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Highlighting the Strategic Value of Green Process Innovation in the Basic Materials Sector

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Abstract

As awareness of environmental and social issues increases, responsible business practices, such as green accounting, Corporate Social Responsibility (CSR) disclosure, and green process innovation, are increasingly recognized for their role in creating long-term value. This study aims to empirically examine the impact of three sustainability initiatives (green accounting, CSR disclosure, and green process innovation) on company profitability in the basic materials sub-sector listed on the Indonesia Stock Exchange (IDX) during the 2020-2024 period. Green accounting and CSR disclosure have not been proven to have a significant impact on company profitability. However, different findings were found for green process innovation, which showed a positive and significant effect on profitability. This implies that companies' efforts to integrate innovative practices that reduce environmental impacts into their operational processes tend to correlate with improved financial performance. Green process innovation has been empirically proven to have a positive influence, as it can serve as a source of competitive advantage that is difficult to imitate (inimitable), thereby driving profitability. Companies should allocate more resources to developing green process innovations, such as energy efficiency, waste recycling, and low-emission technologies. Investments in R&D and collaborations with third parties can be effective strategies for accelerating innovation.

Keywords: Green Process Innovation, Green Accounting, Corporate Social Responsibility, Profitability.

1. Introduction

Companies should ideally focus not only on profit but also on social responsibility towards people, culture, and the planet, the environment (Alim & Puji, 2021). Indonesia has Law No. 32 of 2009 concerning Environmental Protection and Management, which guarantees the right of all citizens to live in a clean and healthy environment (Dewi & Wardani, 2022). Social and environmental issues are crucial for companies, as they can negatively affect life in general and therefore require the attention of all parties (Suryaningsih et al., 2024). Geologists worldwide have noted that Indonesia has one of the world's largest nickel deposits, leading to increased nickel exploitation since 2014 (Verselita, 2025).

To increase state revenue, Indonesia has banned nickel ore exports since 2020. According to a study by CREA and CELIOS, nickel exports are expected to reach US$34 billion (Rp 532 trillion) in 2022, up from US$4 billion (Rp 62.8 trillion) in 2017. However, these profits come at a cost to health, the environment, and people's livelihoods. Environmental degradation from nickel processing leads to declines in water, soil, and air quality, with potential losses for fishermen and farmers totaling approximately Rp 3.64 trillion over the next 15 years (Jasmine, 2024).

One of the state-owned companies, PT Timah (Persero) Tbk, is incurring losses to the state amounting to IDR 271 trillion. This comprises environmental damage valued at IDR 157.83 trillion, environmental-related economic losses of IDR 60.28 trillion, environmental restoration costs of IDR 5.26 trillion, and losses outside the forest of IDR 47.70 trillion. The consequences of these illegal activities not only damage the environment in the mining area but also threaten the ecosystem outside the mine site, thereby creating broader environmental and economic problems for the nation (Sidik, 2024). The 2024 incident involving PT Timah Tbk is a primary concern in this study, as it highlights the potential risks and dynamics that affect profitability.

In pursuit of maximum profits, many companies exploit natural resources without considering the environmental impacts and recovery efforts (Wedari & Alfian, 2024). One way to increase profitability within the dynamics of company management is to build a positive public image (Suryaningsih et al., 2024). Green accounting is a method that integrates the environmental impact of an event into financial statements (Nurrasyidin et al., 2024). Green accounting provides information that supports decision-making, thereby helping reduce commercial risk costs and create added value (Refalina et al., 2024). According to a study by Suryaningsih et al. (2024) and Chasbiandani et al. (2019), green accounting has a positive impact on company profitability. Indirectly, this not only contributes to building positive value for stakeholders but also enhances the company's trust and image among consumers, which in turn has the potential to increase profitability (Endiana et al., 2020).

CSR implementation is a long-term investment that can help companies manage and mitigate social risks while strengthening their public image (Laksmi & Hasri, 2022). According to Lindawati & Puspita (2015), Laksmi & Hasri (2022), and Kholmi & Nafiza (2022), CSR disclosure within a company serves as a form of communication to stakeholders, including investors and potential investors, regarding the company's future business prospects. Furthermore, this disclosure can add value to the company by demonstrating its concern for the economic, social, and environmental impacts of its operations.

For companies, implementing environmentally friendly practices is a crucial factor in building public trust and enhancing competitive advantage. In the context of environmental degradation, green innovation is realized through reducing pollution in business processes, designing more environmentally friendly products, and implementing sustainability-oriented management systems. This includes improving production systems and processes to minimize adverse environmental impacts, such as reducing pollution and increasing energy efficiency (Wedari & Alfian, 2024). The implementation of green process innovation improves a company's economic performance by producing environmentally friendly products that capture public and consumer attention (Cahyaningsih & Ihromi, 2024). Previous research, reviewed by Wedari & Alfian (2024) and Xie et al. (2019), on the relationship between green process innovation and profitability indicates that green process innovation positively affects profitability.

As explained in previous research, Return on Assets (ROA) is adopted as a profitability indicator because it reflects a company's efficiency in generating profits from its total assets (Suryaningsih et al., 2024). In the context of this research, the implementation of green accounting, CSR disclosure, and green process innovation is expected to increase ROA by reducing environmental costs, enhancing consumer image and trust, and increasing production process efficiency. Therefore, ROA is not only a financial indicator but also reflects the market's and stakeholders' responses to a company's sustainability strategy. The basic materials sector was selected for this study because the material processing process can have a direct impact on the environment, including waste accumulation and ecosystem damage (Muflihah & Pamungkas, 2024). The selection of companies in the basic materials sector as the research object was based on their high environmental impact from operational activities. The high level of natural resource exploitation makes this sector a primary contributor to environmental problems, including carbon emissions, industrial waste, and pollution, which directly affect the ecosystem and the lives of communities surrounding the company's operational areas.

A notable contribution of this study is the inclusion of green process innovation as a variable in the analysis of factors influencing company profitability. This research also seeks to identify which green aspect of the company can affect profitability. The results of this study are expected to serve as an academic reference for future researchers interested in exploring similar topics, particularly in the context of sustainable business practices. This research is expected not only to provide scientific contributions but also to encourage more responsible and sustainable business practices.

"Which specific green aspect—green process innovation or other operational practices—most significantly drives company profitability?" This question is essential because, despite broad advocacy for sustainability, managers lack clear, empirical evidence that green initiatives directly impact financial performance, making this study necessary to move from theoretical endorsement to strategic prioritization. The novelty of our research lies in its direct comparative analysis that positions green process innovation as a central, measurable variable influencing profitability. This focus moves beyond generic sustainability claims to provide actionable insights for businesses seeking to align environmental responsibility with economic gain, thereby filling a critical gap between theory and practice.

2. Literature Review

2.1. Legitimacy and Stakeholder Theory

Legitimacy theory was initially systematically explained by Dowling & Pfeffer (1975), who stated that organizational legitimacy is a condition in which there is harmony between the various social values associated with organizational activities and the behavioral norms accepted within a broader social system. When this harmony is threatened, the organization can face social, legal, and economic sanctions. Legitimacy theory posits that companies have an obligation to prioritize moral principles in their operations and to encourage greater social and environmental responsibility, thereby fostering societal acceptance and trust. Legitimacy theory also suggests that, for society to accept them, companies must consistently prioritize transparency in their social actions to ensure their continued existence (Suryaningsih et al., 2024). According to Laksmi & Hasri (2022), legitimacy theory is employed by organizations or business entities to disclose information, thereby enhancing the company's image as one that operates responsibly and in accordance with various social norms, thereby gaining social legitimacy in the eyes of the public.

Stakeholder theory, initially proposed by Freeman (1984), holds that a company is responsible not only to its shareholders but also to all parties who can influence or be influenced by the company's activities, collectively referred to as stakeholders. In this view, a company is seen as a collection of relationships among various interest groups, including employees, customers, suppliers, communities, and investors. According to Suryaningsih et al. (2024), stakeholder theory is a set of practices and principles that examine stakeholders, legal requirements, morality, environmental and social issues, and the business community's commitment to sustainable development. Stakeholders are not only investors or creditors, but also the environment as an aspect of the ongoing dynamics of the social order (buyers, communities, governments, trade associations, workers, and so on), with the primary goal of helping company management maximize the value generated from decisions taken and minimize the possibility of losses for interested parties.

2.2. Profitability

A high level of profitability reflects the effectiveness of management in managing its business operations (Fauzan & Salira, 2022). As a primary indicator, profit is used by stakeholders to gauge management's effectiveness in the company's operations. A company's ability to generate profit can be analyzed and measured through its financial statements, including the return on assets (ROA) ratio (Suryaningsih et al., 2024).

2.3. Green Accounting

According to Lako (2018), green accounting is a process that encompasses the measurement, recognition, recording, summarization, and reporting of information in an integrated manner. This approach is believed to be the foundation for sustainable economic development that upholds social justice, both within and across generations. The development of green accounting focuses not only on quantitative economic growth but also emphasizes the quality of growth that positively impacts the economy, the environment, and the social welfare of the community.

2.4. Corporate Social Responsibility (CSR)

CSR is a tangible manifestation of corporate responsibility in contributing sustainably to society and the environment. More than just a social obligation, CSR can also be viewed as a long-term investment strategy aimed at minimizing and managing social risks while simultaneously building a positive corporate image in the public eye. One concrete application of CSR is community development and empowerment programs, which not only improve social welfare but also strengthen the company's long-term position (Laksmi & Hasri, 2022).

2.5. Green Process Innovation (GPI)

Green process innovation refers to changes and improvements in production systems aimed at reducing negative environmental impacts, such as conserving energy, recycling waste, and preventing pollution (Cahyaningsih & Ihromi, 2024). As environmental awareness increases, pressure from consumers and environmental groups is pushing companies to implement more environmentally friendly processes in their operations and management. This innovation involves modifying or adopting new technologies within company processes to minimize pollution and waste contamination, although this requires significant investment. However, these high costs can yield greater effectiveness than conventional approaches (Wedari & Alfian, 2024). Green process innovation also aims to reduce energy consumption during production, optimize resource utilization, minimize air and water emissions, and promote the transition from fossil fuels to renewable energy sources, such as bioenergy. Through this strategy, companies not only achieve cost efficiencies but also sustainable competitive advantages and increased profitability (Xie et al., 2019).

2.6. Previous Research

Previous studies have shown mixed findings regarding the influence of green accounting, CSR, and green process innovation on company profitability. Suryaningsih et al. (2024) found that green accounting and CSR influence company profitability. This study employed a quantitative approach, using a population of companies that were included in the Jakarta Islamic Index and listed on the Indonesia Stock Exchange (IDX) for the period from 2017 to 2021. These results align with the study by Putri et al. (2023), which also confirmed the positive influence of green accounting implementation and CSR disclosure on company profitability and value. This is further reinforced by Dewi & Wardani's (2022) research findings, which indicate that green accounting and CSR disclosure have a partially positive, significant effect on company profitability. Nurrasyidin et al. (2024) found different results, stating that CSR and green accounting variables did not show a significant relationship with company profitability. This study also identified limitations, including a small sample size and the inability to control for other variables that may impact profitability.

Research by Chasbiandani et al. (2019) supports previous findings that green accounting and environmental performance positively impact company profitability. Kholmi & Nafiza (2022) also found different results: green accounting did not affect profitability, whereas CSR did. Furthermore, Laksmi & Hasri (2022) stated that CSR disclosure (CSRD) had a positive and significant effect on ROE, but not on EPS. Studies related to green process innovation also provide relevant findings, such as those expressed by Xie et al., (2019), who concluded that green process innovation has a positive impact on green product innovation, and both can improve a company's financial performance. Similar findings were reported by Wedari & Alfian (2024), who stated that breakthroughs in green process innovation are positively associated with profitability. However, green product innovation does not have a significant effect. Finally, research by Cahyaningsih & Ihromi (2024) confirmed that environmental accounting disclosure, green process innovation, and environmental management accounting positively influence a company's economic performance.

2.7. Hypothesis Development

Green accounting is an accounting approach that integrates environmental costs and impacts into a company's financial statements, thereby acknowledging its responsibility for environmental sustainability (Suryaningsih et al., 2024). Through green accounting, companies can identify hidden environmental costs, such as waste recycling, pollution control, and environmental rehabilitation, enabling management to make more efficient asset management decisions (Chasbiandani et al., 2019). This efficiency will result in increased net profit generated from optimal asset utilization, thereby increasing ROA. Based on stakeholder theory, companies are expected to fulfill the interests of capital owners and be responsible to other parties, such as the government, society, and the environment (Suryaningsih et al., 2024). The implementation of green accounting demonstrates a company's commitment to cost efficiency and sustainable resource governance, ultimately supporting its internal financial performance. This reasoning is supported by studies by Chasbiandani et al. (2019), Suryaningsih et al. (2024), and Dewi & Wardani (2022), which indicate that green accounting positively influences company profitability by enhancing operational efficiency through control over environmental costs. The higher the quality of green accounting implementation, the greater the likelihood that a company will achieve higher profitability.

H_1: Green accounting has a positive impact on profitability.

CSR is a manifestation of a company's responsibility for the environmental and social impacts of its business activities, as demonstrated through sustainable social, environmental, and economic programs (Laksmi & Hasri, 2022). CSR implementation fosters social stability, employee loyalty, and operational efficiency in production processes and management. The effects can be felt directly through reduced unforeseen costs and increased internal company productivity, thereby increasing profits generated from total assets, or in other words, increasing ROA (Kholmi & Nafiza, 2022). From the perspective of stakeholder theory, companies are not only responsible to shareholders but also to the surrounding community, customers, and the government (Suryaningsih et al., 2024). Proper CSR implementation will strengthen a company's social legitimacy and create a conducive environment for long-term operations, which impacts asset-efficiency-based financial performance. Several previous studies have demonstrated that CSR has a significant impact on profitability. Findings from studies by Laksmi & Hasri (2022), Dewi & Wardani (2022), and Kholmi & Nafiza (2022) concluded that CSR has a positive impact on profitability.

H_2: CSR has a positive impact on profitability.

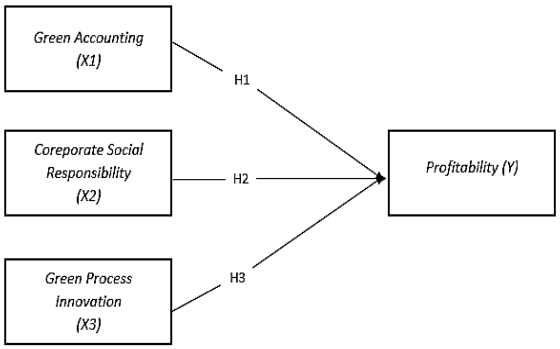

Figure 1. Variables framework

GPI is an innovation in production and operational processes that aims to reduce environmental impact through efficient energy use, waste reduction, and the use of environmentally friendly raw materials (Wedari & Alfian, 2024). This innovation benefits companies by reducing production costs and increasing productivity, as business processes become more efficient and sustainable (Cahyaningsih & Ihromi, 2024). This directly increases company profits from the use of existing assets, thereby boosting ROA. According to legitimacy theory, companies that innovate in environmentally friendly processes will gain legitimacy from the community and stakeholders because they are considered responsible for their environmental impacts (Suryaningsih et al., 2024). This legitimacy can support more stable operations and minimize external risks,

enabling companies to manage their assets and generate profits optimally. Research by Xie et al. (2019), Wedari & Alfian (2024), and Cahyaningsih & Ihromi (2024) indicates that green process innovation significantly enhances a company's financial performance by improving process efficiency and resource management. Therefore, companies that consistently implement GPI actually have higher profitability.
H_3: GPI has an impact on profitability.

3. Methods

This quantitative research utilizes secondary data obtained from annual reports and company sustainability reports, as well as the results of the PROPER rating assessment for the 2020-2024 period, published by the Ministry of Environment and Forestry of the Republic of Indonesia. The sample in the study were basic materials sub-sector companies listed on the IDX with a purposive sampling technique, using the following criteria: 1) Basic materials sub-sector companies listed on the IDX in 2020-2024; 2) Companies in the basic materials sub-sector that have published complete annual reports and have complete data related to the variables studied during the 2020-2024 period; 3) Companies that use the Rupiah currency in their financial reports, and 4) Companies registered with PROPER 2020-2024. The test was conducted using Eviews. A series of analysis stages were conducted, including the regression model estimation test, classical assumption tests, t-tests (partial), F-tests (simultaneous), and analysis of the coefficient of determination (R^2), to ensure the validity and reliability of the findings.

The dependent variable (Y) is profitability. Profitability is a crucial indicator of a company's sustainability and development prospects. Profitability is a ratio used to assess overall management effectiveness, measured by the level of profit earned in relation to sales and investments. A higher profitability ratio indicates a company's ability to generate higher profits. Profit reflects a company's overall performance, specifically the net profit generated during a given period from its operations. The related profit results from various business transactions conducted during that period. According to Suryaningsih et al. (2024), profitability is proxied using Return on Assets (ROA), calculated from net income divided by total assets.

Green accounting (X_1) has evolved into a crucial tool for businesses seeking to mitigate the risks associated with sustainable development and their impact on financial statements. Implementing green accounting, coupled with environmental performance, particularly through participation in the PROPER program organized by the Ministry of Environment and Forestry of the Republic of Indonesia, is crucial. Green accounting utilizes a ranking categorization based on the Environmental Decree (Suryaningsih et al., 2024).

Corporate Social Responsibility (CSR) demonstrates a company's commitment to making long-term contributions to society and the environment. CSR in this study is measured using 89 indicators based on the GRI Standards Guidelines (Ananda et al., 2023), and the measurement is carried out using the following formula: CSR Ij = ∑xij/nj. For each disclosure item, a score of 1 or 0 is assigned. A score of 1 is given if the company discloses the CSR item, and a score of 0 is given if the company does not disclose the CSR item.
Where:
CSR Ij: Company CSR index,
Nj : Total number of CSR disclosure items set,
Σ XIj: Number of CSR items actually disclosed by the company.

Green Process Innovation (X_3) involves a company's efforts to transform its business operations to be more environmentally friendly. GPI, according to (Cahyaningsih & Ihromi, 2024), is measured using the following ratio: GPI = ((Energy Expense + Raw Material Cost)it – (Energy Expense + Raw Material Costs)it-1) / Sales-1

4. Result

4.1. Descriptive Statistics

Based on the output in Table 1, the profitability variable (ROA), the ratio of net profit to total assets, has a minimum value of -4.901678, a maximum of 12.99221, an average of 4.345940, and a standard deviation of 3.611163. The Green Accounting variable, proxied by the PROPER rating, has a minimum value of 2.000000, a maximum value of 5.000000, an average of 3.461538, and a standard deviation of 0.811575. The CSR disclosure variable, measured using the disclosure index based on the GRI Standard, ranges from 0.168539 to 0.977528, with an average of 0.511495 and a standard deviation of 0.205278. Then, the Green Process Innovation (GPI) variable, measured using the GPI Ratio, has a minimum value of -0.458715, a maximum of 0.370490, an average of 0.012846, and a standard deviation of 0.144317.

Table 1. Descriptive result

	Y	X_1	X_2	X_3
Mean	4.3459	3.4615	0.5114	0.0128
Maximum	12.9922	5.0000	0.9775	0.3704
Minimum	-4.9016	2.0000	0.1685	-0.4587
Std. Dev.	3.6111	0.8115	0.2052	0.1443
Jarque-Bera	0.2084	3.8701	2.6389	20.1864

4.2. Model Test

The results of the Chow test show that the probability value (Prob.) for Cross-section F is 0.0111, which is <0.05, so the model selected in this test is the Fixed Effect Model (FEM), and it can be concluded that the FEM model is more appropriate than the Common Effect Model (CEM). The Hausman test results show a probability value (Prob.) for the random cross-section of 0.8913, which is greater than 0.05. This indicates that the model selected in this test is the Random Effect Model (REM). Thus, it can be concluded that the REM model is more suitable than the FEM, and it will be employed as the estimation model in further testing. The Hausman test results show a probability value (Prob.) for the Breusch-Pagan cross-section of 0.0109, which is less than 0.05. This indicates that the selected model in this test is REM. Thus, it can be concluded that the REM model is more suitable than FEM, and it will be employed as the estimation model in further testing.

4.3. Classical Assumption

According to Napitupulu et al. (2021), if the selected model is REM, there is no need to test or address issues with classical assumptions, as the Generalized Least Squares (GLS) method is already employed. Therefore, this study does not include an autocorrelation test.

Based on Figure 2, the results of the normality test are shown in the standardized residual histogram and the Jarque-Bera statistic. The Jarque-Bera value is 0.331162 with a probability value (p-value) of 0.847401 > 0.05. This indicates that the residuals in the regression model are normally distributed. In addition, the skewness value of -0.128775, which is close to zero, and the kurtosis of 3.236523, which is close to the normal kurtosis value (3), also support the assumption of normal distribution. Thus, the regression model meets the normality assumption, making it suitable for further analysis.

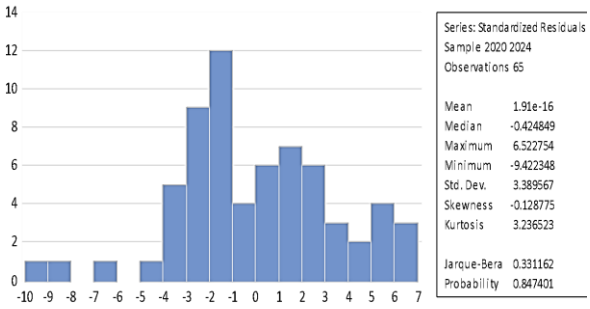

Figure 2. Normality result

The results of the multicollinearity test are shown through the Centered VIF value for each independent variable. Variable X1 has a VIF value of 1.711185 <10, variable X2 of 1.675052 <10, and variable X3 of 1.042578 <10. All VIF values of the independent variables show numbers below the tolerance threshold of 10. Thus, it can be concluded that there are no multicollinearity issues in the regression model. This means that the relationships among the independent variables in this study are not excessively linear, so the regression model is suitable for further analysis.

The results of the heteroscedasticity test using the Glejser method indicate that the probability value (Prob. F-statistic) is 0.603330, which is greater than 0.05. In addition, the probability value of Obs*R-squared is 0.587070, and the probability value of Scaled explained SS is 0.623045, both of which are also above the 5% significance level. These results indicate that there is no significant relationship between the absolute value of the residual and the independent variables in the model. Thus, it can be concluded that the regression model does not exhibit heteroscedasticity; in other words, the residuals are distributed homogeneously (i.e., homoscedastic). Therefore, this regression model meets the classical assumptions of heteroscedasticity and is suitable for further analysis.

4.4. Regression and Hypothesis Test

This study employs a panel data regression method to examine the impact of Green Accounting, Corporate Social Responsibility, and Green Process Innovation on Profitability. Based on the data processing results, the following multiple linear regression model was obtained:

$$\text{Profitability} = Y_{it} = \alpha+\beta_1 X_1 it+\beta_2 X_2 it+\beta_3 X_3 it+e$$

$$Y = 1.30436878159 + 0.448408199562X_1 + 2.74199966567X_2 + 6.76243461514X_3$$

Annotation:

Y = Profitability
i = Data cross-section (company data)
t = Data time series
α = Constanta (intercept)
$\beta_1, \beta_2, \beta_3$ = Coefficient regression
X_1 = *Green Accounting*
X_2 = *Corporate Social Responsibility*
X_3 = *Green Process Innovation*
e = *Error*

The coefficient of determination (R^2) measures the proportion of variation in the dependent variable that can be explained by the independent variables in a panel data regression model. Based on the panel data regression results, the adjusted R-squared of 0.109020 (10.9%) indicates that the model explains 10.9% of the variation in companies' profitability in the basic

materials subsector. This means that the independent variables of green accounting, CSR, and GPI together explain only a small portion of the variation in profitability. In contrast, the remaining 89.1% is attributed to factors outside the model, such as leverage, operational efficiency, capital structure, or external macroeconomic factors.

Based on the partial test results (Table 2), the t-count value is 0.519896 < t-table 1.99897, and the significance value is 0.6050 > 0.05, so Green Accounting has no significant effect on profitability. The t-test results for the CSR disclosure variable show a t-value of 0.791447 < t-table (1.99897) and a significance value of 0.4317 > 0.05, indicating that CSR disclosure has no significant effect on profitability. The t-test results show that the GPI variable (X_3) has a t-value of 2.655436 > t-table 1.99897 and a significance value of 0.0101 < 0.05, indicating that GPI has a significant effect on profitability.

The F-test in panel data regression is used to determine whether all independent variables simultaneously have a significant effect on the dependent variable. Based on the panel data regression model output (Table 2), the F-statistic value is 3.610351 with a probability value (Prob. F-statistic) of 0.018145. Because the significance value is less than 0.05, the panel data regression model is statistically significant. This indicates that the combined impact of green accounting, CSR disclosure, and GPI significantly affects the profitability of basic materials subsector companies listed on the IDX during the 2020–2024 period.

Table 2. Hypothesis result

Variabel	Coeff.	T-Stat.	Prob.
Constanta	1.5633	0.6130	0.5421
GA	0.4418	0.5198	0.6050
CSR	2.2615	0.7914	0.4317
GPI	7.5016	2.6554	0.0101
F Test			
Prob(F-stat)	0.0181	F-stat.	3.6103
Adj. R-squared	0.1090	DW Stat.	1.7658

5. Discussion

5.1. Green Accounting Has No Impact on Profitability

The implementation of green accounting by companies has not had a direct impact on improving financial performance, particularly profitability as measured by ROA. This finding aligns with research by Kholmi & Nafiza (2022), Refalina et al. (2024), and Nurrasyidin et al. (2024), which suggests that green accounting does not have a significant impact on profitability. Green accounting is a method that integrates the environmental impact of an event into financial statements (Nurrasyidin et al., 2024). Green accounting provides information that supports decision-making, thereby helping reduce commercial risk costs and create added value (Refalina et al., 2024). Several arguments why green accounting, using PROPER status as a proxy, does not affect ROA include: a) According to Kholmi & Nafiza (2022), one of the causes is the still low level of integration of environmental information in financial reports, which means the benefits of green accounting practices are not fully reflected in profitability indicators; b) The green accounting approach used is still symbolic or normative, namely merely fulfilling regulatory demands and not being part of a long-term business strategy (Refalina et al., 2024), c) In the short term, green accounting can increase the company's cost burden due to investments in environmentally friendly equipment, training, environmental audits, and waste processing, which can suppress profit margins (Nurrasyidin et al., 2024), d) the characteristics of this industry which still focuses on short-term operational efficiency rather than sustainable practices; e) The basic material sector, which includes mining, cement, and other heavy industries, tends to prioritize low production costs and high output to maintain profitability, so that the implementation of green accounting is considered an additional burden that does not directly improve financial performance, f) Market pressure on short-term financial performance makes companies prioritize capacity expansion and meeting market demand rather than investing in environmentally friendly practices whose results are only visible in the long term, and g) Indonesia's less-than-strict environmental regulations also reduce the urgency of implementing green accounting as a determinant of profitability. Therefore, while green accounting can theoretically improve a company's image, in the context of the basic materials sector in Indonesia for the 2020-2024 period, this practice has not statistically significantly impacted ROA because it has not been prioritized in business strategy.

5.2. CSR Has No Impact on Profitability

This finding aligns with research by Nurrasyidin et al. (2024) and Pratiwi et al. (2020), which states that corporate social responsibility (CSR) does not significantly impact ROA. Many countries around the world have begun to shift to more sustainable corporate operational practices. A company's existence is always closely linked to society and the environment, as it impacts the surrounding area. Several arguments explaining why CSR disclosure does not significantly impact ROA include: a) The lack of effectiveness of CSR implemented by companies. Many companies only present CSR activities descriptively in their annual

reports without following up with strategic implementation that directly impacts stakeholders. This was also stated by Lindawati & Puspita (2015), who stated that CSR disclosure that is irrelevant or inconsistent with stakeholder interests will reduce the added value of these CSR activities on the company's financial performance; b) CSR tends to be long-term and its impact is not immediately visible in the annual financial report, c) Other factors, such as public perception, marketing strategy, and media involvement, also influence the effectiveness of CSR in building company value and profitability, d) Companies in the basic material sector such as mining, cement, and heavy industry generally operate with a capital-intensive business model and focus on production efficiency, so that the allocation of funds for CSR programs is seen more as a regulatory obligation than a strategic investment; e) In the 2020-2024 period, this sector faced various macroeconomic challenges, including commodity price fluctuations and post-pandemic recovery pressures, which made management prioritize cash flow stabilization and reduce non-operational spending such as CSR, and f) The lack of pressure from investors and consumers on sustainable practices in this sector also reduced the company's incentive to integrate CSR into its core business strategy.

5.3. Green Process Innovation Has a Positive Impact on Profitability

These results reinforce the findings of research by Wedari & Alfian (2024), Xie et al. (2019), and Cahyaningsih & Ihromi (2024). The environmental crisis has escalated in recent years, further damaging the ozone layer. Global warming, climate change, pollution, the extinction of flora and fauna, and the greenhouse effect are all examples of environmental changes resulting from the overexploitation of natural resources by humans. While natural resources can take a long time to recover, companies continue to exploit them in order to increase profitability. In addition to producing products, production activities also generate waste that requires management to prevent environmental pollution and harm to society. Several arguments explaining why GPI has a significant effect on ROA include: a) GPI shows that innovation in environmentally friendly production processes can significantly increase efficiency, reduce operational costs, and provide competitive added value, thus having a positive impact on profitability, b) Green innovation processes enable companies to reduce waste, minimize energy use, and better comply with environmental regulations, c) Xie et al., (2019) emphasized that GPI increases the company's attractiveness in the eyes of consumers and investors who are increasingly concerned about sustainability, thereby creating increased demand for the company's products and contributing to profit growth; d) Innovations that focus on energy efficiency, carbon emission reduction, and raw material recycling not only create cost efficiencies, but also improve the company's reputation in the long term, e) In the context of resource-intensive industries such as mining, cement, and basic manufacturing, the implementation of environmentally friendly technologies such as more effective waste processing, the use of renewable energy, and raw material optimization not only lowers production costs but also reduces potential environmental fines. These efficiencies directly improve financial margins, as reflected in ROA, and f) Regulatory pressures and increasing market demand for sustainable practices are driving companies to adopt green innovation as part of their competitive strategy. During the 2020-2024 period, companies that invested in green process innovation successfully transformed environmental challenges into operational advantages, such as reducing energy and raw material costs through recycling or cleaner production processes. Thus, green process innovation not only contributes to environmental sustainability but also serves as a key driver of increased profitability and financial performance in Indonesia's basic materials sector.

5.4. Managerial Implications

The results of this research shift the paradigm, suggesting that not all sustainability practices have a direct impact on profitability. Companies in the basic materials sector are advised to place greater emphasis on GPI when re-evaluating their CSR and green accounting strategies for greater effectiveness. These implications can guide academics, practitioners, and regulators in formulating more targeted business policies and strategies. This study has important implications for managers and policymakers, suggesting that they consider a holistic approach to integrating sustainability practices. Although green accounting and CSR disclosure have not shown a direct impact individually, the synergy of all sustainability initiatives, particularly supported by green process innovation, can be an effective strategy to improve profitability and ensure future business sustainability.

Practical implications include: a) focusing on green innovation to increase profitability and b) re-evaluating CSR and green accounting strategies. Since CSR does not directly impact profitability, companies must evaluate whether their existing CSR programs are practical or merely symbolic. Green accounting may need to be integrated with a more comprehensive performance management system to ensure its long-term impact.

The implications for regulators and investors are as follows: a) Regulators need to promote more measurable environmental reporting standards so that green accounting can become a more relevant decision-making tool, and b) Investors need to consider green innovation as a stronger indicator of corporate profitability than CSR. Investors can consider this factor in fundamental analysis.

5.5. Limitations and Directions for Future Research

This study has several limitations, including the use of profitability indicators limited to ROA and the limited sample selection of companies in the basic materials sub-sector, so the results cannot be generalized to all industrial sectors. Furthermore, green accounting measures rely solely on the PROPER indicator, failing to account for internal factors such as environmental costs. Therefore, future researchers are advised to use multiple financial performance indicators and expand the scope of variables and sectors to achieve more comprehensive research results. Companies are also expected to optimize green process innovation to improve business efficiency and sustainability.

The theoretical direction is as follows: a) Updating stakeholder theory and the Resource-Based View (RBV). The finding that CSR does not affect profitability contradicts several previous studies that have linked CSR practices to improved financial performance. This suggests that in the basic materials sector, CSR motivation may be driven more by regulatory compliance or stakeholder pressure than competitive advantage; and b) Limited relevance of green accounting. The insignificant effect of green accounting on profitability indicates that environmental reporting has not been considered a determinant of financial performance in this sector. The green accounting measurement model, as well as moderating factors such as company size, leverage, or regulatory intensity, need to be reviewed.

6. Conclusions

The study's results revealed several interesting findings. Based on the panel data regression analysis, it was concluded that, to some extent, green accounting had no significant effect on company profitability. This suggests that although companies have implemented green accounting practices, their impact on financial performance has not been clearly evident, likely because the implementation is still in its early stages and has not yet been fully integrated into the core business strategy. Furthermore, the CSR disclosure variable did not show a significant effect on profitability. This suggests that the corporate social responsibility activities undertaken are not sufficiently robust to enhance stakeholder trust or the company's image, thereby driving profit growth. This indicates that, among basic materials companies in Indonesia during the study period, the adoption of green accounting and CSR transparency has not been directly reflected in increased individual profitability. Conversely, the green process innovation variable has been shown to have a positive and significant effect on profitability. This finding suggests that environmentally oriented process innovation can enhance production efficiency, reduce operational costs, and provide competitive added value, thereby directly impacting financial performance. Simultaneously, the three independent variables significantly influence profitability; however, individually, only green process innovation has a significant effect in this research model. All three variables (green accounting, CSR disclosure, and GPI) collectively have a significant effect on corporate profitability. This confirms that, although partial effects may vary, a company's integrated commitment to all aspects of sustainability can make a substantial contribution to improved profitability.

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