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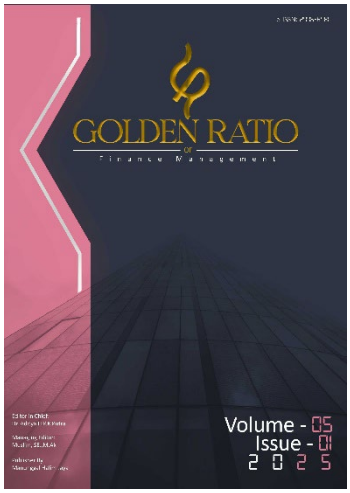

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FINANCE | RESEARCH ARTICLE

The Effect of Green Accounting and Carbon Accounting on Production Sustainability in Financial Performance in Agribusiness Companies

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Abstract: This research aims to describe the evolution of internal audit, focusing on identifying the most productive and cited articles, authors, countries, and institutions. The study used bibliometric analysis with VOSviewer software based on Scopus data, covering 490 articles published from 2017–2023. Data was collected using the "internal audit" keyword and analyzed to identify publication trends, author collaborations, and citation patterns. The results showed that the number of publications on internal audits continues to increase, with 2020 being the most productive year, with 80 articles (16.33%). The United States leads in the number of articles and citations, followed by Malaysia and other countries. Authors such as Eulerich Marc and institutions such as Brigham Young University are among the most productive in this study. The article " Influence of Audit Committee and Internal Audit Function Effectiveness on Enterprise Risk Management Adoption" by Callahan et al. is the most cited. The implications of this study show the importance of the evolution of the role of internal audit in risk management, control, and organizational governance, especially in the era of digitalization. Then, for further research evolution, other software and visualization methods can be used besides VOSviewers, such as CiteSpace or Gephi, to provide more comprehensive insights into the structure of internal audit research.

Keywords: Internal Audit, Bibliometric Analysis, VOSviewer, Scopus.

JEL Classification Code: M42, C80, D83, G32, L21.

1. INTRODUCTION

Climate change has become one of the most pressing challenges facing the global industry, with its impacts increasingly visible in environmental degradation, health risks, and economic instability. The rise in global temperatures, shifts in extreme weather patterns, and threats to ecosystems have sparked worldwide calls to mitigate industrial activities. One key contributor to this crisis is the high carbon dioxide (CO2) emissions from energy-intensive industrial processes. These emissions significantly accelerate global warming, threatening human life and the ecosystems that sustain it. According to data from (BMKG Indonesia, 2023), the average temperature in Indonesia in September 2023 was 0.4°C higher than usual (27.0°C compared to the 1991–2020 average of 26.6°C). Without immediate and effective action, the risks of further environmental degradation, such as rising sea levels, natural disasters, and biodiversity loss, will intensify, endangering future generations.

As global awareness of climate change rises, there is growing momentum to embed sustainability principles in corporate operations, especially in industries with considerable environmental impact. Green and carbon accounting are essential for measuring and managing these ecological effects. Green accounting tracks and measures environmental costs, enabling companies to understand the ecological impact of their activities and make more sustainable decisions. Carbon accounting, on the other hand, quantifies CO2 emissions, allowing companies to implement strategies for reduction and contribute to sustainability goals.

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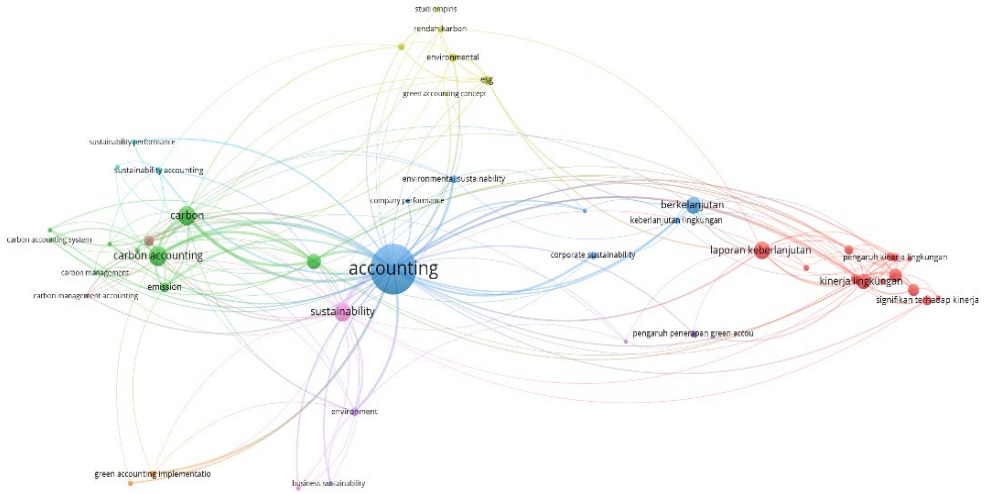

Figure 1. VOS Viewer

This research explores the integration of green and carbon accounting within Indonesia's agribusiness sector, specifically in the agricultural food product industry. The study aims to measure the environmental impact of agribusiness activities while examining how the combination of these accounting practices influences production sustainability, which in turn affects financial performance. This approach is novel as it connects environmental sustainability to economic outcomes, an area that remains underexplored in the literature.

2. LITERATURE REVIEW

This study's success is based on applying various relevant theories, which form the basis for analyzing the relationship between green accounting, carbon accounting, and the financial performance of agribusiness companies. This study was built by integrating three primary levels of theory, grand theory, middle theory, and applied theory, which are interrelated to comprehensively understand the phenomenon being studied. The Grand Theory that is the primary basis for this study is Management Accounting Theory. This theory functions as an internal financial reporting system and an essential element in strategic decision-making directly affecting the company's sustainability. With this approach, management accounting allows companies to evaluate operational efficiency and the effectiveness of business strategies and consider external challenges, such as market demands that increasingly prioritize sustainability and environmentally friendly practices. The supporting Middle Theory is the Sustainability Theory, which links environmental aspects to the accounting framework. These theories provide insight into how companies can integrate sustainability into their accounting processes and how measuring environmental impacts through green and carbon accounting can affect a company's financial performance.

2.1 Management Accounting Theory

Management accounting encompasses the measurement, collection, analysis, and communication of economic events that assist management in planning, controlling, decision-making, and evaluating the performance of an organization (Kardinal, 2014). According to Firmansyah et al (2020) Management accounting is a structured system that provides valuable and efficient information to help achieve organizational goals, including performance measurement, cost analysis, and resource management. Additionally Azhar et al (2023) Management accounting is crucial for identifying and analyzing existing data to improve company performance.

2.2 Theory of Sustainability

Sustainability refers to maintaining ecosystems, natural resources, and social well-being for future generations. It encompasses three key dimensions: economic, social, and environmental (Youmatter,

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2024). From an economic perspective, sustainability emphasizes maintaining natural and financial capital. In the ecological dimension, sustainability emphasizes biodiversity and ecosystem integrity, while from the social side, the focus is on human dignity and social justice worldwide. Notes that sustainability addresses environmental and cultural challenges while maintaining natural capital, biodiversity, and human dignity. Ultimately, sustainability seeks to ensure the ability to maintain an entity or process without depleting the resources that sustain it (Mensah, 2019).

2.3 Green Accounting

Green Accounting, also known as environmental accounting, is an accounting method that incorporates environmental costs into financial reporting. This approach has gained significant importance due to the increasing global awareness of the ecological impacts of industrial activities (Lako, 2019). Green Accounting helps companies assess their operations' environmental and financial impact, identifying areas for improvement in environmental efficiency (Widyastuti, 2024). According to Herny & Herawaty (2024) Suggests that green accounting includes costs related to environmental conservation, providing a more holistic perspective on business performance. This means that in addition to traditional financial metrics, it also accounts for the costs of preserving the environment, offering a more holistic approach to business accounting. The application of Green Accounting brings several benefits, such as improving a company's reputation among stakeholders, including investors, consumers, and the general public, and providing a competitive edge for businesses that demonstrate a commitment to environmental responsibility (Angelina & Nursasi, 2021). This is reflected in proactive policies managing natural resources, reducing greenhouse gas emissions, and reducing waste. (Endiana et al., 2020).

2.4 Carbon Accounting

Carbon accounting involves integrating carbon-related information into a company's financial records, focusing on measuring, recording, and reporting carbon emissions generated by business operations (Taurisianti & Kurniawati, 2014). This process plays a key role in corporate social responsibility by helping companies manage their greenhouse gas (GHG) emissions, set emission reduction targets, and report progress to stakeholders (Dwijayanti, 2011). Indriyani & Sudibyo (2024) Argue that carbon accounting reflects a company's commitment to environmental responsibility, which stakeholders, including governments and investors, increasingly demand. Companies that incorporate carbon accounting into their business strategies can adapt more effectively to regulatory changes and capitalize on opportunities in carbon trading schemes.

2.5 Production Sustainability

Sustainability of production is defined as the ability of a production system to meet current needs without compromising the ability of future generations to meet their own needs (Cardoso & Barbero, 2020). According to Demiral (2023) Suggests that sustainable production often involves efficiently using natural resources and reducing environmental impacts, such as CO2 emissions and waste. Companies must use a multidisciplinary approach that includes economic, environmental, and social aspects to achieve sustainable production goals. By adopting sustainability principles, companies contribute to ecological preservation and create a positive image in the eyes of consumers and society, who increasingly prioritize social and environmental responsibility in their decisions (Viles et al., 2022).

2.6 Financial Performance

Financial performance is an indicator used to assess the effectiveness of a company in managing resources to generate profits. Financial performance refers to the outcomes or accomplishments a company's management attained through effectively managing its assets over a specific period (Rasyid & Zakaria, 2023). According to Ramadhani & Saputra (2022) Financial performance is an assessment to determine how well a company performs using appropriate and correct financial implementation

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standards. This performance provides an overview of how well a company manages resources and maximizes profits for shareholders (Putri & Mayangsari, 2024). Financial performance impacts the company's stability and is the basis for strategic decision-making. The concept in this study is the influence of Green Accounting and carbon accounting on financial performance with production sustainability as an intervening variable, so the conceptual research framework is prepared as follows:

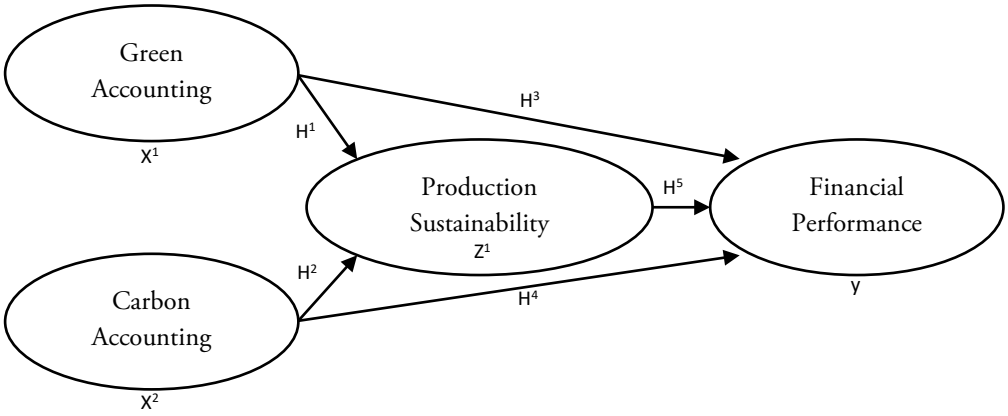

Figure 2. Conceptual Framework

3. RESEARCH METHOD AND MATERIALS

This study uses a quantitative approach with a causal design to measure the relationship between variables: green accounting, carbon accounting, production sustainability, and company financial performance. The researcher used the Partial Least Squares (PLS) method to test the relationship between latent variables, suitable for small samples and non-normally distributed data. This causal design aims to identify the direct and indirect impacts of implementing Green Accounting and carbon accounting on the sustainability of production and the company's financial performance.

3.1. Research Method

The study was conducted on agribusiness companies listed on the Indonesia Stock Exchange (IDX), focusing on financial data and sustainability reports for 2019-2023. The sample used was eight agribusiness companies that consistently implement green and carbon accounting, selected using purposive sampling. Data collection techniques were carried out by documentation and downloading financial and sustainability reports published by the company.

3.2. Variable and Data Processing

The variables studied include green accounting, carbon accounting, production sustainability, and financial performance. Data processing was carried out using PLS software to test the validity and reliability of the instrument, as well as the relationship between variables. Hypothesis testing is done by looking at the p-value and f-square to test the significance of the relationship between variables and to evaluate whether production sustainability acts as an intervening variable between green accounting, carbon accounting, and financial performance. Overall, this study aims to understand how implementing Green Accounting and carbon accounting affects the sustainability of production and economic performance of agribusiness companies listed on the IDX.

3.3. Theoretical Framework

The study is grounded in Management Accounting Theory, which helps assess the efficiency of business strategies and operational performance. Sustainability Theory connects environmental issues with accounting practices, showing how measuring ecological impacts can affect financial

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performance. These theories guide the study in analyzing the effects of green and carbon accounting on the sustainability of production and company performance.

4. RESULTS AND DISCUSSION

The results of this study focus on the evaluation and improvement of the measurement model used to measure the constructs in the study. In the analysis process, loading factors ensure that the relationship between variables accurately represents the constructs being measured more representatively and reliably.

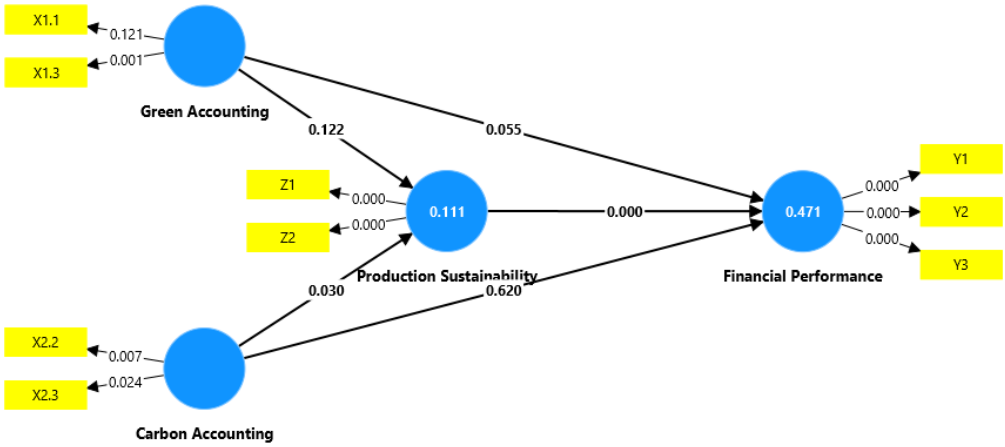

Figure 3. Loading Factor

Table 1. Hypothesis Testing

Hypothesis	p-value	95% Confidence Interval		f-square	Significant
		Bottom	Top		
H1, Green Accounting → Production Sustainability	0,122	-0,132	-0,307	0,065	H1 rejected, Green Accounting has no significant influence on production sustainability.
H2, Carbon Accounting → Production Sustainability	0,030	0,031	0,536	0,008	H2 is accepted, and there is a significant influence between carbon accounting and production sustainability.
H3, Green Accounting → Financial Performance	0,055	-0,381	-0,013	0,023	H3 rejected, Green Accounting has no significant influence on financial performance.
H4, Carbon Accounting → Financial Performance	0,620	-0,077	-0,359	0,086	H4 rejected the idea that carbon accounting does not significantly influence financial performance.
H5, Production Sustainability → Financial Performance	0,000	0,387	0,816	0,699	H5 accepted that production sustainability has a significant influence on financial performance.

The first hypothesis (H_1), stating that Green Accounting significantly affects production sustainability, is rejected. Based on the analysis results, the p-value of 0.122 is greater than 0.09,

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indicating no significant relationship between Green Accounting and production sustainability. In addition, the range of confidence intervals that include negative values and a small F-square value (0.065) strengthens this finding. Therefore, there is no significant influence between Green Accounting and production sustainability in the agribusiness companies studied.

The second hypothesis (H_2) is accepted, which states that carbon accounting significantly affects production sustainability. The analysis results show a p-value of 0.030, more diminutive than 0.09, indicating a significant positive relationship between carbon accounting and production sustainability. However, the effect is relatively small, with an F-square value of 0.008, indicating that the impact of carbon accounting on production sustainability does exist but is not too large.

The third hypothesis (H_3) that tests the effect of Green Accounting on financial performance is rejected. The P-value of 0.055 indicates that the impact of Green Accounting on financial performance is insignificant. The extensive confidence interval range (-0.381 to -0.013) indicates a significant positive and negative impact variability. In addition, the small F-square value (0.023) confirms that the effect of Green Accounting on financial performance is minimal, so this hypothesis is not accepted.

The fourth hypothesis (H_4), stating that carbon accounting significantly affects financial performance, is also rejected. The P-value of 0.620 indicates that the effect of carbon accounting on financial performance is insignificant. The confidence interval covering negative values (-0.077 to -0.359) supports this finding, while the minimal F-square value (0.086) indicates that the effect of carbon accounting on financial performance is very low. Thus, this hypothesis is not accepted. The fifth hypothesis (H_5) is accepted, which states that production sustainability significantly affects financial performance. A small P-value (0.000) indicates a significant relationship between production sustainability and financial performance. The confidence interval ranging from 0.387 to 0.816 indicates that the effect of production sustainability on financial performance is positive and consistent. The considerable F-square value (0.699) strengthens this finding, suggesting that production sustainability is essential in improving the company's financial performance.

5. CONCLUSION

Green accounting does not significantly influence the sustainability of the company's production. This indicates that although Green Accounting is implemented in the company, its impact on increasing the sustainability of production is not strong enough. This could be due to the less-than-optimal implementation of Green Accounting or other challenges, such as limited resources or an in-depth understanding of this concept, especially in the agribusiness sector. When Green Accounting does not significantly influence, the company may need more time and effort to integrate sustainability principles into its production practices. This also leads to the idea that implementing this concept requires a more profound change in the mindset and structure of the company to affect sustainability significantly.

Carbon accounting has a significant influence on the sustainability of production. This means that implementing carbon accounting can positively increase sustainability in the company's production process. Better carbon footprint management allows companies to reduce negative environmental impacts while also improving operational efficiency. Although the effect is relatively small, this finding suggests that even though its contribution is not immediately enormous, broader and more effective carbon footprint management still has the potential to support long-term production sustainability. This indicates that more profound environmentally friendly practices, especially concerning carbon emissions, can strengthen production sustainability even with smaller initial steps. This result aligns with research conducted by (Ali et al., 2024), which shows that carbon accounting can positively affect production sustainability.

Green Accounting also does not show a significant effect on financial performance. Although implementing Green Accounting can benefit production sustainability, its impact on the company's financial performance is not immediately reflected. Most likely, the high initial implementation costs and the time required to see concrete results in financial performance cause the effect to be insignificant. Companies may not yet feel the financial benefits of implementing Green Accounting, which may require a long-term approach or further strategy adjustments to be more visible in the

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financial statements. This result aligns with research conducted by (Angelina and Nursasi, 2021), which states that Green Accounting has little positive effect on financial performance.

Carbon Accounting does not show a significant effect on the financial performance of agribusiness companies. This shows that although companies implementing carbon accounting can improve operational efficiency and reduce carbon footprints, its impact on the company's financial performance is still limited. This could mean that although there are long-term cost savings through reduced environmental impacts, the direct benefits realized in financial performance are not yet large enough in the context of the agribusiness companies studied. Therefore, companies must re-evaluate their carbon accounting strategies and implementations to reflect their financial impacts and more significant financial performance. This result does not align with research conducted by (Indriyani & Sudibyo, 2024), which states that carbon accounting does not significantly affect financial performance.

Production Sustainability has been shown to affect the company's financial performance significantly. This indicates that companies that integrate sustainability practices into their production tend to experience significant improvements in economic performance. Focusing on production sustainability gives companies a competitive advantage through more efficient resource management, cost reduction, and improved corporate image in the eyes of consumers. In the long term, this contributes to increased profitability and competitiveness of companies, making them better able to survive and thrive in a market that increasingly prioritizes sustainability aspects. This means that production sustainability impacts the environment and significantly impacts the company's financial performance. This result aligns with research conducted by (Ali et al., 2024), which states that production sustainability positively affects economic performance.

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