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Implementation of Corporate Social Responsibility (CSR) in Improving Environmental Performance and its Impact on Green Accounting and Green Innovation

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ABSTRACT

This study was conducted to examine the effect of CSR implementation on environmental performance and to examine its impact on green accounting and green innovation. The research method used a quantitative approach with secondary data obtained from annual reports and sustainability reports of manufacturing companies in Indonesia listed on the Indonesia Stock Exchange (IDX) for the 2020-2024 period. Sampling was conducted using purposive sampling, obtaining 325 companies as samples. The analysis results show that CSR implementation has a significant positive effect on environmental performance but does not affect green accounting or green innovation. Green accounting has been shown to have a significant effect on environmental performance and acts as a mediator between CSR and environmental performance, while green innovation does not show a significant effect either directly or indirectly. These findings confirm that the improvement in environmental performance of manufacturing companies is more supported by the integration of CSR with green accounting practices, while the contribution of green innovation is still not optimal.

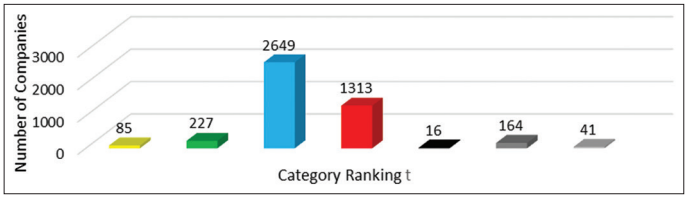
Keywords: Corporate Social Responsibility, Green Accounting, Green Innovation, Implementation, Environmental Performance
JEL Classifications: M14, M41, Q55, Q56

1. INTRODUCTION

Environmental sustainability issues are increasingly becoming a major focus in global and national economic development. Companies are required to pursue not only financial profit but also to maintain environmental sustainability and social welfare through the principles of Corporate Social Responsibility (CSR). In Indonesia, environmental issues such as air pollution, industrial waste, and declining water quality are increasing from 2020 to 2025 along with the intensification of industrial activities and weak enforcement of environmental regulations (Darsono et al., 2024; Hasan et al., 2024). Although the government has implemented various environmental policies, their effectiveness remains questionable, as evidenced by the results of the Environmental Management Performance Rating Program (PROPER). The 2023-2024 PROPER rating for 4,495 companies was determined through Decree of the Minister of Environment/Head of the Environmental Control Agency Number 129 of 2025 concerning the Results of the Environmental Management Performance Rating Assessment for 2023-2024 is shown in the Figure 1.

The data above shows that 85 companies received the best rating, namely the gold rating, 227 companies received the green rating, meaning they were beyond compliance, and 2,649 companies received the blue rating, meaning they were compliant as a safe limit ranking (passing grade). Meanwhile, there were still 1,313 factories with a red rating, meaning they were not yet compliant, and 16 companies were not compliant. It can be seen that most companies are ranked blue or compliant, but there are still quite a number that are in the red category or not yet compliant. The

Figure 1: Results of the 2023-2024 PROPER assessment



Source: Ministry of Environment and Forestry (KLKH), 2025

gold and green ratings, which reflect the best performance in environmental management, are still relatively small compared to the total number of companies assessed. Therefore, it is necessary to examine the extent to which CSR implementation can improve environmental performance. CSR increases green innovation, which in turn improves company performance (Aftab et al., 2024). Environmental commitment, green innovation, and environmental management accounting contribute to improved company performance (Somjai et al., 2020). CSR is increasingly viewed as a critical component of green accounting implementation, supporting sustainable development goals (Prahara and A'yuni, 2021). These findings underscore the importance of integrating CSR, green innovation, and environmental management practices for sustainable business growth and environmental management.

CSR plays a central role in encouraging companies to be more proactive in environmental management. CSR is no longer merely a philanthropic activity, but has become part of a business strategy that integrates social and environmental concerns into company operations (Niazi et al., 2023). Effective CSR implementation has been shown to positively impact corporate environmental performance, both directly and through the mediation of green innovation and green accounting systems (Xu et al., 2022). Previous studies confirmed that CSR encourages the development of internal company capabilities such as green intellectual capital (Asiaei et al., 2023), green human resource management (Zhou and Zhao, 2023), and green technology innovation (Bag et al., 2024a), which ultimately impacts the achievement of environmental sustainability.

On the other hand, green accounting is an important tool for integrating environmental information into financial reporting. Green accounting not only serves as a reporting instrument but also supports strategic decision-making based on environmental data (Bhat et al., 2024). Green accounting enables companies to calculate environmental costs transparently and accurately, significantly impacting operational efficiency and more environmentally friendly technological innovation (Simmou et al., 2023). This is in line with the findings of Fang et al., (2022), stated that companies that adopt green accounting have higher levels of environmental compliance and resource efficiency. Meanwhile, green innovation is a crucial driver in industrial decarbonization efforts. Green innovation not only creates new economic value through energy efficiency and waste reduction but also serves as a strategic response to environmental regulations and increasingly environmentally conscious market demands (Cheng et al., 2025).

Recent research has explored the relationship between corporate social responsibility (CSR), environmental performance, green accounting, and financial results. CSR implementation has been found to have a positive impact on environmental performance through green innovation mechanisms (CNAWP et al., 2023). Green accounting and environmental performance can influence financial performance, with CSR potentially mediating this relationship (Handoko and Santoso, 2023). However, findings on the direct impact of green accounting on CSR disclosure are mixed (Azizah and Cahyaningtyas, 2023). CSR practices positively influence green innovation and environmental performance (Kraus et al., 2020a), (Shahzad et al., 2020). Furthermore, sustainable development and green innovation strategies strengthen the relationship between CSR and environmental performance (Sarfraz et al., 2023). Green accounting has a positive impact on environmental performance and CSR disclosure (Ratmono et al., 2023). Green behavior mediates the relationship between CSR and firm performance, leading to sustainable competitive advantage (Abubakar et al., 2022). This finding is consistent across various manufacturing sectors in developing countries, including Indonesia, China, Malaysia, and Pakistan (Gazi et al., 2024). In emerging markets, CSR and green finance have a positive impact on environmental performance through green innovation (Dai et al., 2022).

However, there is still a gap in understanding about how the interaction between CSR, green accounting, and green innovation can collectively strengthen environmental performance, especially in developing countries like Indonesia (Rahman and Islam, 2023). Therefore, this study will examine the relationship between CSR implementation and environmental performance and its role in encouraging the adoption of green accounting and green innovation. Unlike previous studies, which tended to examine the relationship between these variables partially, (Rehman et al., 2022), this study attempts to build a conceptual framework that integrates these four components simultaneously.

2. LITERATURE REVIEW AND DEVELOPMENT HYPOTHESES

2.1. Theoretical Foundations

2.1.1. Stakeholder theory

Stakeholder Theory, as proposed by Freeman (1998), is a theoretical framework stating that companies are not solely responsible to shareholders, but also to all stakeholders affected by the company's activities, such as consumers, employees, the community, the government, and the environment. This theory emphasizes that the long-term sustainability of a company depends heavily on the extent to which the company is able to pay attention to and balance the interests of these various parties. In practice, stakeholder theory encourages companies to incorporate sustainability principles into their business strategies, including in decision-making regarding environmental policies, green innovation, and the implementation of green accounting as a form of broader ecological and social responsibility (Freeman, 1998).

The application of stakeholder theory is reflected in the practices of Corporate Social Responsibility (CSR), green innovation, and green accounting, which serve as strategic tools to respond to

stakeholder pressure. Several studies have shown that stakeholders, such as the public and regulators, demand transparency and accountability in environmental impact management, which encourages companies to implement CSR effectively and in-depth (Dai et al., 2022). This external pressure also encourages companies to adopt green accounting as a sustainability reporting tool (Gazi et al., 2024), and to develop green innovation to improve resource efficiency and reduce emissions. (Rahman and Islam, 2023). Thus, stakeholder theory serves as a basis for understanding how stakeholder expectations guide companies toward improving environmental performance through various managerial and strategic approaches.

2.1.2. Legitimacy theory

Legitimacy Theory explains that companies are not only responsible to shareholders but also to the wider community, which provides social legitimacy for their existence. This theory states that the sustainability of a company's operations depends heavily on the extent to which the company can align its activities with societal values, norms, and expectations (Suchman, 1995). In the modern context, legitimacy is achieved by demonstrating corporate accountability and transparency, particularly in environmental and social areas. Therefore, companies tend to adopt corporate social responsibility (CSR) policies, green accounting practices, and green innovation to gain public support and maintain their institutional legitimacy (Gazi et al., 2024). The application of legitimacy theory can be seen in the tendency of companies to strategically disclose CSR activities as a form of social and environmental accountability. As explained by Niazi et al. (2023), good CSR disclosure reflects a company's efforts to meet societal expectations regarding sustainability. Zhou et al. (2023) and Dai et al. (2022) add that environmental reporting through green accounting is a key tool for companies to maintain public legitimacy, especially amid regulatory pressure and consumer awareness of environmental issues. Green accounting allows companies to communicate their ecological impacts measurably and strengthens the perception that they are responsible for sustainability. Even in the industrial sector, Rehman et al. (2022) show that legitimacy can be built through alignment between corporate strategy and national environmental policies.

2.1.3. Environmental performance

Environmental performance is a measure that reflects a company's effectiveness and efficiency in managing the environmental impacts of its operational activities. This performance indicates the extent to which a company is responsible for maintaining ecological balance, reducing pollution, and using natural resources sustainably. According to Hasan et al. (2024), environmental performance encompasses a company's ability to meet environmental standards, whether set by the government, industry, or community expectations. Gazi et al. (2024) add that this performance is not only a technical indicator but also a strategic measure that influences a company's legitimacy, reputation, and sustainability.

Environmental performance can be measured through various quantitative and qualitative indicators. Zhou et al. (2023) identified key indicators such as greenhouse gas (GHG) emission levels, energy and water consumption efficiency, the volume of hazardous waste managed, and the use of environmentally friendly materials in production processes. Fang et al. (2022) stated that international standards such as ISO 14001 and the Global Reporting Initiative (GRI) Environmental Indicators can be used as references in assessing a company's environmental achievements. Meanwhile, Alnaim and Metwally (2024) underscored the importance of disclosing environmental information in sustainability reports as part of a transparent environmental performance evaluation.

2.1.4. Corporate social responsibility (CSR)

Corporate Social Responsibility (CSR) is a concept in which companies consciously and voluntarily carry out their social responsibilities to contribute to sustainable development, including social, economic, and especially environmental aspects. According to Abro et al. (2024), CSR is not only a form of compliance with regulations, but is part of a company's strategy to build harmonious relationships with stakeholders and gain social legitimacy. This is also emphasized by Hasan et al. (2024), who stated that CSR reflects the company's ethical values in creating a positive impact on the community and environment in which the company operates. In an environmental context, CSR becomes a strategic instrument in encouraging companies to actively contribute to addressing environmental problems such as climate change, land degradation, and industrial pollution (Cheng et al., 2025).

CSR can be measured through various indicators, both quantitative and qualitative. One commonly used approach is based on the Global Reporting Initiative (GRI) framework, specifically in the environmental and social categories. Frequently measured indicators include: the amount of CSR funds allocated to environmental and social programs, involvement in conservation activities, annual sustainability reporting, the existence of a social responsibility policy, and local community involvement (Fang et al., 2022). According to Bhat et al. (2024), CSR disclosure in a company's annual report can be a valid measurement tool, especially when linked to the ISO 26000 standard or ESG (Environmental, Social, and Governance) reporting guidelines.

2.1.5. Green accounting

Green accounting is an accounting approach that integrates financial and environmental information into a company's reporting system, with the aim of systematically measuring, managing, and disclosing the impact of economic activities on the environment. This concept arose from the global urgency of corporate sustainability and environmental responsibility, as well as the need for transparency regarding environmental costs that are often hidden in conventional financial reports (Pratiwi and Hidayah, 2023). Green accounting serves as a strategic management tool that helps companies evaluate the efficiency of natural resource utilization and their contribution to environmental conservation, while strengthening social and economic legitimacy before stakeholders (Wati et al., 2024).

In practice, green accounting refers to the process of recording and reporting environmental costs such as waste management, energy use, recycling, emissions mitigation, and environmental rehabilitation (Alnaim and Metwally, 2024; Ratmono et al., 2023).

Reporting models used can include disclosure of environmental costs in financial statements, integration of environmental management accounting (EMA), or reporting within the Environmental, Social, and Governance (ESG) framework and sustainability reports (Rahim et al., 2022). The Material Flow Cost Accounting (MFCA) approach is also increasingly being adopted to identify inefficient material and energy flows in the production process (Nadhifah and Kartika, 2025).

2.1.6. Green innovation

Green innovation is a company's innovative strategy specifically aimed at reducing negative environmental impacts through the development of environmentally friendly products, processes, technologies, and business models. Green innovation is not only part of a company's sustainability strategy but also serves as a response to stakeholder demands, environmental regulatory pressures, and the company's internal drive to create long-term value sustainably (Wang and Gualberto, 2024). This concept combines an innovative orientation with ecological awareness, making it a crucial foundation for the green development agenda and the transition to a low-carbon economy.

In general, green innovation is divided into several dimensions: green product innovation (development of environmentally friendly products), green process innovation (modification of production processes for efficiency and waste reduction), green managerial innovation (sustainability-based managerial practices), and green marketing innovation (marketing strategies based on environmental values) (Liu et al., 2021). These dimensions enable companies to design comprehensive strategies that not only improve ecological performance but also create competitive differentiation in the market. Green innovation is measured in various studies using quantitative and qualitative indicators. Commonly used indicators include: the number of patents or environmentally friendly technologies produced, the amount of investment in green R and D, the rate of adoption of sustainable technologies, waste or emission reduction, and increased energy efficiency (Bao and Nguyet, 2025; Pérez and Galindo, 2025).

2.2. Hypothesis Development

2.2.1. The influence of CSR on green accounting

CSR implemented by companies can strengthen the role of green accounting and green innovation in improving corporate environmental performance. Green accounting provides a tool for measuring and reporting the environmental impacts of a company's operational activities, which in turn can motivate companies to adopt environmentally friendly innovations (Lusiana et al., 2021). According to Legitimacy Theory (Suchman, 1995), companies need to gain legitimacy from society to continue operating, especially in social and environmental aspects. In this context, green accounting practices become an important means of demonstrating accountability and transparency on environmental issues as a form of CSR implementation. Meanwhile, Stakeholder Theory (Freeman, 1998) emphasized that companies must meet the expectations of all stakeholders, including in terms of environmental impact reporting. Well-executed CSR has the potential to encourage the development of a green accounting system as an environmental accounting tool that measures, records, and reports sustainability activities more accurately.

Several previous studies support a positive relationship between CSR and green accounting. Dai et al. (2022) stated that companies active in CSR tend to develop environmental accounting reporting systems as a form of transparency and accountability for sustainability. Gazi et al. (2024) also found that CSR plays a significant role in encouraging the integration of green accounting into corporate reporting structures. Zhou et al. (2023) emphasized that the existence of strong CSR improves the quality of environmental reporting through structured green accounting. Furthermore, (Niazi et al., 2023) stated that strategic CSR implementation increases the likelihood of companies adopting environmentally-based reporting practices. Rahman and Islam (2023) reinforced these findings by stating that CSR encourages companies to develop systems for measuring the impact of sustainability activities through green accounting as a form of public responsibility. Based on the above theories and findings, the following hypothesis can be formulated:

H_1: Corporate Social Responsibility (CSR) has a significant influence on Green Accounting.

2.2.2. The influence of CSR on green innovation

CSR also serves as a driving force for companies to implement green innovation. Through CSR, companies are expected to adopt environmentally friendly technologies that can reduce negative impacts on the environment. CSR focused on sustainability encompasses not only emission reduction and energy efficiency policies but also encourages companies to develop and implement greener innovations in their production processes and products. Research by Marietza and Nadia (2021) revealed that CSR integrated with green innovation can result in long-term operational cost savings and provide a competitive advantage in a market increasingly concerned with environmental issues.

Several previous studies have confirmed the positive relationship between CSR and green innovation. Xu (2022) found that CSR can create an organizational culture that supports environmentally friendly innovation. Dai et al. (2022) demonstrated that CSR implementation focused on carbon reporting can encourage low-emission technology innovation. Niazi et al. (2023) emphasized that CSR plays a crucial role in building an organizational climate conducive to green innovation, particularly through responsible resource management. Rahman and Islam (2023) also stated that strategic CSR can enhance a company's capacity for sustainable innovation, particularly in industrial sectors facing high environmental pressure. Furthermore, Niazi et al. (2023) explained that integrating CSR into a company's business strategy can create an internal drive for sustainability-based innovation to address environmental challenges. Based on these theoretical foundations and empirical findings, the following hypotheses can be proposed:

H_2: Corporate Social Responsibility (CSR) has a significant influence on Green Innovation.

2.2.3. The influence of CSR on environmental performance

CSR in the manufacturing sector often focuses on implementing policies that can mitigate negative environmental impacts, such

as reducing carbon emissions, improving waste management, and more efficient energy use. Companies that implement CSR effectively are expected to achieve better environmental performance by minimizing pollution and preserving the environment. Companies with environmentally-based CSR programs often report reduced greenhouse gas emissions and reduced natural resource use (Pamungkas et al., 2024).

Many previous studies support the positive influence of CSR on environmental performance. For example, Zhou et al. (2023) found that CSR significantly impacts companies' environmental efficiency through environmentally friendly initiatives. Gazi et al. (2024) emphasized that companies actively engaging in CSR programs demonstrate better environmental performance because they consider sustainability as part of their business strategy. Rahman and Islam (2023) showed that corporate social responsibility strengthens environmental conservation practices, which in turn improves ecological efficiency. Xu et al. (2022) revealed that CSR strengthens commitment to reducing environmental impacts through the implementation of programs relevant to climate and conservation issues. Furthermore, Bhat et al. (2024) also stated that CSR is a crucial driver for companies to adopt environmental management principles in their operations. Based on these theoretical foundations and empirical results, the following hypotheses can be formulated:

H_3: Corporate Social Responsibility (CSR) has a significant influence on Environmental Performance.

2.2.4. The influence of green accounting on environmental performance

Research shows that companies that effectively implement green accounting tend to have better environmental performance, leading to cost savings and increased long-term profitability. Green accounting can identify opportunities for energy efficiency, waste reduction, and better natural resource management, all of which can reduce a company's operating costs (Marietza and Nadia, 2021). Furthermore, green accounting provides investors and other stakeholders with better information about a company's environmental impact, which can improve investment decisions and increase the company's market value (Lusiana et al., 2021).

Several studies support a positive relationship between green accounting and environmental performance. Rahman and Islam (2023) asserted that implementing green accounting can improve the effectiveness of environmental management through accurate measurement of environmental costs. Gazi et al. (2024) stated that green accounting encourages companies to undertake environmental innovation and improve their management of ecological impacts. Alnaim and Metwally (2024) found that companies that consistently implement green accounting are able to reduce pollution levels and increase energy efficiency. Darsono et al. (2024) also revealed that environmental accounting systems assist companies in making environmentally friendly decisions and improving ecological performance. Furthermore, Zhou et al. (2023) showed that integrating green accounting into a company's reporting system strengthens internal control over environmental activities and has a positive impact on environmental performance. Based on these theories and empirical evidence, the following hypotheses can be proposed:

H_4: Green Accounting has a significant influence on Environmental Performance.

2.2.5. The impact of green innovation on environmental performance

Green innovation plays a crucial role in improving a company's environmental and financial performance. By adopting more environmentally friendly technologies and processes, companies can reduce carbon emissions, conserve energy, and better manage waste, which in turn improves their environmental performance (Ratmono et al., 2023). Furthermore, green innovation can also reduce operational costs and increase profitability, which in turn contributes to a company's overall financial performance. Green innovation has significant potential to improve environmental performance through emission reductions, energy efficiency, the use of environmentally friendly raw materials, and more efficient waste management. This innovation is not only a response to external pressures such as regulations or consumer demands, but also an internal corporate strategy to achieve long-term sustainability.

Several previous studies support a positive and significant relationship between green innovation and environmental performance. Xu et al. (2025) showed that green innovation increases resource efficiency and significantly reduces environmental impacts. Dai et al. (2022) emphasized that green innovation in production processes can improve environmental performance and help companies comply with environmental regulations. Rahman and Islam (2023) also found that companies investing in green technology and process innovation are better able to manage waste and emissions effectively. Niazi et al. (2023) stated that green innovation contributes significantly to reducing a company's carbon footprint and achieving sustainability goals. Meanwhile, Bhat et al. (2024) added that green innovation not only improves environmental efficiency but also strengthens a company's image as a socially and ecologically responsible organization. Based on these theories and empirical evidence, the following hypotheses can be developed:

H_5: Green Innovation has a significant influence on Environmental Performance.

2.2.6. Green accounting is able to mediate between CSR and environmental performance

Stakeholder Theory states that companies are obligated to meet stakeholder expectations, including in terms of social and environmental responsibility. In this regard, CSR serves as a manifestation of a company's commitment to social and ecological sustainability. Meanwhile, Legitimacy Theory emphasizes the importance of companies maintaining legitimacy in the public eye through concrete actions that can be accounted for transparently, one of which is through environmentally oriented reporting practices, such as green accounting.

Several studies support the ability of green accounting to mediate the relationship between CSR and environmental performance.

Gazi et al. (2024) stated that CSR is a key driver of green accounting implementation, which then results in improved environmental reporting and management. Rahman and Islam (2023) found that companies with a strong CSR commitment tend to develop green accounting systems that can improve environmental efficiency. Zhou et al. (2023) emphasized that CSR integrated into an environmental-based reporting system strengthens green accounting practices, which have a positive impact on environmental sustainability. Alnaim and Metwally (2024) also stated that green accounting practices serve as a transition mechanism between CSR values and environmental performance. Meanwhile, Bhat et al. (2024) emphasized that green accounting can bridge CSR commitments toward more environmentally friendly operational sustainability. Based on this theoretical foundation and empirical support, the following hypotheses can be formulated:

H_6: Green Accounting significantly mediates between Corporate Social Responsibility (CSR) and Environmental Performance.

2.2.7. Green innovation is able to mediate between CSR and environmental performance

Stakeholder theory emphasizes that companies must meet stakeholder expectations, including environmental concerns, through meaningful CSR activities. In this context, CSR becomes a strategic tool that can encourage companies to develop green innovation, namely innovation in environmentally friendly products, processes, or technologies. Legitimacy theory supports this argument by stating that companies need to demonstrate tangible environmental responsibility to maintain social legitimacy one way of doing this is through green innovation that improves environmental performance.

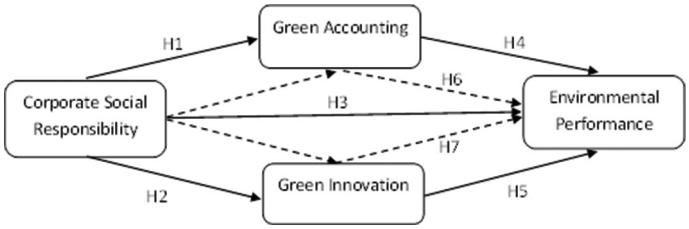
Several studies support the argument that green innovation can mediate the relationship between CSR and environmental performance. Rahman and Islam (2023) showed that CSR influences green innovation, which in turn leads to better environmental management. Niazi et al. (2023) found that CSR integrated into a company's managerial system can trigger green innovation as a bridge to improving environmental performance. Niazi et al. (2023) stated that strategic CSR fosters a culture of environmental innovation that ultimately supports a company's ecological performance. Xu et al. (2022) concluded that CSR activities encourage green innovation, which in turn improves environmental reputation and efficiency. Dai et al. (2022) also stated that the success of CSR in improving environmental performance is greatly influenced by the company's capacity to implement environmentally friendly innovation as its operational strategy. Based on theoretical support and the research results, the following hypotheses can be developed:

H_7: Green Innovation is significantly able to mediate between Corporate Social Responsibility (CSR) and Environmental Performance.

Based on the hypothesis above, a research model can be described as follows:

Figure 2 shows a research model that links the influence of CSR implementation on financial performance mediated by green accounting and green innovation.

Figure 2: Research model



3. RESEARCH METHODOLOGY

3.1. Research Design

This research is a quantitative research, where the data used is secondary data derived from the annual financial reports of manufacturing companies listed on the Indonesia Stock Exchange (IDX) and included in the Company Performance Rating Assessment Program (PROPER) in Environmental Management for 5 consecutive years from 2020 to 2025.

The population used in this study is all manufacturing companies listed on the Indonesia Stock Exchange (IDX) and participating in PROPER. While the research sample is manufacturing companies listed on the IDX and participating in PROPER during the 2020-2024 period. The researcher used a purposive sampling technique for sampling, which is a technique based on predetermined criteria (Ma and Qin, 2022). The sample criteria in this study are as follows: (1) Manufacturing companies listed on the IDX for the 2020-2024 period consecutively. (2) Companies reporting financial reports consecutively in the 2020-2024 period. (3) Companies participating in PROPER in Environmental Management consecutively for the 2020-2024 period. (4) Companies disclosing CSR for the 2020-2024 period consecutively. Based on these research criteria, 325 samples were collected. The IDX was chosen as the object of research because it plays an important role in economic and financial development. Therefore, the IDX needs to consider sustainable operations, including sustainability reporting (Siregar et al., 2024).

3.2. Operational Research Variables

The operational definitions in this study can be seen or explained further in Table 1.

3.3. Data Analysis Method

This study uses quantitative analysis with direct correlation tests using Stata software. The panel regression model used includes three equations:

$$GA_{it} = \alpha + \beta 1 CSR_{it} + \varepsilon \quad \text{Model 1}$$

$$GI_{it} = \alpha + \beta 2 CSR_{it} + \varepsilon \quad \text{Model 2}$$

$$EP_{it} = \alpha + \beta 3 CSR_{it} + \beta 4 GA_{it} + \beta\ 5 GI_{it} + \varepsilon \quad \text{Model 3}$$

Information:

EP_{it} = Environmental Performance i year t
α = Constant
β = Regression coefficient of independent variable
CSR_{it} = Corporate Social Responsibility of company i in year t

Table 1: Operational definitions

No	Variables	Definition	Measurement	Source
1	Corporate Social Responsibility (CSR)	A concept that emphasizes corporate awareness and volunteerism in carrying out social responsibilities to support sustainable development, covering social, economic and especially environmental dimensions.	GRI (Global Reporting Initiative) Index	(Darsono et al., 2024)
2	Environmental Performance	A measure of a company's performance in minimizing negative impacts on the environment, such as emissions, waste, and energy use.	PROPER scale (1-5) from the Ministry of Environment and Forestry of the Republic of Indonesia (KLHK RI)	(Darsono et al., 2024)
3	Green Accounting	An accounting approach that combines financial and environmental data in company reports, with the aim of systematically assessing, controlling and presenting the impact of economic activities on the environment.	$GA = \frac{\text{Environmental Management Cost}}{\text{Net profit}}$	(Andrian and Pangestu, 2022)
4	Green Innovation	Updates to environmentally friendly processes and products to improve environmental performance.	Dummy: 1 If has patent, 0 If does not have patent	(Rauf et al., 2024)

Source: Processed data

GA_{it} = Green Accounting of company i in year t
GI_{it} = Green Innovation i year t
ε = error

Data analysis was conducted in three stages. First, descriptive statistics were used to describe the characteristics of the research variables. Second, panel data regression was conducted with model selection using the Chow test, the Hausman test, and the Lagrange Multiplier test. Third, hypothesis testing included the F test, the t test, the coefficient of determination (R^2), and the Sobel test to identify indirect effects.

4. RESULTS AND DISCUSSION

4.1. Description of Research Objects

The research object used is manufacturing companies listed on the Indonesia Stock Exchange (IDX) for the period 2020-2024. The population in this study is all manufacturing companies listed on the Indonesia Stock Exchange (IDX), while the sample is manufacturing companies listed on the Indonesia Stock Exchange (IDX) for the period 2020-2024. The sampling criteria used purposive sampling, resulting in a sample size of 36 companies over the 5-year observation period 2020-2024. The results of the research sample determination can be seen in the following table:

In Table 2, it can be seen that the number of samples that meet the criteria is 65 companies, so that over 5 years there are 325 data.

Table 2: Determination of research samples

No	Sample Criteria	Amount
1	Manufacturing companies listed on the IDX during the 2020-2024 period	156
2	Manufacturing companies that did not report financial reports consecutively in the 2020-2024 period	(5)
3	The company did not follow PROPOER in Environmental Management for the 2020-2024 Period	(70)
4	Companies that did not disclose CSR for the 2020-2024 period	(16)
Number of Samples		65
Number of Data (65×5)		325

Source: Processed data

Table 3: Descriptive statistics

Variable	Obs	Mean	Standard Deviation	Min	Max
CSR	325	0.194	0.089	0.033	0.494
GA~g	325	0.021	0.133	−1.381	0.918
GI~n	325	0.018	0.135	0	1
EP~n	325	3.123	0.258	1.827	4.289

Source: Processed

4.2. Analysis Results

4.2.1. Descriptive statistics

The first step in data analysis is descriptive statistical testing, which is conducted to understand the distribution of data from the research sample collected to answer and test the hypothesis. The following are the results of the descriptive statistics:

The results of the descriptive statistical analysis in Table 3 show that the average level of Corporate Social Responsibility (CSR) implementation in the sample companies was 0.194 with relatively low variation, while Green Accounting and Green Innovation had a fairly wide distribution of values, indicating heterogeneity between companies. The average environmental performance was at 3.123, indicating a fairly good level of environmental achievement for manufacturing companies.

4.2.2. Model selection test and classical assumption test

The next step is to test the model selection through three calculation methods, namely the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). From the results of the Chow Test, a probability value of 0.950 is obtained which is >0.05, therefore it is concluded that the common effect model is more suitable to use than the fixed effect model. Next, the Hausman Test is carried out, a probability value of 0.976 is obtained which is >0.05, therefore it is concluded that the random effect model is more suitable to use than the fixed effect model. Next, the Lagrange Multiplier Test is carried out, a probability value of 1 is obtained which is >0.05, therefore it is concluded that the common effect model is more suitable to use than the fixed effect model. Based on these three tests, it can be concluded that the common effect model is the most suitable model to use.

Next, a classical assumption test was performed to ensure that the independent variables, as estimators of the independent

variables, are unbiased. Overall, it can be concluded that the residual data is normally distributed, with no multicollinearity, no heteroscedasticity, and no autocorrelation. This ensures that the regression model meets the requirements for further estimation.

4.2.3. Panel data regression results

Panel data opens up opportunities for deeper analysis of variable dynamics, both over time and between entities.

The results of the panel data analysis in Tables 4-6 show that CSR has no significant effect on Green Accounting or Green Innovation, although the regression coefficients are positive, at 0.009 and 0.071, respectively. Conversely, in the regression model involving Environmental Performance, CSR and Green Accounting are proven to have a positive and significant effect with coefficients of 0.619 and 1.012, respectively. This indicates that the higher the implementation of CSR and Green Accounting practices, the better the company's environmental performance. Meanwhile, Green Innovation, although having a positive coefficient (0.022), does not have a significant effect on Environmental Performance. Thus, it can be concluded that the role of CSR in improving environmental performance is stronger when mediated through Green Accounting, while the contribution of Green Innovation is not proven to be significant in this research model.

4.2.4. Hypothesis testing

The results of the simultaneous test (F Test) show that the independent variables together do not have a significant effect on Green Accounting or Green Innovation, indicated by the significance values of 0.911 and 0.389, respectively, which are greater than 0.05. In contrast, in the model that tests Environmental Performance, a significance value of 0.000 is obtained which is smaller than 0.05 with an R^2 of 0.318. This means that collectively, the CSR, Green Accounting, and Green Innovation variables are able to explain 31.8% of the variation in Environmental Performance. Thus, it can be concluded that the simultaneous influence of independent variables is only significant on Environmental Performance, while it is not proven to have an effect on Green Accounting or Green Innovation.

The results of the Partial Test (t-Test) measure the influence of each independent variable on the dependent variable separately.

Based on the partial test results in table 7, the CSR variable on Green Accounting shows a significance value of 0.912 (>0.05), so it has no significant effect and the first hypothesis (H_1) is rejected. The same thing also occurs in the relationship between CSR and Green Innovation in Table 8 with a significance value of 0.390 (>0.05), which means it has no significant effect so the second hypothesis (H_2) is rejected. On the other hand, in the Environmental Performance model Table 9, the CSR variable has a significance value of 0.000 (<0.05), so it has a significant effect and the third hypothesis (H_3) is accepted. Likewise, the Green Accounting variable with a significance value of 0.000 (<0.05), is proven to have a significant effect on Environmental Performance, so the fourth hypothesis (H_4) is accepted. Meanwhile, Green Innovation obtains a significance value of 0.799 (>0.05), so it has no significant effect on Environmental Performance, and the fifth hypothesis (H_5) is rejected.

Table 4: Regression model 1

GA~g	Coefficient	Standard Error	t	P>|t|	[95% Confidence Interval]	
CSR	0.009	0.082	0.11	0.912	−0.152	0.171
_cons	0.019	0.017	1.11	0.269	−0.015	0.054

Source: Processed

Table 5: Regression model 2

GI~n	Coefficient	Standard Error	t	P>|t|	[95% Confidence Interval]	
CSR	0.071	0.083	0.86	0.390	−0.092	0.236
_cons	0.004	0.017	0.25	0.800	−0.030	0.039

Source: Processed

Table 6: Regression model 3

EP~n	Coefficient	Standard Error	z	P>|z|	[95% Confidence Interval]	
CSR	0.619	0.132	4.67	0.000	0.359	0.880
GA	1.012	0.089	11.30	0.000	0.836	1.187
GI	0.022	0.088	0.25	0.799	−0.150	0.195
_cons	2.980	0.028	104.97	0.000	2.925	3.036

Source: Processed

Table 7: t-test model 1

GA~g	Coefficient	Standard Error	t	P>|t|	[95% Confidence Interval]	
CSR	0.009	0.082	0.11	0.912	−0.152	0.171
_cons	0.019	0.017	1.11	0.269	−0.015	0.054

Source: Processed

Table 8: t-test of model 2

GI~n	Coefficient	Standard Error	t	P>|t|	[95% Confidence Interval]	
CSR	0.071	0.083	0.86	0.390	−0.092	0.236
_cons	0.004	0.017	0.25	0.800	−0.030	0.039

Source: Processed

Table 9: t-test of model 3

EP~n	Coefficient	Standard Error	z	P>|z|	[95% Conf. Interval]	
CSR	0.619	0.132	4.67	0.000	0.359	0.880
GA	1.012	0.089	11.30	0.000	0.836	1.187
GI	0.022	0.088	0.25	0.799	−0.150	0.195
_cons	2.980	0.028	104.97	0.000	2.925	3.036

Source: Processed

Table 10: Sobel test

Variables	Sobel	Prob	Information
CSR -> Green Accounting -> Environmental Performance	4.315	0.000	Hypothesis accepted
CSR -> Green Innovation -> Environmental Performance	0.249	0.802	Hypothesis rejected

Source: Processed

The results of the mediation test using the Sobel Test in Table 10 show that CSR has a significant effect on Environmental Performance through Green Accounting (P = 0.000), so the sixth hypothesis (H_6) is accepted. However, CSR does not have a significant effect on Environmental Performance through Green Innovation (P = 0.802), so the seventh hypothesis (H_7) is rejected.

4.3. Discussion

4.3.1. The influence of CSR on green accounting

Based on the results of the research analysis that has been carried out, the CSR variable does not have a significant effect on Green Accounting, thus the first hypothesis (H_1) is rejected. These results indicate that companies' CSR initiatives are not yet strong enough to influence the implementation of environmentally-based accounting practices. Theoretically, CSR serves as a moral and strategic foundation that encourages companies to be more socially and ecologically responsible, including in the aspect of reporting and recording environmental activities through green accounting (Wang et al., 2025). However, when CSR is not yet integrated into the internal reporting system and focuses more on external activities such as philanthropy or image-based CSR, its influence on green accounting becomes insignificant.

These findings align with research by Fang et al. (2022), which states that CSR implementation in some companies tends to be ceremonial and not yet linked to an environmentally-based recording and reporting system. Gazi et al. (2024) also found that green accounting implementation is more influenced by regulatory pressure and encouragement to comply with environmental reporting standards, rather than solely by corporate CSR awareness. However, these findings contradict research by Lusiana et al. (2021) and Bhat et al. (2024), which show that CSR has a positive influence on green accounting when it is integrated into a company's holistic management system. They argue that companies that strategically adopt CSR tend to develop robust environmental reporting systems to support transparency, accountability, and stakeholder engagement. Research by Gazi et al. (2024) also supports this positive relationship, emphasizing that CSR linked to sustainability will encourage the adoption of green accounting practices to measurably monitor environmental performance.

4.3.2. The influence of CSR on green innovation

Based on the results of the research analysis that has been conducted, the CSR variable does not have a significant influence on Green Innovation, thus the first hypothesis (H_2) is rejected. These results indicate that CSR practices carried out by companies have not been sufficiently internalized to encourage the formation of green innovation. Green innovation itself includes company efforts to create environmentally friendly products, processes, and technologies to reduce negative impacts on the environment and support resource efficiency (Xu et al., 2022). CSR should be a strategic foundation for cultivating an innovative culture that cares about the environment. However, when CSR implementation is only symbolic or focuses on philanthropic activities without addressing operational and technological aspects, CSR is unable to trigger the transformation towards green innovation (Rahman and Islam, 2023).

These findings align with research by (Xu et al., 2022) and (Rahman and Islam, 2023), which revealed that CSR has not fully impacted green innovation because it is still largely focused on social activities and does not address the innovative dimension. (Bhat et al., 2024) also highlighted that CSR is often not integrated into a company's innovation management system, thus weakening its impact on green innovation. However, these findings differ from a study by (Niazi et al., 2023), which stated that CSR significantly influences green innovation when integrated through a resource orchestration approach and a sustainability-based corporate strategy. (Dai et al., 2022) also stated that CSR based on emissions transparency and long-term commitments can be a key driver of low-carbon innovation. Similarly, (Leniwati et al., 2023) showed that CSR can enhance a company's innovative capabilities if it is grounded in sustainability values and developed through corporate policies that support green innovation.

4.3.3. The influence of CSR on environmental performance

Based on the results of the research analysis that has been carried out, the CSR variable has a positive and significant effect on Environmental Performance, thus the third hypothesis (H_3) is accepted. This result indicates that the higher a company's commitment to social responsibility, the better its environmental performance. Strategically implemented CSR can encourage companies to implement pro-environmental policies, better manage waste, reduce emissions, and use natural resources efficiently, ultimately improving overall environmental performance (Kraus et al., 2020b).

This research aligns with the findings of a study by Bhat et al. (2024), which found that CSR drives improvements in environmental performance through the adoption of an integrated sustainability system. Zhou et al. (2023) also confirmed that strategically designed CSR can lead to strengthening corporate environmental responsibility. Research by Bag et al. (2024b) added that CSR serves as a catalyst for organizational behavioral change, directly impacting environmental efficiency and reducing negative impacts on ecosystems. However, there are also studies that disagree, such as that by Owusu et al. (2024), which found that even when CSR is implemented, its impact on environmental performance can be minimal if not supported by a measurable environmental reporting and evaluation system. In some cases, CSR tends to be used as a marketing or image tool, resulting in an insubstantial impact on a company's ecological performance.

4.3.4. The influence of green accounting on environmental performance

Based on the results of the research analysis that has been carried out, the Green Accounting variable has a positive and significant effect on Environmental Performance, thus the fourth hypothesis (H_4) is accepted. These results indicate that green accounting has a positive and significant impact on environmental performance, indicating that implementing accounting practices that take environmental aspects into account can directly strengthen a company's ecological performance. Green accounting encourages transparency in recording environmental costs, pollution control, energy use, and investment in green technology. When companies are able to measure and report the environmental impact of their

operational activities, it is easier to manage, monitor, and improve their performance sustainably (Gazi et al., 2024).

This research aligns with findings by Bhat et al., 2024, which revealed that *green accounting* practices can improve environmental compliance and encourage companies to achieve sustainability targets. Similarly, Gazi et al., 2024, emphasized that green accounting plays a role in identifying the hidden costs of environmental damage and enabling companies to establish more environmentally friendly internal policies. Zhou et al., 2023, also showed that integrating green accounting into management systems can reduce inefficiencies and improve long-term environmental performance. However, several studies do not fully support these findings. Niazi et al., 2023, noted that the impact of green accounting on environmental performance can be weakened if a company lacks adequate information systems or if its implementation is merely symbolic. Xu, 2023, also stated that *green accounting* is often hampered by a lack of clear regulations and implementation standards, making its impact on environmental performance less significant in some industrial contexts.

4.3.5. The impact of green innovation on environmental performance

Based on the results of the research analysis that has been conducted, the Green Innovation variable does not have a significant effect on Environmental Performance, thus the fifth hypothesis (H_5) is rejected. This result reflects that the existence of green innovation in a company does not necessarily automatically result in real improvements to the company's ecological performance. Although green innovation includes innovative efforts in products, processes, and technologies to reduce environmental impacts, its effectiveness depends greatly on the extent to which these innovations are implemented comprehensively, consistently, and oriented towards long-term sustainability (Xu et al., 2022).

These results align with research by (Bhat et al., 2024) which states that green innovation not supported by long-term strategy and commitment tends not to have a significant impact on improving environmental performance. (Xu et al., 2022) also suggest that green innovation still faces obstacles in various sectors, particularly in terms of integration into strategic environmental management. (Hussain et al., 2022) add that implementing green innovation without synergy with environmental management systems or without performance measurement targets will be difficult to show concrete results. However, these findings contradict several other studies. (Dai et al., 2022) and (Gazi et al., 2024) found that green innovation can significantly improve a company's environmental performance through process efficiency, waste reduction, and the adoption of environmentally friendly technologies. (Altassan, 2024) further emphasized that green innovation is a key driver for corporate sustainability transformation, especially in the manufacturing sector.

4.3.6. Green accounting is able to mediate between CSR and environmental performance

Based on the results of the research analysis that has been carried out, the CSR variable has a positive and significant effect on Environmental Performance through Green Accounting, thus the sixth hypothesis (H_6) is accepted. These results demonstrate that sound CSR practices not only directly contribute to social and environmental issues but also play a role in strengthening environmental reporting and management systems through a green accounting approach. This confirms that CSR internalized within a company's management processes can be a significant driver of green accounting implementation, ultimately improving environmental performance (Dai et al., 2022).

This research aligns with previous findings, such as those presented by (Simmou et al., 2023) and (Ulupui et al., 2020), that CSR plays a significant role in encouraging the development of a robust green accounting system. Their study showed that companies with high levels of CSR are more likely to implement comprehensive environmental reporting systems, ultimately improving the effectiveness of environmental management. (Niazi et al., 2023) also stated that strategically implemented CSR can create economic and ecological value by strengthening green accounting practices. Conversely, some studies suggest that the relationship between CSR and green accounting is not always significant. (Ramadhani et al., 2022) and (Nurrasyidin et al., 2024) highlight that in some contexts, CSR is still carried out symbolically or for reputational purposes, thus not fully promoting a credible environmental accounting system. However, these differences are generally influenced by contextual factors such as the level of regulation, organizational readiness, and the company's sustainability culture.

4.3.7. Green innovation is able to mediate between CSR and environmental performance

Based on the results of the research analysis that has been carried out, the CSR variable does not have a significant effect on Environmental Performance through Green Innovation, thus the seventh hypothesis (H_7) is rejected. These results indicate that corporate social responsibility initiatives have not yet been fully internalized and systematically promoted environmentally friendly innovation to achieve improved environmental performance. Although CSR reflects a company's commitment to social and ecological aspects, CSR activities may not yet be focused on developing environmental innovation capacity, such as the development of clean technologies, green production processes, or increased energy efficiency that have a direct impact on reducing pollution and environmental damage (Simmou et al., 2023), (Kraus et al., 2020b), and (Zain et al., 2024).

These findings align with a study by Homayoun et al., 2023, which showed that CSR in many companies remains ineffective in driving green innovation, primarily due to a lack of integration between sustainability strategies and technological or operational innovation processes. They emphasized that green innovation requires internal policy support such as incentives, research investment, and human resource training, which may not be achieved solely through CSR programs. Bhat et al., 2024 also stated that many CSR activities fail to address the technical aspects necessary to generate green innovation. However, these findings contradict studies by Niazi et al., 2023 and Dai et al., 2022, which

found that CSR can be an important driver of green innovation, especially when it is understood as an integral part of corporate strategy and not merely an external activity. In this context, strategic CSR can increase internal environmental awareness and encourage companies to allocate resources to create more environmentally friendly products and processes. Niazi et al., 2023 even showed that companies that make CSR a core strategy tend to be more innovative in developing sustainable solutions.

5. CONCLUSION AND SUGGESTIONS

Based on the research results and discussions that have been conducted, it can be concluded that Corporate Social Responsibility (CSR) has been proven to have a positive and significant effect on environmental performance, which means that the higher the company's commitment to implementing social responsibility, the better the environmental performance achieved. However, CSR does not have a significant effect on green accounting or green innovation, so that the CSR activities carried out tend to be external and philanthropic, not yet optimally integrated with the environmental reporting system or research and development of green innovation. Furthermore, green accounting has been proven to have a positive and significant effect on environmental performance because environmental reporting practices can help companies in making more appropriate management decisions, while green innovation does not have a significant effect on environmental performance, possibly due to the lack of implementation of green innovations that focus on environmental aspects. In addition, the results of the study also confirm that green accounting is able to mediate the effect of CSR on environmental performance, indicating that the integration of CSR with environmental accounting practices will strengthen its positive impact on corporate environmental performance. Conversely, green innovation is not able to mediate the relationship between CSR and environmental performance, so that without real green innovation, the contribution of CSR to environmental sustainability cannot be maximized.

Based on the research findings and limitations, several suggestions can be put forward for future research and practice. Future research is recommended to include other variables, such as institutional factors, organizational culture, or government regulations, to enrich the analytical model of the relationship between CSR, green accounting, green innovation, and environmental performance. Furthermore, expanding the sample to different industrial sectors or across countries, as well as using a longer observation period, will provide a more representative picture of the dynamics of the influence of CSR and green innovation over the long term. From a methodological perspective, the use of mixed methods or a qualitative approach through in-depth interviews with company managers can complement the quantitative results obtained. Practically, companies need to strengthen the implementation of green accounting, as it has been proven to contribute significantly to environmental performance, while simultaneously improving the quality and effectiveness of green innovation to truly support sustainability. Furthermore, government support through regulations and incentives, such as fiscal policies and awards for environmental achievements, is also essential to encourage increased CSR practices and green innovation at the company level.

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