and resource efficiency (Anmiao, 2025; DH & MA, 2025; Tjahjadi et al., 2023). This result is consistent with Stakeholder Theory, which posits that firms must respond to stakeholder expectations, including environmental responsibility, to maintain legitimacy and ensure sustainability of performance (Donaldson & Davis, 1991; Freeman, 1984).

Empirically, this finding aligns with studies showing that Environmental Performance enhances operational efficiency and firm reputation (Jiang & Li, 2023) and supports evidence from emerging markets where environmental innovation improves access to sustainable financing and investor confidence (Anmiao, 2025; Gabr & ElBannan, 2025). However, international evidence remains mixed. Several studies report that Environmental Performance may initially reduce profitability due to high investment costs and technological transition burdens (Chen & Yang, 2023; Misra et al., 2023). This suggests that the financial effect of Environmental Performance is not automatic but depends on governance quality and organizational capability. In addition, a potential reverse causality issue exists, where firms with stronger financial performance are more capable of investing in Environmental Performance.

Therefore, the observed relationship should be interpreted as potentially bidirectional. In the Indonesian context, regulatory support and OJK sustainability initiatives also play an important role in transforming environmental performance into long-term financial value creation. In addition, reverse causality may exist because financially stronger firms generally possess greater resources to invest in environmental innovation and sustainability programs. Therefore, the relationship between Environmental Performance and financial performance should be interpreted as potentially bidirectional rather than purely one directional.

Carbon Emission Disclosure and Financial Performance

The results demonstrate that carbon emission disclosure positively affects financial performance, indicating that transparent environmental reporting enhances stakeholder trust, market legitimacy, and access to sustainability-oriented financing. This finding supports previous international evidence suggesting that carbon transparency strengthens firm reputation and reduces information asymmetry between firms and stakeholders (Lu et al., 2021; Zhang & Li, 2025). In emerging markets, investors increasingly consider environmental disclosure as an indicator of long-term corporate sustainability and risk management capability.

Nevertheless, prior studies also report contradictory findings because not all disclosure practices reflect substantive environmental commitment. Some firms engage primarily in symbolic disclosure aimed at satisfying regulatory pressure or maintaining legitimacy without implementing meaningful environmental improvements (Han et al., 2023; Liu & Yaacob, 2026). The findings of this

study, therefore emphasize that disclosure credibility and reporting quality are critical in determining whether carbon transparency generates real economic value. Within the Indonesian setting, disclosure practices remain heterogeneous across industries, particularly among high-emission sectors facing greater environmental scrutiny. Reverse causality may also occur because firms with superior financial performance are generally more capable of producing comprehensive sustainability reports and maintaining broader environmental transparency. Consequently, carbon disclosure should be understood both as a strategic communication mechanism and as an outcome influenced by firm resources and governance quality.

Environmental Performance on Financial Performance Moderated by Gender Diversity.

The findings further reveal that board gender diversity strengthens the positive relationship between Environmental Performance and financial performance. This result suggests that gender-diverse boards improve environmental oversight, strategic monitoring, and sustainability-oriented decision-making, thereby increasing the effectiveness of environmental initiatives. Prior international studies similarly demonstrate that female board representation contributes to stronger sustainability performance, broader strategic perspectives, and improved governance quality (Kouaib et al., 2024; Yue et al., 2025).

The moderating effect can be explained by the tendency of gender-diverse boards to reduce groupthink, enhance ethical sensitivity, and strengthen long-term risk evaluation in sustainability-related decisions. In Indonesia, where board diversity remains relatively limited, the presence of female directors may contribute additional perspectives that improve the strategic implementation of environmental programs. However, the effectiveness of gender diversity depends on whether board participation is substantive rather than symbolic. Therefore, firms should not treat gender diversity solely as a regulatory or reputational requirement but as a governance mechanism capable of improving the financial effectiveness of sustainability strategies

Carbon Emission Disclosure on Financial Performance Moderated by Board Gender Diversity

The results also indicate that board gender diversity strengthens the positive effect of carbon emission disclosure on financial performance. This finding implies that gender-diverse boards improve the credibility, transparency, and strategic value of sustainability reporting. Prior studies support this result by showing that female board representation enhances environmental accountability and disclosure quality (Ma'wa & Setiawan, 2025; Monica et al., 2021). Boards with broader demographic diversity are generally more responsive to stakeholder concerns and more attentive to reputational risk associated with environmental reporting. Consequently, firms with greater female representation tend to communicate sustainability information more transparently and consistently. In the Indonesian corporate environment, where disclosure quality varies substantially across firms, gender-diverse governance structures may strengthen stakeholder confidence in environmental reporting practices. Nevertheless, reverse causality concerns remain relevant because firms with stronger financial conditions may simultaneously adopt broader disclosure practices and appoint more diverse boards.

Environmental Performance on Financial Performance Moderated by Corporate Governance

Corporate governance is found to strengthen the relationship between Environmental Performance and financial performance, indicating that governance effectiveness plays a critical role in transforming environmental initiatives into measurable economic benefits. Strong governance mechanisms improve monitoring quality, strategic alignment, and managerial accountability, thereby reducing the likelihood that environmental programs become merely symbolic activities. This finding is consistent with international evidence showing that governance quality enhances the effectiveness of sustainability strategies and environmental innovation (Agnese et al., 2026; Dohrmann et al., 2024). In this study, governance quality is reflected primarily through board independence and monitoring effectiveness. Firms with stronger governance structures are generally more capable of supervising sustainability investments, managing environmental risks, and ensuring long-term strategic consistency. The Indonesian context further reinforces this finding because governance quality among listed companies remains heterogeneous, particularly regarding environmental oversight and sustainability accountability. Therefore, governance mechanisms become essential in ensuring that Environmental Performance contributes not only to legitimacy but also to sustainable financial value creation.

Carbon Emission Disclosure on Financial Performance Moderated by Corporate Governance

The findings further demonstrate that corporate governance strengthens the positive relationship between carbon emission disclosure and financial performance. This result indicates that governance quality enhances the reliability and credibility of environmental reporting, thereby increasing stakeholder confidence and the economic relevance of disclosure practices. Strong governance mechanisms, particularly independent oversight and effective monitoring systems, reduce opportunistic behavior and minimize the risk of symbolic disclosure or greenwashing. These findings align with prior international studies emphasizing that governance effectiveness improves carbon disclosure quality and strengthens the relationship between environmental transparency and corporate performance (Fahmi et al., 2025; Luo et al., 2024; Sobhan et al., 2025). In Indonesia, where sustainability disclosure standards are still evolving, governance quality becomes increasingly important in ensuring that environmental reporting reflects substantive environmental commitment rather than compliance-oriented behavior. However, reverse causality may also exist because firms with stronger financial performance often possess greater incentives and resources to implement stronger governance structures and broader environmental disclosure practices. Therefore, governance, disclosure, and financial performance should be understood as mutually reinforcing dimensions within corporate sustainability strategy.

CONCLUSION

This study provides empirical evidence on the relationship between Environmental Performance and Carbon Emission Disclosure (CED) toward financial performance, with Board Gender Diversity and Corporate Governance as moderating variables. The findings indicate that Environmental Performance and CED have a significant positive effect on financial performance, suggesting that firms' environmental strategies and transparency practices are not merely compliance mechanisms, but strategic resources that contribute to efficiency improvement, reputational gains, and long-term value creation. Furthermore, the moderating results show that both Board Gender Diversity and Corporate Governance strengthen the relationship between environmental variables and financial performance, indicating that governance structure plays a crucial role in determining whether sustainability initiatives translate into economic outcomes. From a theoretical perspective, this study extends Stakeholder Theory by demonstrating that firms' ability to respond to stakeholder environmental expectations enhances legitimacy, trust, and financial outcomes.

From a theoretical perspective, this study extends Stakeholder Theory by demonstrating that firms responding effectively to stakeholder expectations regarding environmental accountability are more likely to strengthen legitimacy, transparency, and financial outcomes. More importantly, this study reinforces Contingency Theory by confirming that the financial benefits of Environmental Performance and carbon disclosure are conditional rather than universal. Sustainability strategies generate stronger economic value when supported by effective governance structures, independent monitoring mechanisms, and diverse board composition. Accordingly, this study contributes to the sustainability and governance literature by emphasizing that governance quality and board diversity operate as important boundary conditions that determine whether environmental initiatives can be transformed into measurable financial benefits, particularly within emerging-market contexts such as Indonesia.

Practically, the findings imply that corporate managers should integrate environmental initiatives into long-term strategic planning rather than treating sustainability reporting as symbolic compliance. Firms with stronger governance mechanisms and more gender-diverse boards appear better positioned to convert environmental accountability into competitive advantage and improved financial performance. For investors, the findings suggest that environmental disclosure quality and governance effectiveness may serve as important indicators in evaluating long-term corporate sustainability and risk management. For regulators and policymakers, the study highlights the importance of strengthening sustainability reporting standards, governance enforcement, and environmental transparency

regulations to improve disclosure credibility and reduce symbolic reporting behavior in emerging markets.

Despite these contributions, several limitations should be acknowledged. First, this study faces potential endogeneity and reverse causality concerns, where firms with stronger financial performance may possess greater financial capacity to invest in Environmental Performance and provide more extensive carbon disclosures. Therefore, the observed relationships should be interpreted as potentially bidirectional. Second, the relatively short observation period may limit the ability to capture the long-term economic consequences of sustainability strategies. Third, the use of disclosure-based indices may not fully reflect the substantive quality of environmental innovation and carbon reporting practices, as some disclosures may remain compliance-oriented rather than performance-oriented. Fourth, although Corporate Governance and Board Gender Diversity were operationalized using commonly accepted quantitative proxies, these measures may not entirely capture deeper qualitative dimensions of governance effectiveness, board expertise, environmental awareness, and strategic monitoring quality.

Future research is therefore encouraged to employ longer longitudinal observation periods and more advanced econometric approaches, such as dynamic panel models or Generalized Method of Moments (GMM), to better address endogeneity concerns and causal relationships. Further studies are also recommended to distinguish between symbolic and substantive environmental disclosure practices to better evaluate the actual economic impact of sustainability reporting. In addition, future research may expand Environmental, Social, and Governance (ESG) measurements using multidimensional indicators that capture governance quality, environmental innovation intensity, and board sustainability expertise more comprehensively. Comparative studies across emerging and developed markets are also recommended to provide stronger external validity and deeper understanding regarding how institutional environments shape the effectiveness of environmental strategies and governance mechanisms in improving financial performance.

List of Abbreviations

IDX	:	Indonesia Stock Exchange
EP	:	Environmental Performance
CED	:	Carbon Emission Disclosure
BGD	:	Board Gender Diversity
ESG	:	Environment, Social, Governance
BGD	:	Board Gender Diversity
GRI	:	Global Reporting Index
CG	:	Corporate Governance
FP	:	Financial Performance
OJK	:	Financial Services Authority of Indonesia
PLS-SEM	:	Partial Least Squares Structural Equation Modelling
AVE	:	Average Variance Extracted
APC	:	Average Path Coefficient
ARS	:	Average R-Squared
AARS	:	Average Adjusted R-Squared
AVIF	:	Average Block Variance Inflation Factor

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work the author(s) used Chat GPT in order to support content organization, academic language improvement, paraphrasing, and preliminary literature synthesis. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article

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Authors' Contribution

RY conceptualized the study, developed the theoretical framework, and drafted and revised the manuscript. H contributed to the research methodology, data analysis, and interpretation of the results. SJ assisted with data collection, preliminary data processing, and the preparation of the literature review section. All authors have read and approved the final version of the manuscript.

Conflict of Interest

The authors declare no competing interests.

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Availability of Data and Materials

The data used in this study were obtained from annual reports and sustainability reports of companies listed on the Indonesia Stock Exchange and are publicly available. The data and supporting materials are available from the corresponding author upon reasonable request.

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