SUSTAINABLE DEVELOPMENT: IMPLEMENTATION OF GREEN ACCOUNTING AND MATERIAL FLOW COST ACCOUNTING (CASE STUDY OF CONSUMER COMPANY NON-CYCLICALS YEAR 2021-2023)

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Abstract

This study aims to analyze the contribution of Green Accounting and Material Flow Cost Accounting (MFCA) to the achievement of sustainable development in consumer non-cyclical sector companies listed on the Indonesia Stock Exchange (IDX) during the 2021–2023 period. The background of this study stems from the increasing pressure to integrate environmental aspects into business strategies, both as a form of social responsibility and as an effort to maintain the company's legitimacy in the eyes of the public. This research employs a quantitative approach with a sample of 61 companies and a total of 183 observational data points. The testing was conducted using panel data regression analysis with the Random Effect Model (REM). The classical assumption test results indicated no multicollinearity, but heteroscedasticity was found; therefore, Robust Standard Errors were applied in the data processing. The findings reveal that Green Accounting does not have a significant effect on sustainable development, whereas MFCA has a positive and significant influence. These results suggest that cost efficiency through the management of material flows can drive a company's sustainability achievements. On the other hand, the suboptimal implementation of Green Accounting in strategic decision-making processes hinders its contribution to sustainability. This study provides important implications for companies and policymakers to strengthen the implementation of integrated, measurable, and goal-aligned environmental accounting practices in support of sustainable development.

Keywords: Green Accounting, MFCA, Sustainable Development, Sector Consumer Non-Cyclicals

INTRODUCTION

In the era of globalization marked by technological advancements, information transparency, and increasingly intense business competition, companies are no longer evaluated solely based on financial achievements. Demands from consumers, investors, and other stakeholders are pushing companies to take a greater role in addressing social and environmental issues. The environment is a crucial element in supporting the continuity of industrial processes. However, industries often become one of the main causes of environmental damage due to carbon emissions, water and air pollution, and excessive exploitation of natural resources (Nengsih et al., 2022). Therefore, in facing these sustainability challenges, the concept of sustainable development becomes very important to balance economic, social, and environmental aspects within a company's business strategy (Hindriani et al., 2024).

The concept of Sustainable development emphasizes the importance of balancing economic, social, and environmental aspects in every development activity, including corporate business practices. Sustainable development is not only oriented toward achieving short-term profits but also considers the sustainability of natural resources and the overall well-being of society. In the industrial context, this principle requires companies to manage the negative impacts of their operations on the environment and enhance their social contributions while still creating sustainable economic value. According to Brundtland, (2017), sustainable development is an effort to meet the needs of the present without compromising the ability of future generations to meet their own needs. Furthermore, Hindriani et al., (2024) state that sustainable development is a crucial foundation for companies in addressing global challenges such as climate change, declining environmental quality, and social inequality. By applying the principles of sustainability, companies not only strengthen their long-term competitiveness but also demonstrate a commitment to environmental preservation and the continuity of life for future generations.

In 2021, villagers living around the Kali Kunir river complained about pollution allegedly originating from PT Myr's factory waste (Monitor Tangerang, 2021). The river water, which was previously clear, had turned black, emitted a pungent odor, and even contaminated residents' wells, thereby disrupting daily activities. Until now, the company has not provided compensation or an official explanation to the affected community, although water sampling was once carried out by company representatives. Complaints from the village regarding the disposal of waste into the river have also not received adequate responses. Meanwhile, the company denied that its waste was harmful and claimed that the discharged waste had been sterilized, although field conditions suggested otherwise. This phenomenon indicates weak environmental management and low accountability, which ultimately negatively impacts the social and ecological aspects surrounding the company's operational area.

The pollution case of Kali Kunir caused by PT Myr's waste indicates that Green accounting, which is a system for recording environmental costs such as waste management and pollution prevention, has not been implemented or even allocated by the company in its environmental management. The change in color and odor of the river water reflects the occurrence of pollution that should have been identified in a Green accounting system through environmental cost records and disclosure of ecological impacts. The absence of such reporting shows that environmental accounting principles have not been effectively integrated into the company's operational management. The lack of adequate reporting and absence of compensation for affected communities reflects that Green accounting principles have not become part of operational policy. In fact, Green accounting encourages companies not only to focus on financial aspects but also to consider the ecological impact of all their business activities. This approach helps identify the costs

and benefits of environmental management, presents data quantitatively, and supports sustainable business communication while strengthening relationships with communities and stakeholders (Veronika et al., 2022). In fact, Green accounting has been proven to have a positive impact on a company's financial performance, especially in the food and beverage sector (Aisyah, 2022). The absence of environmental accounting information in this case reflects that ecological aspects have not been integrated into the company's operational reporting as a whole, making sustainable development goals difficult to achieve.

In line with this, the Material Flow Cost Accounting (MFCA) approach should be able to strengthen the implementation of Green accounting by emphasizing efficiency in material flow management and waste reduction. However, the case of Kali Kunir river pollution by PT Myr's liquid waste shows that the principle of material flow efficiency has not been fully applied. Waste that should have been treated or reused was instead discharged directly into the river, polluting residents' wells and harming the surrounding environment. MFCA implementation can help companies identify loss points from wasted materials and encourage overall optimization of production processes. A study by Baene et al., (2025) shows that MFCA has proven to improve resource efficiency, reduce waste, and result in more cost-effective and environmentally friendly decisions. Thus, MFCA implementation becomes a strategic approach in promoting more sustainable production practices.

Nevertheless, although the application of Green accounting and Material Flow Cost Accounting (MFCA) has been proven to drive resource efficiency and support environmental conservation efforts, its implementation in the industrial sector, particularly among consumer non-cyclicals companies in Indonesia, remains uneven. The pollution case of Kali Kunir river caused by PT Myr's liquid waste reflects that there are still major companies in this sector that have not fully integrated sustainability principles into their business processes. This case also highlights the urgency of MFCA implementation, as this approach enables companies to identify and quantify the hidden costs of waste flows which, if managed properly, can increase resource efficiency and support operational sustainability (Sartika et al., 2025). Each company has different approaches and levels of readiness in implementing environmental practices. Some may have shown progress, while others still display gaps between environmental commitments and operational practices on the ground. This condition raises the question of to what extent Green accounting and MFCA truly contribute to sustainable development in the consumer non-cyclicals sector. Moreover, empirical studies specifically evaluating the effectiveness of these two approaches in the context of this sector remain limited, despite their influential role in meeting the basic needs of society.

Several studies show that the implementation of Green accounting positively contributes to the achievement of sustainable development goals, especially in certain industrial sectors. For example, Green accounting has been proven to have a positive and significant influence on sustainable development in palm oil companies listed on the Indonesia Stock Exchange (IDX) during 2017–2022 (Nugraha, 2023), as well as in basic materials sector companies during the 2017–2021 period (Trevanti & Yuliati, 2023). Similar results were also found in studies on manufacturing companies in the basic and chemical industries sector in 2020–2022 (Somantri & Sudrajat, 2023). However, not all studies yielded consistent findings. Research in the mining sector during 2019–2023 showed that Green accounting did not have a significant effect on achieving sustainable development (Efria et al., 2023), likewise in consumer goods manufacturing companies (Nadia et al., 2025). These differences in results indicate the need for more optimal, consistent, and sustainable application of Green accounting so that its impact on sustainable development can be fully realized.

In addition to Green accounting, another variable that is also closely related to achieving sustainable development goals, but still shows varying findings, is Material Flow Cost Accounting (MFCA). Several studies indicate that MFCA plays a role in increasing cost efficiency and resource utilization, which impacts corporate sustainability. It has been proven that MFCA implementation supports sustainable development in palm oil companies (Selpiyanti & Fakhroni, 2020). Similar results were found in another study stating that MFCA disclosure significantly improves sustainability practices (May et al., 2023). Other research also shows that cost and production outcome elements in MFCA contribute positively to sustainable development (Damayanti & Harti Budi Yanti, 2023). However, not all studies show consistent results. A study found that because production costs recorded through this method do not directly reflect sustainability efforts, MFCA does not influence sustainable development (Santoso & Handoko, 2025). The same was found in another study stating that the land area element in MFCA did not have a significant impact on sustainability, especially in energy sector companies such as oil, gas, coal, and palm oil listed on the IDX during the 2020–2022 period (Kurnianingtyas et al., n.d.). These differences in results indicate that the effectiveness of MFCA in supporting sustainable development greatly depends on the industrial sector and the aspects of MFCA used, hence further and more specific research is needed according to the context of the company.

The previous study by Selpiyanti & Fakhroni, (2020) was expanded in this research, which focuses on companies in the consumer non-cyclical sector during the 2021–2023 period. The methodology used is more structured, employing panel data regression analysis with the Random Effect Model (REM), complemented by classical assumption tests and the use of robust standard error to address heteroscedasticity issues. Variable measurement was conducted more thoroughly, including content analysis for Green accounting and Material Flow Cost Accounting (MFCA) calculations based on the mass balance principle. This study aims to examine the influence of Green accounting and MFCA on sustainable development in the consumer non-cyclical industry. The urgency of this research lies in the importance of understanding the contribution of Green accounting practices in supporting corporate sustainability amidst increasing regulatory pressures and environmental issues. With a comprehensive approach, this study is expected to enrich empirical literature and provide practical recommendations for companies and policymakers in formulating effective sustainability strategies. In this context, the main question that this research seeks to answer is to what extent Green accounting and MFCA significantly influence sustainable development in consumer non-cyclical sector companies in Indonesia during the 2021–2023 period.

REVIEW OF LITERATURE

Legitimacy Theory

In this study, legitimacy theory is used as the theoretical foundation. This is because legitimacy theory can explain why companies adopt Green accounting and Material Flow Cost Accounting (MFCA) as a form of environmental responsibility. Through this approach, companies strive to maintain their existence and social legitimacy. Legitimacy theory states that companies will continuously adjust their activities to align with prevailing social norms and values in order to gain support from the public and stakeholders (Suchman, 1995). Therefore, this theory encourages companies to ensure that their activities and performance are socially acceptable (Amira & Siswanto, 2022). In this context, environmental reporting and cost management through MFCA become strategies to demonstrate a commitment to sustainable development, especially amidst increasing public and regulatory pressure for environmental transparency and

accountability. This is highly relevant for companies in the consumer non-cyclicals sector, which directly engage with consumers and are more sensitive to sustainability and business ethics issues (Deegan, 2002). Therefore, legitimacy theory becomes an appropriate framework for understanding corporate motivation in adopting environmental accounting to maintain operational continuity and social support.

Sustainable Development

Sustainable Development emerged as a response to the increasing environmental degradation caused by human activities. This principle emphasizes the importance of development as a means to meet current human needs without compromising the environment's ability to support future generations (Wahanisa & Adiyatma, 2021). In this context, companies play a crucial role in supporting the achievement of sustainable development goals by adopting environmentally friendly technologies, energy efficiency, and waste reduction (May et al., 2023). In such situations, to ensure operational continuity, companies must maintain profit stability or growth each year. This effort is also expected to provide added value for employees, investors, and society, both economically, socially, environmentally, and technologically. Besides maintaining profitability, companies also need to perform cost efficiency to remain competitive in the long term (Loen, 2018). The implementation of Environmental, Social, and Governance (ESG) principles becomes one form of tangible commitment to supporting sustainability. In accordance with POJK NO 51/POJK.03/2017, which encourages a balance between economic, social, and environmental interests, ESG emphasizes the importance of aligning environmental, social, and governance elements within business strategies (Inayati et al., 2025).

Green Accounting

Green accounting is a cost accounting method that focuses on a company's environmental responsibility by incorporating environmental costs as part of financial accountability (Lestari & Alim, n.d.). This system serves to identify, calculate, evaluate, and report costs arising from company activities, especially those related to the environment (Santoso & Handoko, 2025). By using Green accounting, companies do not only think about their financial profits but also how their operations impact the environment. These environmental impacts include costs for waste management, use of natural resources, pollution prevention, and environmental conservation programs. Furthermore, Green accounting encourages companies to produce more environmentally friendly cost reports and motivates them to make more eco-friendly decisions. This system can also enhance a company's reputation in the eyes of the public and investors by showing the company's commitment to social and environmental responsibility.

Material Flow Cost Accounting

The measurement tool used to assess company efforts in improving cost efficiency can reduce waste generated from production activities when applying MFCA, resulting in increased profits and stable productivity, which allows companies to remain viable in the future (Hindriani et al., 2024). The results will lead to increased company productivity (Loen, 2018). In addition, MFCA implementation also encourages companies to be more aware of resource usage and environmental impacts, thereby creating a more environmentally friendly and sustainable production process. Thus, MFCA not only provides economic benefits but also strengthens the company's position in meeting regulatory demands and stakeholder expectations related to social and environmental responsibility. The calculation is carried out by identifying raw materials, calculating inputs and waste at each stage of production, and assessing system and labor costs. The data is classified based on the mass balance principle into positive output (valuable products) and negative output (waste) (Santi et al., 2022).

The Influence of Green Accounting on Sustainable Development

Green accounting assists companies in evaluating and managing the environmental impact of their operational activities and their effects on community well-being. The more optimally it is implemented, the greater the company's role in supporting the achievement of sustainable development (Loen, 2018). This affirms that Green accounting does not solely focus on environmental aspects but also plays a strategic role in shaping a positive corporate image and maintaining public trust. This practice also reflects a form of corporate responsibility in gaining legitimacy from the public as stakeholders (Trevanti & Yuliati, 2023). Furthermore, according to Ogunode, (2022) legitimacy theory provides a basis for understanding how businesses use environmental reporting such as Green accounting as a means to align with prevailing social principles and gain public acceptance. When a business transparently carries out its environmental responsibilities, it is viewed as a commitment to public interests, which ultimately strengthens its legitimacy. Research conducted by Nugraha, (2023), Trevanti & Yuliati, (2023), and Somantri & Sudrajat, (2023) has proven that Green accounting has a positive influence on sustainable development. Based on previous studies and by referring to legitimacy theory, the following hypothesis can be developed:

H1: Green accounting has a positive effect on sustainable development.

The Influence of Material Flow Cost Accounting (MFCA) on Sustainable Development

The environmental accounting method known as Material Flow Cost Accounting (MFCA) aims to reduce negative environmental impacts while simultaneously decreasing operational costs. This approach offers dual benefits for companies, as it can minimize material and energy waste, ultimately producing both financial advantages and enhancing the company's public image (Suprianing Arum & Farida, 2023). MFCA helps identify inefficient material and energy flows and accurately allocates costs at each stage of production. In doing so, companies can reduce waste, increase efficiency, and contribute to the achievement of sustainable development goals. A study by Trisnaningsih et al., (2024) demonstrated that the implementation of MFCA has a significantly positive effect on sustainable development. In that study, companies that implemented MFCA were proven to be more efficient in managing costs and reducing production waste. Within the framework of legitimacy theory, the application of MFCA reflects a company's commitment to social and environmental responsibility, while also showing its effort to meet public and stakeholder expectations to gain social legitimacy. Research by Selpiyanti & Fakhroni, (2020), May et al., (2023), and Damayanti & Harti Budi Yanti, (2023) has proven that MFCA positively influences sustainable development. Based on the explanations and previous research findings, the hypothesis proposed in this study is:

H2: Material Flow Cost Accounting (MFCA) has a positive effect on sustainable development.

RESEARCH METHOD

This study focuses on companies operating in the consumer non-cyclicals sector listed on the Indonesia Stock Exchange (IDX). Using a quantitative approach, the study aims to analyze the influence of Green Accounting and Material Flow Cost Accounting (MFCA) on Sustainable Development. The research population includes all companies within the sector, with samples selected using purposive sampling. The sample selection is based on companies that consistently publish annual and financial reports, and disclose information related to environmental costs and MFCA variables used in their annual reports during the 2021–2023 period. The data used are

secondary data and were processed using Stata statistical software to produce objective and empirically testable findings.

Table 1.
Sampling Criteria

No	Sampling Criteria	Amount
1.	Non-cyclical consumer sector companies listed on the Indonesia Stock Exchange (BEI)	122
2.	Companies that do not publish annual reports or financial statements	(18)
3.	Companies that do not submit information related to MFCA variables	(43)
Number of samples for 1 year		61
Final sample size for 3 years		183

Source: (Data processed by the author,2025)

Operational Definition of Variables and Variable Measurement

Green Accounting

According to Lako, as cited by Nur'ainun & Lestari, (2017) the disclosure of Green Accounting encompasses three dimensions of information, comprising a total of 14 indicators. The information presented in Green Accounting disclosure includes various aspects related to.

Table 2.
Dimensions and indicators of environmental disclosure

No	Dimensions	Indicator
1.	Company contribution to the natural environment, energy, human resources (employees), and society	Implementation of environmental management in operations
		Efficiency in energy use
		Emission reduction
		Implementation of the 3R principles (reduce, reuse, recycle) for hazardous and non-hazardous waste
		Water conservation efforts and pollution reduction
		Protection of biodiversity
		Community development activities
2.	Positive and negative impacts of the company's business, economically, socially, and ecologically on the environment, energy, employees, and society.	Positive impacts arising from business activities
		Negative impacts resulting from company activities
3.	Company participation in addressing environmental problems	Control of water pollution
		Efforts to reduce air pollution
		Management of hazardous and toxic waste (B3)
		Handling of marine pollution
		Prevention of land degradation risks

Source: Ainun & Lestari (2017)

Environmental disclosure indicators in annual reports are used to assess the use of green accounting. This measurement process is conducted through content analysis (Al-Tuwaijri et al., 2005).

Table 3.
Explanation of content analysis

No	Score	Description
1	0	The company does not disclose Green accounting indicators in its annual report.
2	1	The company only discloses Green accounting indicators in numerical or visual form without narrative explanation in the annual report.
3	2	The company presents Green accounting indicators in narrative form without supporting figures or images in the annual report.
4	3	The company discloses complete Green Accounting indicators, either in narrative form accompanied by data in the form of figures or images in the annual report.

Material Flow Cost Accounting (MFCA)

The process of collecting and compiling data for Material Flow Cost Accounting (MFCA) begins with identifying the raw materials used, followed by calculating the amount of input and waste at each stage of the production process. Subsequently, the calculation includes system costs and related labor costs.

In the implementation of the MFCA model, data are organized based on the quantity and type of inputs used, then classified into value-added products (positive products) and waste or by-products (negative products), based on the principle of mass balance. The final outcome of this process provides a detailed breakdown of the costs associated with each type of product, both valuable and waste, which can be used to evaluate production process efficiency.

To obtain systematic and accurate calculation results, there are specific steps that must be followed in the implementation of MFCA, as outlined by Santi et al., (2022):

Material Usage Allocation

In determining material utilization, the following percentages are used as the basis for identifying positive and negative outputs:

Percentage of Positive Output:

$$\frac{Positive\ Output}{Positive\ Output\ +Negative\ Output}\ x100\%$$

Percentage of Negative Output:

$$\frac{Negatif\ Output}{Positif\ Output\ +Negatif\ Output}\ x100\%$$

Positive output includes the costs associated with raw material usage, while negative output includes the costs arising from waste management and environmental impacts.

System Cost Allocation

The cost allocation system is based on material usage, calculated using a percentage with the following formula:

$$Positive\ Product = Total\ system\ cost\ x\ Number\ of\ positive\ output\ percentages$$

$$Negative\ Product = Total\ system\ cost\ \ x\ \ Number\ of\ negative\ output\ percentages$$

Costs in this system include labor costs, asset depreciation, transportation and freight, and maintenance costs.

Energy Cost Allocation

Energy cost allocation is based on the percentage of material used, which is calculated using the following calculation:

$$Positive\ Product = Total\ energy\ cost\ x\ Number\ of\ positive\ output\ percentages$$
$$Negative\ Product = Total\ energy\ cost\ x\ Number\ of\ negative\ output\ percentages$$

Energy costs include expenses for electricity, fuel, steam, heat, and compressed air.

MFCA Cost Allocation and Results

The total costs of the material flow are summarized by constructing a material flow cost matrix, in accordance with the guidelines contained in the Material Flow Cost Accounting Manual (ISO 14051, 2014).

Table 4.
Cost Flow Matrix

Table Cost Flow Matrix					
		Material Cost	Energy Cost	Total System	Cost
Positive output	product				
Negative output	product				
Amount					

Positive product output includes the cost of positive materials, positive energy costs, and positive system costs, while negative product output includes the cost of negative materials, negative energy costs, and negative system costs. After that, the final result is the sum of the negative product output added to the negative product output.

Sustainable development

The extent of profit achieved by a company can indicate its sustainability. A company's opportunity to grow and survive is proportional to the profit obtained. This aligns with the findings of previous research by Marota, (2017) namely:

Sustainable development = Economic + Social + Environmental + Technological

Note: Investment indicators, net profit, and sales are used to measure the economic dimension in the annual report. Corporate social responsibility (CSR) costs, employee salaries, and severance pay reflect the social dimension. Utility costs, such as electricity and water (PDAM), as well as occupational health and safety (OHS) costs, represent the environmental dimension. In addition, research and development (R&D) costs indicate the technological dimension, showing the company's efforts for innovation and quality improvement.

RESULTS AND DISCUSSION

Descriptive Statistical Test Results

The mean, standard deviation, and the highest and lowest values are shown by descriptive statistics. In this study, a total of 183 observational data from companies in the consumer non-cyclicals sector were analyzed from 2021 to 2023.

Table 5.
Deskriptive Statistic

Descriptive Statistics					
	N	**Min**	**Max**	**Mean**	**Std. Dev**
Green accounting	183	0	3	2.26	0.68
Material Flow Cost Accounting	183	1,74*	739*	55,1*	120*
Sustainable development	183	6,03**	548*	16,9*	55,8*

Description:
*: units in the form of trillions
**: units in the form of billions

Source: (Data processed by the author, 2025)

Based on the results of the descriptive statistical test, the Green accounting variable has 183 observational data with an average value of 2.26, a standard deviation of approximately 0.68, a minimum value of 0, and a maximum value of 3. These values indicate that Green accounting is a variable with a small scale and relatively low data distribution, likely in the form of a categorical variable or a small ordinal scale. Meanwhile, the Material Flow Cost Accounting (MFCA) variable also has 183 observational data with an average of IDR 55.1 trillion and a standard deviation of approximately IDR 120 trillion. The minimum value of Material Flow Cost Accounting is IDR 1.74 trillion, and the maximum value reaches IDR 739 trillion. This indicates that Material Flow Cost Accounting has a very large variation in data among observations and is most likely to represent high economic values, such as total assets, revenue, or investment value. For the Sustainable development variable as the dependent variable, there are 183 observational data with an average of IDR 16.9 trillion, a standard deviation of approximately IDR 55.8 trillion, a minimum value of IDR 6.03 billion, and a maximum value reaching IDR 548 trillion. These figures indicate that the Sustainable development variable has a wide data distribution and can be significantly influenced by independent variables with a large economic scale.

Table 6.
Model Selection Test

Type of Test	Probability Statistical	Value (p-value)	Decision Model
Uji Chow (CEM vs FEM)	F (60,120) = 3.94	0.000	Use FEM
Uji Hausman (FEM vs REM)	Chi^2 (1) = 0.87	0.3521	Use REM
Uji Lagrange Multiplier (FEM vs REM)	$Chibar^2$ (1) = 43.16	0.000	Use REM

Source: (Data processed by the author,2025)

The Chow test was conducted to determine the most appropriate model between the Common Effect Model (CEM) and the Fixed Effect Model (FEM). The results showed that H0 was rejected because the p-value of 0.000 was below the significance threshold of 0.05. Thus, FEM was chosen as the more appropriate model compared to CEM. Next, the Hausman test was used to compare FEM with the Random Effect Model (REM). The resulting p-value was 0.3521, which is greater than 0.05, so H0 was accepted. This indicates that REM is more suitable to use than FEM. Finally, the Lagrange Multiplier test was applied to evaluate the best model between REM and CEM. The results showed a p-value of 0.000, which is less than 0.05, so H0 was rejected and REM was declared the most appropriate model. Based on these three tests, the most suitable model used in this study is the Random Effect Model (REM).

Table 7.
Classical Assumption Test

Test Type	Type of Test	Result	Decision
Multikolinearitas test	Variance Inflation Factor (VIF) and Tolerance (1/VIF)	Highest VIF = 1.07 Mean VIF = 1.07 Tolerance = 1/1.07 = 0.9374	There is no multicollinearity between the independent variables.

Heteroscedasticity test	Breusch-Pagan/Cook-Weisberg Test (estat hettest)	Chi2(1) = 9.69 Prob > Chi2 = 0.0019	Since the p-value is <0.05, heteroscedasticity is present. Therefore, to resolve this, regression was performed using vce (robust).

Source: (Data processed by the author,2025)

Multicollinearity test in this study was conducted using the Variance Inflation Factor (VIF) method and tolerance values. The results showed that the highest VIF value as well as the average was only 1.07, with a tolerance value of 0.937. There were no signs of multicollinearity among the independent variables, as all these values were far below the common threshold, which is 10 for VIF and tolerance values well above the minimum limit of 0.1. In other words, each variable in the model is independent and does not excessively influence each other. To detect the presence of heteroskedasticity, the Breusch-Pagan/Cook-Weisberg Test was used. Based on the test results, a Chi2 value of 9.69 with a p-value of 0.0019 was obtained. Since the p-value is less than 0.05, it can be concluded that heteroskedasticity occurs in the model. Therefore, to address this issue, the regression was rerun using robust standard error (through the command vce(robust)) so that the estimation results remain valid despite inconsistencies in error variance. The use of robust standard error was also considered because the Material Flow Cost Accounting and Sustainable Development variables have high standard deviations and a very wide data range, thus potentially containing outliers. With this approach, the coefficient estimates become more stable and reliable, as well as not distorted by non-homogeneous residual variance. The regression estimation results with robust standard error are shown in Table 8. Robust standard error is used to correct potential bias due to heteroskedasticity and outliers, as previously explained.

Table 8.
Robust Standard Error Results

Variable	Robust Std. Err
Green accounting	$6{,}48 \times 10^{12}$
Material Flow Cost Accounting	0,0285223

Source: (Data processed by the author,2025)

The table above shows the results of robust standard error calculations as a correction for heteroscedasticity detected in the regression model. Using robust standard errors allows for accurate coefficient estimation despite the presence of heteroscedasticity in the data, resulting in more stable and reliable analysis results. With robust standard error correction, the panel regression model still provides valid estimates despite the presence of heteroscedasticity and the possibility of outliers, thus strengthening the reliability of this study's results.

Table 9.
F-test and R-squared

Test Type	Probability Statistical	Value (p-value)	Decision
F Test (Wald chi^2)	59.88	0.0000	The independent and dependent variables have a simultaneous effect, according to a

			significant model ($p < 0.05$).
R-squared	Within: 0.0143 Between: 0.2437 Overall: 0.1792	-	The independent variable can account for 17.92% of the total variation in the dependent variable.

Source: (Data processed by the author,2025)

The regression results of panel data using the Random Effects Model (REM) approach yielded a Wald chi² value of 59.88 with a p-value of 0.0000. Because this p-value is far below the 5% significance threshold (even less than 1%), it can be concluded that the model is simultaneously significant. This means that the dependent variable is influenced by all independent variables together.

Furthermore, the overall R-squared value of 0.1792 indicates that approximately 17.92% of the variation in the dependent variable can be explained by the independent variables used in the model. Meanwhile, the between R-squared value of 0.2437 indicates how much of the variation between entities (e.g., between companies) can be explained by the model, and the within value of 0.0143 shows the variation within entities over time explained by the model. Although the R-squared values are not very large, this is quite common in social or management research, where many external factors cannot be fully included in the model.

Table 10.
Hypothesis Testing

Variable	Coefficient	Std. Error	P-value	Decision
Green accounting	-6.860	6.480	0.289	Not significant ($p > 0.05$), no effect
Material Flow Cost Accounting	0.2012199	0.0285223	0.000	Significant ($p < 0.05$), positive effect on y (α = 1%)

Source: (Data processed by the author,2025)

The p-value for the Green Accounting variable exceeds the 0.05 significance threshold, indicating that this variable does not have a statistically significant effect on the dependent variable. In other words, changes in Green Accounting are not strong enough to explain variations in the dependent variable (Y) in this model. Meanwhile, the Material Flow Cost Accounting (MFCA) variable has a coefficient of 0.2012 with a p-value of 0.000, well below the 0.05 significance level. This indicates that MFCA has a positive and significant effect on the dependent variable. The higher its level of implementation, the greater the increase in the value of the dependent variable. In fact, the result remains significant at the 1% level ($\alpha = 0.01$), indicating a statistically strong relationship.

Green Accounting Has No Significant Effect on Sustainable Development

The first hypothesis in this study states that Green Accounting has a positive influence on sustainable development. However, the test results show a coefficient of -6.860 billion with a p-value of 0.289, which exceeds the 0.05 significance threshold. Therefore, the alternative hypothesis (H_1) is rejected. This means that, in the consumer non-cyclicals sector during the 2021-2023 period, the implementation of Green Accounting has not been proven to significantly influence the achievement of sustainable development.

According to the results of the descriptive statistical test, the Green Accounting variable consists of 183 observations with an average value of 2.26, a standard deviation of approximately 0.68, a minimum value of 0, and a maximum of 3. These values suggest that Green Accounting is a low-scale variable with minimal data dispersion, indicating that it is likely a categorical or low-level ordinal variable. This scale imbalance becomes relevant when compared to the Sustainable Development variable, which in this study represents large-scale financial figures ranging from billions to trillions. The scale discrepancy between these two variables may be one of the reasons why the statistical effect is not significant.

Beyond statistical factors, these results also reflect on-the-ground realities namely, that Green Accounting in many companies still functions merely as administrative formality. Environmental information is not yet actively used in strategic decision-making or as a basis for operational improvements. This is evidenced by a real-world case in Kali Kunir in 2021, where local villagers complained of river pollution allegedly caused by operational waste from PT Myr. Water that was once clear turned pitch black and foul-smelling, contaminating the community's clean water sources. Although the company claimed the waste had been sterilized, the situation on the ground indicated otherwise. To this day, no compensation or official explanation has been provided to the affected residents, reflecting weak environmental accountability and management. This phenomenon demonstrates that Green Accounting is not always implemented in a substantive manner and that environmental reporting often does not reflect real conditions.

Based on legitimacy theory, this result suggests that companies may be implementing Green Accounting more to maintain a positive public image rather than as part of a genuine sustainability strategy. The theory posits that companies align their reporting and actions to appear consistent with social expectations. However, if this is done only symbolically for instance, through narratives or images without supporting data then the legitimacy gained is superficial and does not reflect a real commitment to sustainability.

As a result, Green Accounting does not have a significant impact because it is not deeply integrated into company operations. This finding aligns with research by Lusia & Effriyanti, (2024) which states that although environmental reporting is increasingly common, its contribution to sustainability remains limited due to weak strategic integration and a tendency for reporting to be administrative in nature. This highlights that the success of Green Accounting in supporting sustainable development depends not just on its existence, but also on the quality of its implementation and its integration into company management processes.

Additionally, previous research by Nadia et al., (2025) also showed that the implementation of Green Accounting through environmental cost allocation and financing CSR activities such as employee education and training, social assistance, and production waste management remains suboptimal and therefore has not fully supported Sustainable Development. Some companies in the consumer sector have not explicitly disclosed environmental cost information in their sustainability reports. Thus, future research should explore the extent to which Green Accounting is genuinely integrated into corporate management systems, as well as the factors influencing its effectiveness in driving real sustainability performance.

Material Flow Cost Accounting (MFCA) Has a Positive Effect on Sustainable Development

Based on the hypothesis testing results, the MFCA variable has a coefficient of 0.2012199 with a positive direction, consistent with the proposed hypothesis. The test results show a significance value of 0.0000, which is below the 5% significance level ($\alpha = 0.05$). This finding indicates that MFCA has a statistically significant positive impact on the achievement of sustainable development in the consumer non-cyclicals sector during 2021–2023.

The implementation of MFCA enables companies to identify and manage material flows and related costs more efficiently. This not only promotes resource savings and environmental impact reduction, but also enhances company profitability through environmental cost efficiency. Although cost reductions reflect a negative direction, their impact actually reinforces the achievement of Sustainable Development. This means that companies are not only able to survive but also make real contributions to sustainable development (Hindriani et al., 2024).

From the perspective of legitimacy theory, these findings show that companies implementing MFCA effectively have aligned their operational activities with societal values and expectations, particularly in terms of environmental concern and resource efficiency. The theory asserts that companies gain support and trust from the public when their operations and reporting are seen as socially legitimate. By transparently and efficiently managing waste, resources, and environmental costs through MFCA, companies strengthen their social legitimacy in the eyes of the public, investors, and regulators. This not only improves their image and reputation but also contributes directly to long-term sustainability.

These findings are supported by Sartika et al., (2025) which showed that with a t-statistic of 9.628 and a p-value of 0.000, Material Flow Cost Accounting (MFCA) significantly influences sustainable development. This is also consistent with the findings of Damayanti & Harti Budi Yanti, (2023), who explained that MFCA comprises three key elements: production costs, factory area, and production output. In this study, the second hypothesis specifically tested the effect of production costs on sustainable development, and the test results show that H2 is accepted, confirming a positive relationship between production costs (as part of MFCA) and sustainable development. Therefore, the second hypothesis (H_2) is accepted, as MFCA has a positive effect on sustainable development.

CONCLUSION

This study shows that the implementation of Green Accounting in consumer non-cyclicals sector companies has not had a significant impact, and even tends to have a negative effect on Sustainable Development. This is likely due to the fact that while companies may be applying Green Accounting in practice, they do not explicitly include it in their annual reports some only present it as narrative or images, without quantitative data that can be analyzed. Additionally, limitations in Green Accounting disclosure and recording are reflected in the data tabulation results, which show a significant difference in value compared to the MFCA and Sustainable Development variables. This mismatch is one of the reasons why the effect of Green Accounting was not statistically significant.

On the other hand, Material Flow Cost Accounting (MFCA) has been proven to have a positive effect, as it enhances cost efficiency while supporting corporate sustainability. These findings contribute to the development of sustainability reporting theory by emphasizing the importance of measurability and consistency in environmental cost disclosures. Future research is recommended to develop Green Accounting measurement methods in the form of a numerical index so that its values can be statistically quantified, similar to MFCA and Sustainable Development variables.

Given the large numerical values of the latter two variables in some cases reaching billions or trillions of rupiah, data transformation using the natural logarithm (Ln) is necessary to stabilize variance, normalize data scale, and improve the validity and accuracy of the regression model used. Theoretically, these findings imply the need for more standardized and quantitative sustainability reporting, while practically, companies must improve transparency and

accountability in environmental cost reporting so their contribution to Sustainable Development can be objectively and measurably assessed.

REFERENCES

14051, I. (2014). Manual Of Material Flow Cost Accounting. In *Early Human Development* (Vol. 83, Issue 4). Https://Doi.Org/10.1016/J.Earlhumdev.2006.05.022

Aisyah, N. A. (2022). *The Effect Of Implementing Green Accounting On Company Performance (Case In Green Industry Award-Winning Companies Listed On The Indonesian …*. *2*(3), 72–77.

Al-Tuwaijri, S. A., Christensen, T. E., & Hughes, K. E. (2005). The Relations Among Environmental Disclosure, Environmental Performance, And Economic Performance: A Simultaneous Equations Approach. *Ssrn Electronic Journal*, *January 2003*. Https://Doi.Org/10.2139/Ssrn.405643

Amira, A., & Siswanto, S. (2022). Pengaruh Penerapan Akuntansi Lingkungan Terhadap Nilai Perusahaan Consumer Non-Cyclicals Yang Terdaftar Di Bursa Efek Indonesia. *Jurnal Pajak Dan Keuangan Negara (Pkn)*, *4*(1s), 200–210. Https://Doi.Org/10.31092/Jpkn.V4i1s.1764

Baene, O. A., Andrianto, W., & Kusumawardhani, D. (2025). *The Impact Of Green Accounting On Material Flow Cost Accounting In Improving Business Sustainability And Palm Oil Company Value In Indonesia In 2021-2023*. *1*, 61–74.

Brundtland, G. H. (2017). Our Common Future (‘The Brundtland Report’): World Commission On Environment And Development. *The Top 50 Sustainability Books*, 52–55. Https://Doi.Org/10.4324/9781351279086-15

Damayanti, R. S., & Harti Budi Yanti. (2023). Pengaruh Implementasi Green Accounting Dan Material Flow Cost Accounting Terhadap Sustainable Development. *Jurnal Ekonomi Trisakti*, *3*(1), 1257–1266. Https://Doi.Org/10.25105/Jet.V3i1.16014

Deegan, C. (2002). Introduction: The Legitimising Effect Of Social And Environmental Disclosures – A Theoretical Foundation. *Accounting, Auditing & Accountability Journal*, *15*(3), 282–311. Https://Doi.Org/10.1108/09513570210435852

Efria, D. A., Baining, M. E., & Orinaldi, M. (2023). Pengaruh Green Accounting Dan Kinerja Lingkungan Terhadap Kinerja Keuangan Perusahaan Pertambangan. *Al Fiddhoh*, *4*(September), 77–88.

Hindriani, R., Siregar, D. K., Idayu, R., & Husni, M. (2024). *Penerapan Green Accounting Dan Material Flow Cost Accounting Terhadap Sustainable Development*. *4*, 845–854.

Inayati, N. I., Rahmawati, I. Y., Pandansari, T., Hapsari, I., & Ramadhani, A. N. (2025). *Environmental , Social And Governance (Esg) And Corporate Financial Performance : Moderating Effects Of Financial Slack*. *15*(1), 110–120.

Kurnianingtyas, I., Putu, L., & Trisnawati, P. (N.D.). *Pengaruh Green Accounting Dan Material Flow Cost*.

Lestari, W., & Alim, M. (N.D.). *Jurnal Digital Akuntansi (Judika) Pengaruh Green Accounting, Material Flow Cost Accounting (Mfca) Terhadap Sustainable Development*.

Loen, M. (2018). Penerapan Green Accounting Dan Material Flow Cost Accounting (Mfca)Terhadap Sustainable Development. *Jurnal Akuntansi Dan Bisnis Krisnadwipayana*, *5*(1), 1–14. Https://Doi.Org/10.35137/Jabk.V5i1.182

Lusia, M. G., & Effriyanti, E. (2024). Pengaruh Penerapan Green Accounting, Kinerja Lingkungan Dan Struktur Modal Terhadap Kinerja Keuangan. *Mantap: Journal Of Management Accounting, Tax And Production*, *2*(2), 1059–1073.

Https://Doi.Org/10.57235/Mantap.V2i2.3545

Marota, R. (2017). Green Concepts And Material Flow Cost Accounting Application For Company Sustainability. *Indonesian Journal Of Business And Entrepreneurship*, *3*(1), 43–51. Https://Doi.Org/10.17358/Ijbe.3.1.43

May, S. P., Zamzam, I., Syahdan, R., & Zainuddin, Z. (2023). Pengaruh Implementasi Green Accounting, Material Flow Cost Accounting Dan Environmental Performance Terhadap Sustainable Development. *Owner*, *7*(3), 2506–2517. Https://Doi.Org/10.33395/Owner.V7i3.1586

Monitor Tangerang. (2021). *Warga Keluhkan Limbah Pabrik Pt. Mayora Ke Sungai Kunir*. Https://Monitortangerang.Com/Warga-Keluhkan-Limbah-Pabrik-Pt-Mayora-Ke-Sungai-Kunir/

Nadia, P., Yupita, L., & Kunci, K. (2025). *Pengaruh Green Accounting Dan Kinerja Lingkungan Terhadap Sustainable Development Goals Pada Perusahaan Manufaktur Sektor Barang Konsumsi Tahun 2021-2023*. *11*(1), 292–306.

Nengsih, T. A., Majid, M. N., & Reza, P. A. (2022). Pengaruh Penerapan Green Accounting Dan Environmental Performance Terhadap Return On Asset. *J-Mas (Jurnal Manajemen Dan Sains)*, *7*(2), 455. Https://Doi.Org/10.33087/Jmas.V7i2.428

Nugraha, N. F. A. S. (2023). Pengaruh Penerapan Green Accounting Dan Environmental Performance Terhadap Sustainability Development Dengan Supply Chain Sebagai Pemoderasi. *Measurement Jurnal Akuntansi*, *17*(2), 346–351.

Nur'ainun, U., & Lestari, R. (2017). Pengungkapan Akuntansi Lingkungan Dan Kinerja Keuangan. *Snab*, *1*(1), 107–116.

Ogunode, O. A. (2022). Legitimacy Theory And Environmental Accounting Reporting And Practice: A Review. *South Asian Journal Of Social Studies And Economics*, *January*, 17–28. Https://Doi.Org/10.9734/Sajsse/2022/V13i130345

Santi, A. R., Andi, K., Lindrianasari, & Oktavia, R. (2022). Pengaruh Penerapan Material Flow Cost Accounting Terhadap Green Accounting Dan Financial Performance. *Fair Value: Jurnal Ilmiah Akuntansi Dan Keuangan*, *5*(2), 723–732. Https://Doi.Org/10.32670/Fairvalue.V5i2.2327

Santoso, M. A. S., & Handoko, J. (2025). Pengaruh Implementasi Green Accounting Dan Material Flow Cost Accounting Terhadap Sustainable Development. *Jak (Jurnal Akuntansi) Kajian Ilmiah Akuntansi*, *12*(1), 1–21. Https://Doi.Org/10.30656/Jak.V12i1.8049

Sartika, D., Rahardian, M., Helmina, A., Nor, W., & Lambung, B. (2025). *Driving Sustainable Development Through Mfca And Green Accounting : The Role Of Resource Efficiency*. *09*(01), 151–162.

Selpiyanti, S., & Fakhroni, Z. (2020). Pengaruh Implementasi Green Accounting Dan Material Flow Cost Accounting Terhadap Sustainable Development. *Jurnal Aset (Akuntansi Riset)*, *12*(1), 109–116. Https://Doi.Org/10.17509/Jaset.V12i1.23281

Somantri, A. J., & Sudrajat, A. M. (2023). Pengaruh Penerapan Green Accounting Dan Kinerja Lingkungan Terhadap Sustainable Development (Pada Perusahaan Manufaktur Sektor Industri Dasar Dan Kimia 2020-2022). *Jurnal Pendidikan Tambusai*, *7*(3), 21397–21401.

Suchman, M. C. (1995). Managing Legitimacy: Strategic And Innovative Approaches. *Academy Of Management Review*, *20*(3), 571–610. Http://Www.Downloadmaghaleh.Com/Wp-Content/Uploads/Edd/9817.Pdf

Suprianing Arum, L., & Farida. (2023). Pengaruh Green Accounting, Environmental Performance, Material Flow Cost Accounting (Mfca) Dan Environmental Disclosure Terhadap

Sustainable Development Goals (Sdgs). *Kajian Bisnis Sekolah Tinggi Ilmu Ekonomi Widya Wiwaha*, *31*(2), 54–67. Https://Doi.Org/10.32477/Jkb.V31i2.711

Trevanti, G. C., & Yuliati, A. (2023). Pengaruh Penerapan Green Accounting Terhadap Sustainable Development Dengan Ukuran Perusahaan Sebagai Variabel Intervening. *Journal Of Economic, Bussines And Accounting (Costing)*, *7*(1), 2208–2218. Https://Doi.Org/10.31539/Costing.V7i1.6439

Trisnaningsih, S., Hendrawan, B. M., & Hendra, F. H. (2024). Application Of Green Accounting And Material Flow Cost Accounting Towards Sustainable Development. *International Journal Of Religion*, *5*(11), 2814–2819. Https://Doi.Org/10.61707/Xzqe8a24

Veronika, J., Ginting, B., Ramles, P., & Ginting, F. (2022). *Implementasi Green Accounting (Akuntansi Lingkungan) Di Indonesia : Studi Literatur*. *8*, 40–49.

Wahanisa, R., & Adiyatma, S. E. (2021). The Conception Of Principle Of Sustainability In Environmental Protection And Management Value Of Pancasila. *Bina Hukum Lingkungan*, *6*(1), 93–118. Http://Dx.Doi.Org/10.24970/Bhl.V6i1.145