AKURASI Jurnal Studi Akuntansi dan Keuangan
p-ISSN : 2720-9067
e-ISSN : 2685-1059
Program Studi Magister Akuntansi
Fakultas Ekonomi dan Bisnis
Universitas Mataram

CLIMATE CHANGE DISCLOSURE AND FINANCIAL PERFORMANCE: EVIDENCE FROM INDONESIA'S PALM OIL INDUSTRY

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ARTICLE INFORMATION

Article history:
Received: 11/02/2026
First Revision: 27/02/2026
Accepted:20/04/2026
Available online: 30/06/2026

ABSTRAK

Penelitian ini bertujuan menganalisis kontribusi adanya pelaporan informasi perubahan iklim terhadap kinerja keuangan industri sektor kelapa sawit Indonesia. Penelitian ini menggunakan data sekunder yang diperoleh dari laporan tahunan dan laporan keberlanjutan pada 23 perusahaan kelapa sawit selama periode 2019–2023. Analisis data dilakukan menggunakan metode *Generalized Least Squares* dengan model regresi linear dan non-linear (kuadrat), serta pengujian asumsi klasik. Hasil penelitian menunjukkan bahwa CCD berpengaruh terhadap *Sales Growth* secara linear. Sementara itu, CCD tidak berpengaruh signifikan terhadap ROA dan ROS baik dalam model linear maupun non-linear. Temuan ini mengindikasikan bahwa pengungkapan terkait perubahan iklim berpotensi meningkatkan kepercayaan pemangku kepentingan dan persepsi pasar, sehingga dapat mendorong pertumbuhan penjualan perusahaan. Namun demikian, pengungkapan tersebut belum secara langsung berdampak pada peningkatan profitabilitas perusahaan dalam jangka pendek.

Kata Kunci: *Return on Assets, Sales Growth, Return on Sales, Climate Change Disclosure(CCD)*

ABSTRACT

This study explores how climate change disclosures affect financial outcomes for palm oil firms in Indonesia. Drawing on secondary data from annual and sustainability reports of 23 listed companies over 2019-2023, we applied generalized least squares regression-both linear and quadratic (non-linear)-along with classical assumption tests. The findings reveal a significant linear link between climate change disclosure (CCD) and sales growth. However, CCD showed no meaningful impact on ROA or ROS in either model. These results suggest that such disclosures can build stakeholder trust and shape positive market perceptions, fueling sales growth-though they haven't yet translated to short-term profitability gains

Keywords: Return on Assets, Sales Growth, Return on Sales, Climate Change Disclosure (CCD)

1. Introduction

Human activities such as fossil fuel combustion and deforestation have contributed significantly to the increase in greenhouse gas emissions, leading to global warming, polar ice melt, and a rise in the frequency of extreme weather events. These impacts extend across multiple sectors, including agriculture, industry, tourism, and global finance (Hariri & Gischa, 2024). According to Lloyd's of London, global economic losses from extreme weather events could reach USD 5 trillion over the next five years. Meanwhile, UNICEF reported that 43,1 million children were displaced by climate-related disasters between 2016 and 2021 (Amani, 2023). Global central banks have warned that climate change can trigger financial crises through transition risks, physical losses, and policy-related impacts on credit quality. Indonesia's palm oil industry, as a highly affected sector, has experienced stagnation in production and exports in recent years due to extreme weather and price fluctuations. Nevertheless, the sector has the potential to add up to USD 9 billion through climate change mitigation (CNN, 2021).

Climate change has become a worldwide threat that extends far beyond nature—shaking economies and financial systems, too. Skyrocketing temperatures, more frequent wild weather, and lasting environmental damage bring real physical dangers. At the same time, new policies, tech shifts, and regulations spark transition risks that hit companies' bottom lines and asset values hard (Bolton & Kacperczyk, 2021; NGFS, 2019). The Intergovernmental Panel on Climate Change (IPCC) emphasizes that climate-related risks pose serious threats to macroeconomic stability and long-term economic growth, thereby necessitating coordinated global mitigation and adaptation strategies (IPCC), 2023). From a financial standpoint, these risks are now widely seen as material, since climate shocks can break supply chains, cut productivity, damage asset values, and heighten default risks, ultimately influencing capital markets and investment outcomes (Battiston, et, al., 2017; Pankratz, Bauer, & Derwall, 2023).

In Indonesia, the palm oil industry which is highly vulnerable to climate risks, has experienced stagnation in production and exports in recent years due to extreme weather and rising fertilizer costs (CNN, 2023). Despite these challenges, the sector has the potential to contribute up to USD 9 billion through effective climate change mitigation. However, realizing this potential requires collaboration between banks, government bodies, and corporations to promote sustainable practices. Climate change negatively affects corporate financial performance, but mitigation strategies such as replanting may offer new growth opportunities (Detik, 2021). Palm oil continues to attract global scrutiny for its role in deforestation and carbon emissions. Bill Gates has emphasized that palm oil has a significant climate impact and is difficult to substitute (Detik, 2024). These concerns increase the pressure on the industry, which also faces fluctuating crude palm oil prices and the effects of climate cycles such as El Niño, as experienced by Astra Agro Lestari (CNN, 2024).

A strategic step to address the impacts of climate change in the palm oil industry is implementing climate change disclosure (CCD). CCD improves transparency, reduces operational costs, and drives efficiency, thereby positively influencing return on sales (ROS) and sales growth. Furthermore, CCD facilitates access to green financing and supports sustainable business practices, enabling companies to better manage climate risks

2720-9067 (ISSN), **2685-1059** (E-ISSN)
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while unlocking growth opportunities. Research highlights the importance of climate-related transparency, with evidence that disclosing carbon emissions is positively associated with operational performance (Anggraeni, 2015). Firms that openly report on emissions reduction and energy efficiency tend to achieve better financial performance. Financial reporting, such as profitability indicators, can also send favorable signals to investors, contributing to increased firm value (Pratama & Wijayanti, 2022).

Studies confirm that Indonesian palm oil firms do release sustainability reports following established frameworks like the Global Reporting Initiative (GRI), but the quality and maturity of these disclosures-especially environmental and climate-related information-are often moderate and skewed toward general narratives rather than comprehensive performance indicators, suggesting room for improvement in transparency and relevance (Soleha & Rosiana, 2021). Moreover, research highlights that sustainability reporting in the sector has the potential to enhance stakeholder decision-making and corporate accountability; however, disclosures may remain symbolic in the absence of third-party verification, clear metrics, or integration with climate disclosure standards such as IFRS S2, which has been found to positively influence corporate performance when implemented (Yunita, 2025). Real-world enforcement actions by the Indonesian government against companies operating illegally in protected forest areas further underscore the regulatory pressure for environmental compliance and credible reporting, as these practices have direct implications for climate change mitigation and corporate legitimacy (Reuters, 2025).

While numerous studies have examined the influence of climate change on financial achievements, findings remain varied. Research by (Aibar-Guzmán, et al., 2024; Ozkan, Temiz, & Yildiz, 2022; (Flammer, Toffel, & Viswanathan, 2021) shows a positive and linear relationship between climate change and financial performance, particularly as measured by return on assets (ROA). However, contrasting results from (Bose et al., 2024; Chen, Khoo, & Peng, 2023; Iriyadi & Antonio, 2021; Sun, et al., 2020; Alam, Ibrahim, & Mia, 2020) suggest that the impact on ROA is not statistically significant. Regarding return on sales (ROS), studies by Iriyadi & Antonio, (2021) and Secinaro, et al., (2020) indicate no significant effect. In contrast, Broadstock, et al., (2018) found that CCD has a linear effect on sales growth, while Iriyadi & Antonio, (2021) reported a positive non-linear effect on sales growth.

Flammer, Toffel, & Viswanathan, (2021) emphasized that shareholder activism, particularly from long-term institutional investors, can enhance climate change risk disclosures, often associated with firm size. In line with this, Alam, Rahman, & Yazdifar, (2022) found that larger firms are more likely to respond innovatively to climate challenges. Additionally, Alam, Ibrahim, & Mia, (2020) reported that climate change has a positive impact on financial performance, especially return on equity (ROE). This is further supported by Secinaro, et al., (2020), who found a positive link between corporate environmental performance and both ROE and return on investment (ROI). Therefore, Aibar-Guzmán, et al., (2024) also noted that effective climate governance improves financial outcomes, as measured by market-to-book ratio and Tobin's Q. Firms with higher Tobin's Q tend to be more proactive in responding to climate issues (Alam, Rahman, & Yazdifar, 2022).

However, other studies, such as Ozkan, Temiz, & Yildiz, (2022), warn that climate risks may also negatively affect financial performance, evident in metrics like EBITDA and cash flow. Nevertheless, strong cash flow may enhance firms' capacity to respond innovatively to climate change (Alam, Rahman, & Yazdifar, 2022). Moreover, Flammer, Toffel, & Viswanathan, (2021) and Bose et al., (2024) found that higher-quality climate change disclosures help cut down leverage while enhancing openness about climate risks. These findings reinforce the conclusion that climate change significantly influences corporate financial performance. Therefore, climate change disclosure is critical for managing climate-related risks, with potential benefits including lower operating costs (ROS), higher profitability (ROA), and greater sales growth. Consequently, firms can enhance their resilience to climate challenges.

Research on climate change disclosure remains limited, particularly in environmentally sensitive industries such as the palm oil sector. This study focuses on the Indonesian palm oil sector, which serves a key strategic function in the country's economy while simultaneously facing significant environmental challenges, including deforestation, carbon emissions, and increasing global scrutiny regarding sustainability practices. Despite growing international pressure for greater transparency in climate-related reporting, corporate disclosures on climate risks among palm oil companies remain heterogeneous and often symbolic, raising questions about whether such disclosures generate meaningful financial value.

Examining climate change disclosure in this context is therefore important for understanding whether sustainability transparency is associated with firm-level financial performance. By situating the analysis within Indonesia's evolving regulatory environment, where sustainability reporting is increasingly encouraged but still developing, this study contributes to the literature by exploring the financial implications of climate change disclosure in a high-impact industry. Specifically, the research provides empirical evidence on how climate-related disclosure may relate to different dimensions of corporate financial performance, thereby offering insights for policymakers, investors, and industry stakeholders seeking to align environmental accountability with economic outcomes.

2. Theoretical Framework dan Hypothesis Development

Legitimacy theory explains that companies seek to maintain public support by acknowledging and addressing their negative environmental impacts, such as reducing carbon emissions or utilizing renewable energy sources (Okada, et al., 2010). According to Dowling & Pfeffer, (1975), organizations do not possess an inherent right to exist; instead, their existence is justified when their operations and values are in harmony with those of the society in which they operate. Expanding this idea, Giannarakis, Zafeiriou, & Sariannidis, (2017) argued that climate-related disclosure is often used as a strategic tool by companies, especially those with poor environmental performance to respond to political and social pressures and to restore or maintain legitimacy. On the other hand, companies with strong environmental track records tend to use such disclosures to reaffirm their ongoing commitment to sustainability, which also serves as an indicator of sound corporate governance (Attig & Cleary, 2015).

2720-9067 (ISSN), 2685-1059 (E-ISSN)
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Meanwhile, stakeholder theory broadens the focus of strategic management by emphasizing the importance of managing relationships with various parties who are affected by or can affect the achievement of organizational goals Freeman & McVea, (2005). A company's survival depends on the support of shareholders, investors, employees, customers, and even the government and local communities that provide infrastructure and regulatory frameworks (Preble, 2005). Climate risk disclosure is crucial given the substantial impact of climate change on corporate financial risks, including property damage, operational disruptions, and shifts in consumer preferences (Hahn & Kuhnen, 2013; Megeid, 2024). Stakeholder theory and risk management theory suggest a link between climate change disclosure performance and financial distress, indicating that companies demonstrating strong performance in addressing climate issues tend to foster trust and solid collaboration with stakeholders (Alshahrani, et al., 2023).

Based on legitimacy theory, higher levels of climate change disclosure (CCD) enhance a company's legitimacy in the eyes of society and stakeholders, thereby increasing trust, support, and ultimately improving the firm's economic performance. Iriyadi & Antonio, (2021) explained that legitimacy theory describes the relationship between climate change reports and financial performance. When a company's activities are not aligned with societal values, its sustainability may be threatened, prompting efforts to restore legitimacy.

The previous study of Soewarno, Tjahjadi, & Firdausi, (2018) found that Indonesian companies disclosing more carbon emissions tend to have higher ROA. Managing emission-reduction initiatives signals to stakeholders that the company is environmentally responsible, which, in turn, enhances ROA. Climate Change Disclosure is expected to positively affect Return on Assets (ROA) because transparent disclosure of climate-related information reflects a firm's commitment to sustainability and risk management. Such transparency can enhance stakeholder trust, improve corporate reputation, and reduce information asymmetry between the firm and investors. As a result, companies that actively disclose climate-related information are more likely to achieve better operational efficiency and resource utilization, which ultimately contributes to improved profitability as measured by ROA. Furthermore, studies by (Iriyadi & Antonio, 2021; Alam, Ibrahim, & Mia, 2020; Sun, et al., 2020; Aibar-Guzmán, et al., 2024; Ozkan, Temiz, & Yildiz, 2022; Flammer, Toffel, & Viswanathan, 2021; Chen, Khoo, & Peng, 2023; Bose et al., 2024) reveal that climate change disclosure has a positive linear effect on ROA. The result of Pellegrino & Lodhia, (2012) argue that climate change threatens the legitimacy of organizations, particularly in environmentally sensitive industries such as mining. (Donnell, 1971) also contends that accounting and disclosure serve as mechanisms to legitimize corporate existence. The findings of Iriyadi & Antonio, (2021) further indicate that climate change disclosure has a positive non-linear effect on ROA and sales growth. Based on these arguments, the proposed hypothesis is as follows:

H_{1a}: Climate change disclosure has a positive and linear effect on ROA

H_{2b}: Climate change disclosure has a positive and non-linear effect on ROA

Stakeholder theory posits that large companies attract greater attention from stakeholders regarding their environmental performance than smaller firms (Giannarakis,

Zafeiriou, & Sariannidis, 2017). According to (Gray, Adams, & Owen, 1994), a management system that prioritizes responsiveness to society, government, individuals, and community groups emphasizes that corporate sustainability depends on the alignment of organizational activities with societal values. Climate change disclosure can enhance a company's legitimacy, brand image, and reputation in the eyes of consumers, thereby driving higher sales and operational efficiency, which in turn improve return on sales (ROS). This also reflects the market's evaluation by consumers and business partners (Okada, et al., 2010).

Based on Soewarno, Tjahjadi, & Firdausi, (2018) found that companies disclosing more carbon emissions demonstrate better financial performance. Other studies also indicate that environmental disclosure can enhance a company's reputation and image, ultimately leading to increased sales and profitability (Hahn & Kuhnen, 2013). Companies that actively disclose their climate strategies are more likely to earn customer trust and market acceptance, thereby increasing sales performance relative to operational costs. Consequently, improved sales efficiency may lead to higher Return on Sales. Prior research supports this hypothesis. Therefore, (Iriyadi & Antonio, 2021; Secinaro, et al., 2020) found that climate change disclosure has a positive linear effect on ROS. Furthermore, Iriyadi & Antonio, (2021) also discovered a positive non-linear relationship between climate change disclosure and ROS. Based on stakeholder theory and previous empirical findings, the proposed hypothesis is as follows:

H_{1b}: Climate change disclosure has a positive and linear effect on ROS

H_{2b}: Climate change disclosure has a positive and non-linear effect on ROS

According to Russo & Pogutz (2009), it was found that reductions in greenhouse gas (GHG) emissions are associated with increased sales profitability. This finding suggests that companies can achieve competitive advantages through product differentiation and enhanced brand value. Climate change disclosure serves as a signal to the market that a company has a clear, measurable strategy for addressing environmental risks, thereby attracting market segments that value sustainability and prefer products from environmentally responsible firms (Hahn & Kuhnen, 2013). Consequently, firms with credible and comprehensive climate change disclosures are more likely to attract sustainability-oriented investors and environmentally conscious consumers, reinforcing positive market perceptions, improving stakeholder trust, and ultimately supporting superior financial performance.

By increasing transparency through climate change disclosure, companies can expand their customer base and boost sales volume. The research of Iriyadi & Antonio, (2021) explained that climate change disclosure has a positive linear effect on sales. A strong commitment to sustainability and environmental responsibility reinforces customer trust and loyalty, which positively affects sales performance. Furthermore, studies by (Iriyadi & Antonio, 2021; Broadstock, et al., 2018) discovered a positive, curved (non-linear) link between climate change reports and sales. Based on theoretical foundations and prior empirical evidence, the proposed hypothesis is as follows:

H_{1c}: Climate change disclosure has a positive and linear effect on sales growth

H_{2c}: Climate change disclosure has a positive and non-linear effect on sales growth

2720-9067 (ISSN), **2685-1059** (E-ISSN)
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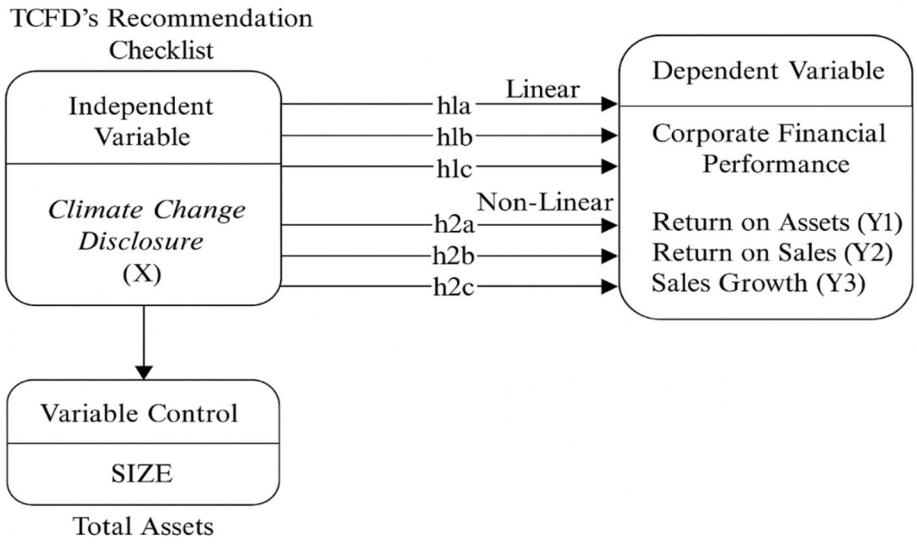

Figure 1. Research Model

Source: Processed by the Researcher, 2025

3. Research Method

This research adopted a quantitative approach, drawing on secondary data from annual reports (AR) and sustainability reports (SR) of palm oil companies listed on the Indonesia Stock Exchange (IDX) for 2019-2023. Information on climate change disclosure (CCD) is sourced from sustainability reports, while corporate financial performance (CFP) data is collected from annual reports, all of which are accessed on the official IDX website (www.idx.co.id). To ensure data consistency, the sample was selected using a purposive sampling technique based on the following criteria: (1) companies must have consistently published both AR and SR over five consecutive years, and (2) financial reports must be presented in Indonesian Rupiah (IDR). Of the 25 palm oil companies considered, 23 met these criteria and were selected as the sample for this study.

The study examines four variables: Climate change disclosure (CCD) serves as the independent variable, while corporate financial performance (CFP) is represented by three dependent variables: return on assets (ROA), return on sales (ROS), and sales growth. The measurement of variables in this study follows the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) for CCD and standard financial ratios for CFP indicators (ROA, ROS, and sales growth). The operational definitions and measurements are presented in the following table.

Table 1. Measurement Approach for Variables

Variable	Definition	Measurement	References
Climate Change Disclosure	The disclosure of corporate information related to the impact of climate change on business operations, including strategies, emission reduction efforts, and adaptation measures, aimed at enhancing	TCFD's recommendations checklist	(Carney, 2016)

Variable	Definition	Measurement	References
	transparency, reputation, brand value, and competitiveness.		
Return on assets (ROA)	Measures the company's efficiency in generating profit from its total assets.	ROA = Profit/Assets	(Iriyadi & Antonio, 2021)
Return on sales (ROS)	Measures the company's efficiency in generating profit from sales.	ROS = Profit/Sales	(Iriyadi & Antonio, 2021)
Sales Growth	Tracks the company's ability to boost revenue over time, fuelling business expansion and competitive edge	SALESt = (Salest – Salest-1) / Salest-1	(Iriyadi & Antonio, 2021)
SIZE	Serves as a control and moderating variable that reflects the scale of the company.	SIZEt = (TAt – TAt-1) / TAt-1	(Iriyadi & Antonio, 2021)

Source: Processed by the Researcher, 2025

Data processing began with the collection of raw data, which was first organized using Microsoft Excel. The data were then analyzed using EViews 12 statistical software. We began with descriptive statistics to outline the key features of our research variables, covering their mean, minimum, maximum, and standard deviation. Subsequently, a series of tests were conducted to determine the most appropriate panel data estimation model. The model selection process began with the Chow Test, which compares the Fixed Effect Model (FEM) with the Common Effect Model (CEM). If the probability value of the cross-section F-test is greater than 0,05, the CEM is considered more appropriate (Basuki & Prawoto, 2019). Next, the Hausman Test was conducted to decide between FEM and the Random Effect Model (REM). If the probability value of the cross-section random test is less than 0,05, FEM is chosen; otherwise, REM is selected (Basuki & Prawoto, 2019). If the two tests yield conflicting results, the Lagrange Multiplier (LM) test is used as the final step to determine which model, CEM or REM, is appropriate. In this test, if the probability value is greater than 0.05, the CEM is preferred; otherwise, the CEM is preferred (Basuki & Prawoto, 2019).

Once the appropriate model was determined, classical assumption tests were performed to ensure model validity, including multicollinearity and heteroskedasticity tests (Ningrum, Khairunnisa, & Huda, 2020). We ran a multicollinearity test to check for strong linear links between independent variables. No issues if the Variance Inflation Factor (VIF) stays under 10 (Widana & Muliani, 2020). Meanwhile, heteroskedasticity was tested using the Glejser test to assess whether the error variance was constant across the board. The test results indicate that data are free from heteroskedasticity if the p-value is greater than 0,05. Conversely, if the p-value is less than 0,05, heteroskedasticity is present (Basuki & Prawoto, 2019). This study applied the generalized least squares method, using cross-

2720-9067 (ISSN), 2685-1059 (E-ISSN)
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section weights for better accuracy for panel data regression analysis, covering both linear and non-linear (quadratic) approaches. The equations for these models are shown below:

$$CFPit = \beta 0 + \beta 1CCDit + \beta 2SIZEit \quad (1)$$
$$CFPit = \beta 0 + \beta 1CCDit + \beta 2SIZEit + \beta 3CCD\_SQit + \beta 4SIZE\_SQit \quad (2)$$

(Description: CFPit measures financial performance for company i at time t, using Return on Assets, Return on Sales, and sales growth as proxies. CCDit captures the climate change disclosure score, while SIZEit serves as a control variable for company size. For the non-linear approach, we switch to quadratic regression, where CCD_SQit and SIZE_SQit represent the squared terms of CCDit and SIZEit).

This analysis tested hypotheses about how climate change disclosure influences financial outcomes, measured through ROA, ROS, and sales growth. We assessed significance using p-values (where $p < 0.05$ indicates a meaningful relationship) and evaluated model fit using the coefficient of determination (R^2 and adjusted R^2). The interpretation criteria are as follows: A coefficient determination value approaching 0,75 interpretation a strong model, around 0,50 indicates a moderate model, and close to 0,25 indicates a weak model (Sarstedt, et al., 2022). The measurement of CCD refers to indicators aligned with the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD), which include four core pillars: governance, strategy, risk management, and metrics and targets. Each sub-criterion was assessed using a binary scoring system: a score of 1 was assigned if disclosed, and 0 if not disclosed, with a maximum total score of 11 points. Past research has used TCFD guidelines as key measures for their studies, such as those by (Williams, 2018; Iriyadi & Antonio, 2021; Yébenes, 2024).

Table 2. Climate Change Disclosure Quick Guide

Indicators	Sub-Criteria
Governance	a) How does the board monitor and stay on top of opportunities and climate risks?
	b) What role does management play in spotting and handling climate risks, challenge and prospects?
Strategy	a) Outline the climate risks and possibilities that the company has identified in the short, medium, and long term
	b) Describe the impact of climate risks and opportunities on the organization's business, strategy, and financial planning
	c) Explain how the organization's strategy remains resilient under various climate scenarios, including a scenario with temperatures limited to 2°C or lower
Risk Management	a) Outline your institution's steps for spotting and evaluating climate-change risks
	b) Explain how you handle those climate-change risks
	c) Explain how these stages fit into your completed risk system
Metrics and Targets	a) Share the key metrics you use to measure climate risks and opportunities, and how they tie into your strategy and risk

Indicators	Sub-Criteria
	approach b) Provide details on your Scope 1 (direct emissions), Scope 2 (indirect from energy), and Scope 3 (GHG emissions), including any linked risks c) Cover the goals you've set for tackling climate risks and opportunities, plus how you're tracking against them

Source: (Carney, 2016)

4. Results and Discussion

Out of the initial 25 palm oil sector companies considered as samples, based on data obtained from each company's official website and the Indonesia Stock Exchange (IDX), a total of 23 companies met the research criteria. These criteria include consistent publication of both annual and sustainability reports during the 2019-2023 period, as well as providing complete data required for the study. Meanwhile, two companies were excluded due to several constraints, including inaccessible websites, unavailable reports for download, lack of response to inquiries, and the absence of sustainability reports aligned with the TCFD recommendations. In addition, six companies were excluded from the analysis because their financial data showed extreme deviations compared to other firms in the sample. These discrepancies posed a potential risk of bias or distortion in data processing using EViews 12. Therefore, these six companies were categorized as outliers and were not included in the subsequent statistical tests.

Based on raw data processed in Microsoft Excel, a total of 115 observations were obtained for each financial outcome variable: return on assets, return on sales, and sales growth. Of these, approximately 41% of ROA observations were negative, as were 41% of ROS observations, and even 43% of sales growth values were negative. The high proportion of negative values indicates that a significant number of companies in the sample experienced suboptimal financial performance during the research period. Statistically, these findings reinforce the analytical results that the relationship between CCD and the three financial performance indicators was not significant in this sample. The lack of a significant relationship may be attributed to the still limited variation and quality of CCD disclosures among palm oil companies. Notably, approximately 24% of the sample companies did not disclose any CCD-related information in their sustainability reports.

Table 3. Descriptive Statistics

	ROA	ROS	SALES	CCD	SIZE
Mean	0,001739	-0,001652	0,126870	6,052174	0,029913
Median	0,010000	0,030000	0,060000	8,000000	0,010000
Maximum	0,490000	0,570000	1,940000	11,00000	1,340000
Minimum	-0,380000	-0,580000	-0,580000	0,000000	-0,460000
Observations	115	115	115	115	115

Source: Processed by the Researcher, 2025

2720-9067 (ISSN), 2685-1059 (E-ISSN)
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Table 3 presents the results of the descriptive analysis based on 115 observations from 23 palm oil companies in Indonesia. The findings indicate that the average profitability, as measured by ROA and ROS, is relatively low, with ROS even showing a negative average. Sales growth shows a positive average of 0,126870, though there is significant variation across companies. The average Climate Change Disclosure (CCD) score is 6,05 out of a maximum of 11, suggesting that most companies disclosed climate-related issues at a moderate level. However, some companies provided no disclosure at all. The SIZE variable also indicates disparities in company size, with the minimum value being negative and the maximum reaching 1,34. Overall, the data reflects diverse company characteristics that are important to consider when analyzing the relationship between climate disclosures and financial productivity.

Table 4. Model Selection Test

Test Type	Value	Criteria	Selection Model
Chow Test (CEM vs FEM)			
Model 1 (ROA)	0.0315	Prob. < 0.05 → FEM	Fixed Effect Model (FEM)
Model 2 (ROS)	0.0002	Prob. < 0.05 → FEM	Fixed Effect Model (FEM)
Model 3 (Sales Growth)	0.6037	Prob. > 0.05 → CEM	Common Effect Model (CEM)
Hausman Test (REM vs FEM)			
Model 1 (ROA)	0.2653	Prob. > 0.05 → REM	Random Effect Model (REM)
Model 2 (ROS)	0.7465	Prob. > 0.05 → REM	Random Effect Model (REM)
Lagrange Multiple Test (CEM vs REM)			
Model 3 (Sales Growth)	0.6854	Prob. > 0.05 → CEM	Common Effect Model (CEM)

Source: Processed by the Researcher, 2025

The selection of the appropriate panel data model was conducted using a series of statistical tests, including the Chow test, the Hausman test, and the Lagrange Multiplier (LM) test. The Chow test results indicate that Model 1 (ROA) and Model 2 (ROS) have probability values of 0.0315 and 0.0002, respectively, both below the 0.05 significance level. This indicates that the Fixed Effect Model (FEM) better suits both models compared to the Common Effect Model (CEM). In contrast, Model 3 (Sales Growth) yields a probability value of 0.6037, which exceeds 0.05, indicating that the Common Effect Model (CEM) is preferable.

Subsequently, the Hausman test was performed for Model 1 and Model 2 to assess which approach-Fixed Effect Model or Random Effect Model-fit best. The finding indicates probability values of 0.2653 for Model 1 and 0.7465 for Model 2, both exceeding the 0.05 significance level, suggests the Random Effect Model works best for these analyses. For Model 3, we also ran a Lagrange Multiplier test to pit the Common Effect Model against the Random Effect Model. With a p-value of 0.6854 (well above 0.05), the results point to the Common Effect Model (CEM) as the right choice for that one. Therefore, the final estimation models used in this study are the Random Effect Model for ROA and ROS, and the Common Effect Model for Sales Growth.

Table 5. Classical Assumption Test Results

Variable	VIF & Probability	Results
Multicollinearity Test		
CCD	1,000055	No Multicollinearity
SIZE	1,000055	No Multicollinearity
Heteroskedasticity Test		
ROA (Y1)	0,8120	No Heteroskedasticity
ROS (Y2)	0,1761	No Heteroskedasticity
Sales Growth (Y3)	0,0674	No Heteroskedasticity

Source: Processed by the Researcher, 2025

The multicollinearity test results show that the Variance Inflation Factor (VIF) values for both Climate Change Disclosure (X) and SIZE (Z) are 1,000055. These values are well below the 10-tolerance threshold, indicating no multicollinearity issues in the model. This shows the independent variables aren't strongly linked in a straight-line way, so each one can uniquely influence the regression model on its own. The heteroskedasticity test using the Glejser method shows that the ROA model (Y1) has a Chi-Square probability value of 0,8120, which is well above the 5% significance level. The ROS model (Y2) and the Sales Growth model (Y3) have probability values of 0,1761 and 0,0674, respectively, both also above the 0,05 threshold. Based on these results, it can be concluded that none of the three regression models suffer from heteroskedasticity.

Table 6. R-Square Test Results

Variable	R-square	Adjusted R-square
ROA	0,214939	0,186392
ROS	0,113159	0,080910
Sales Growth	0,276008	0,249681

Source: Processed by the Researcher, 2025

As shown in Table 6 above, the sales growth model has a coefficient of determinant of 0,2760, with an adjusted R-square of 0,2497. This indicates that approximately 25% of the variation in sales growth can be explained by the variables in the model, which is categorized as weak, although it is the strongest among the three models. The ROA model has a coefficient of determinant of 0,2149 and an adjusted value of 0,1864. The ROS statistics have the lowest explanatory power, with the value of R-square of 0,1132 and an adjusted R^2 of 0,0809. Referring to the general interpretation guidelines, an R-square close to 0,75 is considered strong, around 0,50 is moderate, and near 0,25 is weak. Therefore, all three models fall into the weak category, although the sales growth model demonstrates the best model fit in capturing changes in the outcome variable.

Based on the hypothesis testing results presented in Table 7, only the dependent variable sales growth in the linear model shows a statistically significant relationship, with a P-value of 0,0462 ($p < 0,05$), indicating that the hypothesis is accepted. In contrast, the variables ROA and ROS in the linear model have P-values of 0,9568 and 0,8125, respectively, which are far above the 0,05 threshold, indicating that they are not statistically significant and the hypotheses are rejected. In the non-linear (quadratic) model,

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all variables ROA, ROS, and sales growth have P-values greater than 0,05, specifically 0,5846, 0,2763, and 0,0581, respectively. Thus, none of these relationships are statistically significant. Although the P-value for sales growth in the non-linear model is close to the 0,05 threshold, it still does not meet the significance level, and therefore the hypothesis is also rejected.

Table 7. Statistical Results

	SIZE*	SIZE**	Coefficient CCD (X)	P-values	Result
Linear Hypothesis					
ROA (Y1) – (REM)	0,273859	0,0000	0,000480	0,9568	Rejected
ROS (Y2) – (REM)	0,232638	0,8125	-0,004298	0,8125	Rejected
Sales Growth (Y3) – (CEM)	1,037658	0,0000	0,163944	0,0462	Accepted
Non-Linear Hypothesis					
ROA (Y1) – (REM)	-0,166661	0,0249	0,000473	0,5846	Rejected
ROS (Y2) – (REM)	-0,160327	0,2703	0,001914	0,2763	Rejected
Sales Growth (Y3) – (CEM)	-0,073658	0,7765	-0,011907	0,0581	Rejected

Notes: * SIZE coefficient, ** SIZE p-value

Source: Processed by the Researcher, 2025

Climate Change Disclosure and ROA (Linear). The results indicate that Climate Change Disclosure (CCD) has no statistically significant linear effect on ROA, consistent with previous findings (Bose et al., 2024; Chen, Khoo, & Peng, 2023; Iriyadi & Antonio, 2021). This suggests that climate disclosure tends to function more as a legitimacy tool to maintain corporate image than as an asset-efficiency strategy (Dowling & Pfeffer, 1975; Giannarakis, Zafeiriou, & Sariannidis, 2017). Conversely, SIZE has a positive effect, as large firms often possess better resources and asset management systems, which can enhance asset optimization (Pellegrino & Lodhia, 2012). The low profitability observed by the 41% of firms with negative ROA also appears to weaken the relationship between CCD and financial performance (Maji & Kalita, 2022). *Climate Change Disclosure and ROA (Non-Linear).* This hypothesis affirms that CCD has no significant non-linear impact on ROA, aligning with (Alam, Ibrahim, & Mia, 2020; Sun, et al., 2020). This suggests that climate disclosures are more focused on meeting external expectations rather than being deeply integrated into business strategy. Interestingly, SIZE has a negative effect, implying that excessively large companies may experience reduced efficiency due to operational complexity (Zhang, 2024). Additionally, the lack of CCD disclosure by 24% of firms contributes to the low variation in data and the absence of non-linear CCD effects on ROA.

Climate Change Disclosure and ROS (Linear). This finding, in line with (Iriyadi & Antonio, 2021; Secinaro, et al., 2020), suggests that CCD has not been effectively implemented as a strategy to enhance sales efficiency. Rather, it appears to serve symbolic purposes, fulfilling external expectations. From a stakeholder theory perspective, CCD should strengthen stakeholder trust, though it has yet to translate into operational efficiency (Freeman & McVea, 2005). The 41% negative ROS observations indicate profitability challenges faced by many companies (Grofčíková, 2020). SIZE also does not significantly explain variations in sales efficiency. *Climate Change Disclosure and ROS (Non-Linear).* This result reinforces previous research (Iriyadi & Antonio, 2021), showing that CCD has

no significant non-linear impact on ROS. The SIZE variable also lacks significance, indicating that neither firm size nor its squared form effectively explains variations in ROS (Soewarno, Tjahjadi, & Firdausi, 2018). This reflects that climate disclosure remains a formality rather than a practical strategy for enhancing sales efficiency (Giannarakis, Zafeiriou, & Sariannidis, 2017). The insignificant effect of Climate Change Disclosure (CCD) on sales efficiency can be explained by the fact that many firms still view CCD as a compliance- or legitimacy-oriented activity rather than a core business strategy. Disclosures are often prepared to meet external expectations from regulators, investors, or the public, without being supported by substantive operational changes that directly enhance efficiency or profitability (Maharani & Riadi, 2024).

Climate Change Disclosure and Sales Growth (Linear). This hypothesis (H1c) is supported by the data, showing a statistically significant positive effect of CCD on sales growth, consistent with (Broadstock, et al., 2018). This suggests that effective climate disclosure builds stakeholder trust and opens access to new markets (Freeman & McVea, 2005). The control variable SIZE also has a positive and significant effect, confirming that larger firms are better positioned to drive growth through structured sustainability strategies (Russo & Pogutz, 2009). The last hypothesis (H2c) confirms that CCD has no statistically significant non-linear effect on sales growth, consistent with (Lewandowski, 2016). This implies that companies have not yet developed climate strategies complex enough to drive sales growth. CCD appears to serve more as a legitimizing mechanism than an innovation-based growth strategy (Giannarakis, Zafeiriou, & Sariannidis, 2017). SIZE is also not significant, indicating that non-linear variations in firm size do not consistently affect sales growth.

5. Conclusion, Implications, and Limitations

This research examined how climate change disclosure impacts financial performance among palm oil companies in Indonesia, testing both linear and non-linear relationships. The results show that, of the six hypotheses tested, only one was statistically significant: the positive influence of CCD on sales growth in the linear model. In contrast, the effects of CCD on ROA and ROS were not statistically significant in either the linear or non-linear models. These findings indicate that although CCD is theoretically expected to enhance a company's efficiency and profitability, its practical impact has yet to materialize in Indonesia's palm oil industry. This may be due to the low quality and limited scope of CCD implementation, as well as the high proportion of companies in the sample that recorded negative financial performance during the observation period.

Nonetheless, the results suggest that CCD has strategic potential to drive sales growth, particularly for large companies capable of managing climate-related risks and opportunities more systematically. Proper climate change disclosure can improve corporate image, attract investor interest, and strengthen a company's position in markets that are increasingly focused on sustainability. However, the impact of CCD on short-term profitability indicators such as ROA and ROS have not yet become evident. This highlights the need for deeper and more sustained integration between climate strategies and financial performance.

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This study has several limitations, including limited access to data prior to 2019, variations in reporting standards, such as TCFD, and an exclusive focus on the palm oil industry. Additionally, the use of a binary scoring system for CCD did not capture the narrative quality of disclosures, and approximately 24% of companies in the sample did not disclose CCD at all. These factors may have influenced the robustness of the analysis. Therefore, the findings should be interpreted with caution and not generalized too broadly. Further research with broader coverage and more diverse methodological approaches is needed to strengthen the validity of these findings.

For future studies, it is recommended to expand the scope to other industries affected by climate change. For greater explanatory power, replace ROA/ROS with Tobin's Q or the market-to-book ratio to capture long-term market valuation rather than short-term accounting metrics. Incorporate ESG scores or green innovation proxies as moderators to test strategic integration beyond disclosure. Add carbon intensity (emissions per sales) as a mediator to link CCD directly to emission trajectories in Indonesia's sustainable finance context. Qualitative approaches, such as content analysis or in-depth evaluations of disclosure quality, can provide more comprehensive insights. Moreover, considering moderating variables such as corporate governance, innovation intensity, or institutional ownership could shed fresh light on how climate change disclosure ties into financial performance.

Meanwhile, regulators and financial institutions play a vital role in promoting standardization and enhancing the transparency of climate disclosures so that CCD can meaningfully contribute to corporate sustainability and performance. With a comprehensive approach and appropriate policy support, climate change disclosure can become a key driver in the transition toward more responsible and sustainable business practices. Furthermore, collaboration among companies, governments, and other stakeholders is essential to building an adaptive, resilient business ecosystem that is responsive to climate-related challenges.

Acknowledgements

The authors gratefully acknowledge the support provided by their respective institutions in completing this research. The authors also extend their appreciation to all parties who contributed to data collection and provided valuable insights related to the Indonesian palm oil industry.

Conflict of Interest Statement

The authors hereby declare that no conflicts of interest exist whatsoever-whether financial, personal, professional, or otherwise-that could potentially influence, bias, or otherwise affect the design, execution, analysis, interpretation of results, authorship contributions, or publication process related to this article.

Data Availability Statement

The data underpinning this study's results come from publicly accessible annual and sustainability reports of Indonesian palm oil companies spanning 2019-2023. Additional

processed datasets and methodological details can be obtained from the corresponding author upon reasonable request.

Author Contributions

The first author conceptualized the study, designed the research, performed the formal analysis, reviewed the manuscript, and provided overall supervision. The second author took charge of data collection, curation, and statistical analysis. The third author managed the English editing and proofreading. All authors have reviewed and accepted the final version, and we stand fully behind its quality and accuracy.

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