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ENVIRONMENTAL MANAGEMENT ACCOUNTING, GREEN INNOVATION, AND ENVIRONMENTAL PERFORMANCE IN BATIK MSMES

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Abstract

This study examines how environmental management accounting (EMA) contributes to improved environmental performance, particularly among SMEs in developing economies. Moving beyond identifying direct relationships, it explores the mechanism through which this influence occurs. Drawing on the Natural Resource-Based View and Stakeholder Theory, the study investigates both the direct effect of EMA on environmental performance and its indirect effect through green innovation among Batik MSMEs in the Surakarta Residency. A quantitative approach was employed, with data collected from 60 owners and managers and analyzed using PLS-SEM to test direct and mediating relationships. The results indicate that EMA has a positive and significant effect on environmental performance. In addition, EMA encourages green innovation, which further enhances environmental outcomes. These findings highlight green innovation as a key mechanism through which internal accounting practices are translated into tangible environmental improvements. Theoretically, the study integrates the Natural Resource-Based View and Stakeholder Theory by framing EMA as a strategic internal capability that enables firms to address stakeholder expectations through innovation. Empirically, it provides evidence from an emerging economy context and offers practical insights for SME managers aiming to achieve sustainable competitive advantage.

INTRODUCTION

Growing global concern over critical environmental challenges such as climate change, biodiversity degradation, pollution, and the rapid depletion of natural resources has positioned these issues as serious threats to planetary sustainability (Steffen et al., 2015). The consequences extend beyond ecological damage; they also disrupt social structures and economic stability at a global scale. As a result, businesses are facing mounting expectations to acknowledge and manage the environmental consequences of their operations, integrating greater accountability into their strategic and operational decisions (Elkington John, 1997).

Research on environmental performance is important because it reflects the extent to which we reduce negative impacts on the environment through responsible actions (Andrini et al., 2025). Companies that have good environmental performance are often more transparent in disclosing wish-related information to stakeholders, thereby improving their reputation in the

eyes of consumers and investors (Daromes et al., 2020). Environmental performance is measured through a combination of quantitative and qualitative indicators, including natural resource management, emission control, waste management, and stakeholder involvement in environmental impact mitigation (Rendrarpoetri et al., 2024).

From a theoretical standpoint, the Natural Resource-Based View argues that a firm's ability to manage and capitalize on environmental resources can become a foundation for sustainable competitive advantage (Hart, 1995). In this view, environmental capabilities are not peripheral concerns but integral elements of strategic positioning. Approaches such as pollution prevention, product stewardship, and sustainable development are therefore understood not merely as compliance-driven activities. Rather, they represent deliberate strategic choices that enhance operational efficiency while simultaneously strengthening the firm's competitiveness in the market (Hart & Dowell, 2011). In this sense, the internal capacity to manage environmental information and resources represents a strategic asset rather than an administrative function. Complementing this view, Stakeholder Theory suggests that companies are compelled to respond to expectations and pressures from various stakeholders, including regulators, customers, and local communities (Freeman & McVea, 1984). These pressures often encourage firms to adopt more environmentally oriented strategies and innovations. Consequently, the alignment between internal capabilities and external stakeholder demands becomes a crucial driver in improving environmental performance (Shahzad et al., 2020).

Field research in the traditional batik area of Laweyan reported the findings of significant lead levels in the sample of dye workers and indications of dye waste contamination that needed further toxicological and ecotoxicological treatment (Purwati et al., 2023). The quality analysis of batik waste showed that the content of chromium and synthetic dyes exceeded the quality standard threshold, so it required a specific processing process before being discharged into the environment (Dini et al., 2023). As a result, many MSMEs still dispose of liquid waste directly or only carry out partial treatment, which worsens the quality of local rivers including the stream that empties into Bengawan Solo and raises environmental enforcement issues that need to be strengthened by local authorities (Saadiya et al., 2024). The local government has facilitated the provision of a Wastewater Treatment Plant (WWTP) to support wastewater management efforts, but its effectiveness is still limited due to lack of engineering capacity, operational costs and ongoing supervision (Brontowiyono et al., 2022). On the other hand, the limited technical knowledge of the craftsmen of the dangers of chemicals leads to a lack of awareness of the risks of water pollution and occupational health (Purwati et al., 2023). Therefore, environmental performance research on Batik Solo Raya MSMEs will be maximized by adopting the accounting role of environmental management and green innovation.

A growing body of literature suggests that environmental management accounting and green innovation each play a significant role in strengthening environmental performance. Studies by Aslam et al., (2021) dan García-Machado & Martínez-Ávila, (2019) for example, document these beneficial effects. Yet their analyses tend to focus on direct linkages between variables, paying limited attention to the underlying process through which environmental management accounting translates into better environmental outcomes. In particular, green innovation is rarely positioned explicitly as a mediating mechanism that bridges this relationship. Moreover, prior findings are not entirely consistent. Susanto & Meiryani, (2019) and Sari et al., (2020), report a direct and positive impact of environmental management accounting on environmental performance. By contrast, Agustia et al., (2019), show that the relationship becomes more pronounced when green innovation is incorporated as an intervening variable. These mixed results indicate that the role of green innovation may be more integral than previously assumed.

Despite these advances, an important gap in the literature persists. Much of the existing research emphasizes direct relationships, offering limited explanation of the processes through which environmental management accounting leads to improved environmental outcomes (Christ & Burritt, 2013). In particular, empirical studies that position green innovation as a mediating mechanism remain scarce, especially in the context of MSMEs in developing economies (Shahzad et al., 2020). From the perspective of the Natural Resource-Based View (Hart, 1995), internal capabilities such as environmental management accounting should do more than enhance efficiency; they are expected to stimulate green innovation, which in turn strengthens environmental performance. Thus, effective internal resource management ideally triggers innovative responses that produce measurable environmental improvements. To bridge this gap, the present study investigates not only the direct impact of environmental management accounting on environmental performance but also its indirect influence through green innovation among Batik MSMEs in the Surakarta Residency. By drawing on the Natural Resource-Based View and Stakeholder Theory, the study positions environmental management accounting as a strategic internal capability—one that equips firms to respond to stakeholder expectations through innovation and, in doing so, achieve stronger and more sustainable environmental performance.

HYPOTHESIS DEVELOPMENT

Natural Resource-Based View Theory

Natural Resource-Based Theory introduced by Hart, (1995), presents a strategic perspective that positions environmentally oriented resources and capabilities as foundations for sustainable competitive advantage. Rather than relying solely on conventional assets, this approach highlights the importance of developing competencies that are closely tied to environmental management and stewardship. From this viewpoint, environmental issues are not merely external pressures or regulatory obligations that burden the firm. Instead, they can be incorporated into the organization's core systems and strategic processes. When environmental considerations are embedded into the company's operations and long-term planning, they can become a source of differentiation and strengthened competitiveness.

Theory Natural Resource-Based View enabling companies to identify and develop environmental capabilities, such as superior environmental performance, environmentally friendly innovation, and the application of environmental management accounting. These three aspects are fundamental mechanisms in preserving the environment, while minimizing the ecological impact caused by the company's operational activities. The implications of implementing these capabilities are not only limited to improving the corporate reputation, but also contribute significantly to the achievement of long-term competitive advantage (Mohamed et al., 2022). The findings reported by Hart, (1995), emphasize that strategies such as pollution prevention, product lifecycle management, and sustainable development can enhance operational efficiency, mitigate potential risks, and reinforce a firm's competitive position. Thus, environmental management that is integrated into business strategy is a strategic resource that can produce superior performance in a sustainable manner.

Stakeholder Theory

Stakeholder theory posits that organizations do not function in isolation; rather, they are embedded within a network of individuals and groups who can influence, or are influenced by, the pursuit of organizational goals and long-term business sustainability (Freeman & McVea, 1984). From this perspective, companies are expected to consider not only short-term financial outcomes, but also broader sustainability aspects that ensure continuity in the future. Consequently, organizations require a management approach that is responsive and attentive to the interests, expectations, and welfare of various stakeholders (Oruc & Sarikaya, 2011). In the

context of environmental responsibility, stakeholder involvement becomes particularly significant when companies implement green innovation initiatives aimed at reducing environmental harm (Andi Auliya & Fadlilah, 2021). When environmental management practices are carried out effectively, companies are better positioned to align their operational activities with stakeholder expectations regarding sustainability.

In the batik industry, the low environmental awareness of the community and the absence of policies that suppress the use of environmentally friendly chemicals make MSME actors tend to maintain conventional production processes (Thomas et al., 2021), due to weak pressure from stakeholders will result in low adoption of green innovations in the production and waste treatment process (Baah et al., 2021). Thus, based on stakeholder theory, green innovation emerged as a form of corporate response to pressures, demands, and support from stakeholders who emphasized the importance of environmental sustainability (Singh et al., 2022). Research findings conducted by Xie et al., (2024) shows that stakeholder pressure is only effective when accompanied by strong environmental awareness and ethics in the organization. Without such awareness, external encouragement is not enough to bring about behavior change or sustainable green innovation.

The Influence of Environmental Management Accounting on Environmental Performance

Within the Natural Resource-Based View framework, sustainable competitive advantage is rooted in a firm's internal capabilities to manage its resources effectively, including those related to the natural environment (Hart, 1995). Such capabilities enable firms not only to enhance operational efficiency but also to strengthen their long-term performance (Hart & Dowell, 2011). In this regard, environmental management accounting functions as a strategic information system that captures environmental costs, material flows, energy usage, and the broader operational impacts of the firm (Christ & Burritt, 2013). Once these environmental aspects become measurable and visible, management is better positioned to reduce waste, improve resource efficiency, and control pollution in a more systematic manner, ultimately leading to improved environmental performance.

Empirical findings lend support to this argument Hasan et al., (2024) for instance, report that environmental management accounting has a positive effect on environmental performance, indicating that more comprehensive implementation tends to be associated with stronger environmental outcomes. These results are consistent with the Natural Resource-Based View (Hart, 1995), which asserts that firms able to manage natural resources and environmental impacts effectively are better positioned to secure sustainable competitive advantage.

H_1: Environmental Management Accounting has a positive effect on Environmental Performance.

The Influence of Environmental Management Accounting on Green Innovation

Environmental management accounting acts as a strategic information system that uncovers hidden environmental costs, energy inefficiency, and material waste, thereby reducing internal information asymmetry and improving the quality of managerial decision-making (Qian et al., 2018). This information transparency creates rational pressure for management to design green innovations, namely the development of processes, products, and operational methods that are more efficient and environmentally friendly, thereby triggering green innovation based on resource efficiency (Christ & Burritt, 2013).

Theoretically within the framework of the Natural Resource-Based View put forward by (Hart, 1995), green innovation is a concrete form of organizational capabilities in transforming resource management into sustainable competitive advantage. Environmental management accounting expands a company's internal knowledge base which then increases innovative capacity in responding to cost pressures and stakeholder expectations (Christ & Burritt, 2013).

In other words, green innovation arises not solely because of regulation, but because Companies have enough information to identify and exploit environmental efficiency opportunities (Porter & Linde, 1995). This finding is consistent with Hasan et al., (2024) who demonstrate that environmental management accounting significantly influences green innovation. In other words, the more effectively environmental management accounting is implemented, the greater the firm's capacity to generate and adopt green innovation.
H_2: Environmental Management Accounting has a positive effect on Green Innovation.

The Influence of Green Innovation on Environmental Performance

Green innovation not only presents a normative commitment to environmental issues, but also an operational mechanism that directly changes the structure of the production process and product design to be more efficient and environmentally friendly (Chen et al., 2006). Through innovations in technology, materials, and production systems, the company is able to reduce emission intensity, reduce waste, and improve energy efficiency, resulting in measurable improvements in environmental performance (Singh et al., 2020).

Within the framework of Stakeholder Theory (Freeman & McVea, 1984), irms are expected to respond to the growing demands of stakeholders who place increasing emphasis on sustainability practices. In this context, green innovation can be understood as a strategic response that not only addresses these expectations but also enhances organizational legitimacy and operational efficiency. Consequently, improvements in environmental performance should not be viewed solely as technical outcomes of process changes, but as results of deliberate strategic adjustments to external pressures (Singh et al., 2020). Empirical findings support this view. Companies that consistently implement green innovation initiatives tend to achieve higher levels of environmental performance compared to those that do not (Rehman et al., 2021). The theoretical significance of this relationship lies in recognizing green innovation as a transformational mechanism-one that connects broader sustainability strategies with tangible and measurable performance outcomes
H_3: Green Innovation has a positive effect on Environmental Performance.

Green Innovation can mediate the influence of Environmental Management Accountability on Environmental Performance

The information generated from environmental management accounting encourages the emergence of green innovations in the form of environmentally friendly product development, processes, and systems as a form of company adaptation to the demands of stakeholders (Qian et al., 2018). With the existence of these green innovations, it then contributes to improving environmental performance through reducing waste, emissions, and energy consumption (Singh et al., 2020).

This statement is in line with the Natural Resource Based – View theory and the Stakeholder theory, that the application of environmental management accounting plays an important role in providing cost and environmental impact information, as well as research research conducted Agustia et al., (2019), revealed that the influence of environmental management accounting on environmental performance is stronger when mediated by green innovation. This indicates that green innovation plays a key role as a key mechanism that transforms information-based decisions into measurable performance outcomes (Singh et al., 2020). Thus, because environmental management accounting also has a direct influence on environmental performance, the mediating relationship expected in this study is partial mediation, not full mediation.
H_4: Green Innovation mediates the influence of Environmental Management Accounting on Environmental Performance.

METHOD

This study employs a quantitative research design to explore the causal relationships among the proposed variables (Sugiyono, 2023). Such an approach aligns with the study's objective, which is to test the hypothesized impact of environmental management accounting on environmental performance, both directly and indirectly through green innovation as a mediating variable.

The population consists of owners and managers of Batik MSMEs in the Surakarta Residency. They were selected because of their direct involvement in operational and strategic decision-making, making them well positioned to provide reliable information on the implementation of Environmental Management Accounting, Green Innovation, and Environmental Performance. The sampling technique applied was simple random sampling, with the criterion that respondents must be owners or managers actively engaged in operational decisions. The determination of sample size follows Roscoe's guideline (Scott, 2023), which suggests that an appropriate sample in multivariate research ranges from 30 to 500 respondents and should be at least ten times the number of variables analyzed. Given that this study examines three main variables, the minimum required sample is 30 respondents. With 60 respondents, the sample size is considered adequate and satisfies the recommended criteria.

The distribution of the questionnaire was carried out offline to Batik MSMEs of the Surakarta Residency, with the questionnaire measurement scale using a likert scale of 1-4, where the use of even scales is intended to reduce the tendency of neutral answers (Central Tendency Bias) and encourage respondents to give a more assertive assessment (Scott, 2023). The distribution of the questionnaire lasted about 2 months from December 2025 to January 2026, with the number of questionnaires distributed as many as 100, but there were 26 that refused to be filled, and 14 were returned, so that the number of respondents collected was 60 that were feasible and in accordance with the criteria to be used. The effective response rate of 60% is considered adequate in the Batik MSME survey research. To reduce the potential for non-response bias, a comparison of the initial characteristics between the initial and final respondents was conducted, and no significant differences were found in the main characteristics of the effort. Thus the risk of non-response bias was considered relatively low, in addition, statistical testing was performed using the full collinearity VIF approach in PLS-SEM, where the VIF value below the threshold of 3.3 showed that there were no significant general method bias problems (Kock, 2015).

The data were analyzed using SmartPLS 4 through the Partial Least Squares–Structural Equation Modeling (PLS-SEM) technique (Scott, 2023). The analysis proceeded in two main stages. First, the measurement model (outer model) was evaluated to verify the validity and reliability of the instruments. Convergent validity was assessed using loading factor and Average Variance Extracted (AVE) values, while reliability was examined through Cronbach's Alpha and Composite Reliability coefficients (Ghozali & Kusumadewi, 2023). Indicators were deemed acceptable once they met the established threshold values. The second stage involved assessing the structural model (inner model) to test the relationships among the latent constructs. Multicollinearity was checked using inner VIF values, and the model's explanatory power was evaluated through R-Square and F-Square statistics. Hypotheses were tested using a bootstrapping procedure, based on path coefficients, T-statistics, and P-values. A hypothesis was considered supported when the T-statistic was greater than 1.96 and the P-value was below 0.05 (Ghozali & Kusumadewi, 2023).

This study was conducted in accordance with established research ethics principles. All respondents received a clear explanation of the study's objectives, were assured that their responses would remain confidential, and participated on a voluntary basis. The data collected were used exclusively for academic purposes.

Table 1.
Research Variable

Variable	Definition	Indicators
Environmental Performance (Y)	Environmental performance is the level of an organization's ability to manage natural resources efficiently, reduce pollution, waste, and negative impacts on the environment through sustainable business practices (Hasan et al., 2024).	1. Compliance with environmental standards 2. Reduction of air emissions 3. Reduced energy consumption (Hasan et al., 2024).
Environmental Management Accounting (X)	Environmental management accounting is an accounting system used to identify, measure, analyze, and manage environmental cost information, both financial and physical, to assist management in sustainability-oriented decision-making (Hasan et al., 2024).	1. Recording physical inputs 2. Product environmental impact analysis 3. Setting targets on environmental performance 4. Management of environmental costs and liabilities (Hasan et al., 2024)
Green Innovation (Z)	Green innovation is an innovative effort in products and processes that aims to reduce negative impacts on the environment and improve the efficiency of resource use in production activities (Hasan et al., 2024).	1. Energy-efficient product design 2. Eco-friendly packaging innovation 3. Use of environmentally friendly materials (Hasan et al., 2024)

Source: Data processed, 2026.

RESULTS AND DISCUSSION

This study analyzed data collected from respondents through a questionnaire that was shared and feasible for 60 respondents. The respondents consisted of owners as well as managers and managers of Batik MSMEs of the Surakarta Residency. Detailed respondent data is presented in Table 2.

Table 2.
Respondent Characteristics

Criteria	Amount	Presentation
Gender:		
Male	36	60%
Women	24	40%
Job Title:		
Owner and Manager	51	85%
Manager	9	15%
Place of Business:		
Surakarta	22	37%
Sragen	19	32%
Klaten	12	20%
Wonogiri	2	3%
Sukoharjo	5	8%

Source: Data processed, 2026.

Based on the respondent data contained in Table 2. It is known that there are more male respondents compared to women. Meanwhile, the respondents' positions are dominated by owners and managers in Batik MSMEs in Surakarta Residency.

Data Analysis

Convergent Validity

The statements in these variables have a loading factor value of more than 0.7 and are

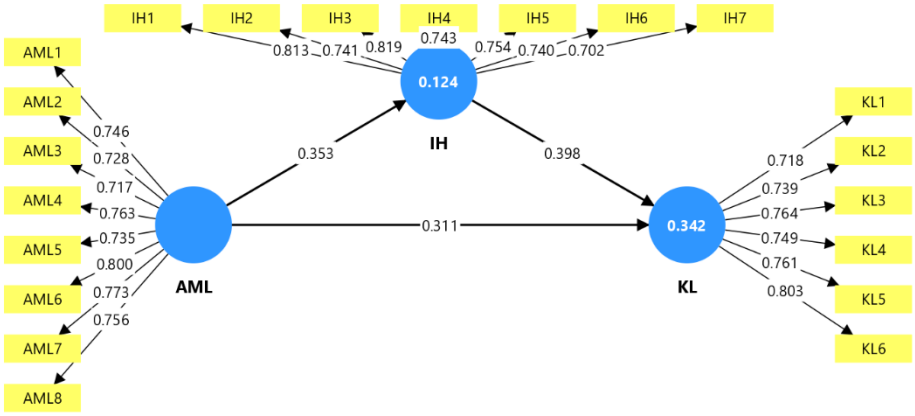
declared valid in this study shown in Table 3. as follows:

Table 3.
Loading Factor

Indicators	Environmental Management Accounting	Green Innovation	Environmental Performance
EMA1	0.746		
EMA2	0.728		
EMA3	0.717		
EMA4	0.763		
EMA5	0.735		
EMA6	0.800		
EMA7	0.773		
EMA8	0.756		
GI1		0.813	
GI2		0.741	
GI3		0.819	
GI4		0.746	
GI5		0.754	
GI6		0.740	
GI7		0.702	
EP1			0.718
EP2			0.739
EP3			0.764
EP4			0.749
EP5			0.761
EP6			0.803

Source: Data processed using SmartPLS 4, 2026

As presented in Table 3, the results of the loading factor test show that all indicator values exceed 0.70, indicating that each item meets the required validity threshold (Ghozali & Kusumadewi, 2023). This finding suggests that the indicators are strongly associated with their respective constructs. In other words, each measurement item is able to adequately reflect the latent variable it represents, thereby confirming the convergent validity of the measurement model. Here's the research model:



Source: Data processed using SmartPLS 4, 2026

Figure 1.
SEM-PLS Model

Figure1. Displays a SEM-PLS measurement model that shows the relationship between the latent construct and its indicator. All indicators have a loading factor value above 0.70, confirming the indicator's strong reliability. Each shows a loading factor value that ranges from

0.702 to 0.819, indicating that all items effectively represent their respective constructs.

Discriminant Validity

Discriminant validity is evaluated to ensure that each construct is conceptually and empirically distinguishable from the others in the model. In this study, it was assessed using the latent variable correlation approach, which examines whether a construct demonstrates stronger associations with its own indicators than with those of other constructs. This analysis helps confirm that the observed relationships reflect genuine distinctions between variables rather than measurement overlap. The results of this assessment are presented in Table 4.

Table 4.
Discriminant Validity

Variabel	Environmental Management Accounting	Green Innovation	Environmental Performance	AVE	√AVE	Valid
Environmental Management Accounting	1.000	0.442	0.514	0.584	0.764	Valid
Green Innovation	0.442	1.000	0.536	0.584	0.764	Valid
Environmental Performance	0.514	0.536	1.000	0.610	0.781	Valid

Source: Data processed using SmartPLS 4, 2026

Value *Latent Variable Correlation* viewed by comparing the values √AVE. Value √AVE must be greater than the correlation value between latent variables in the same row/column. If the result is large, then the validity discriminator is fulfilled (Ghozali & Kusumadewi, 2023).

Table 5.
HTMT Criterion Assessment

	Environmental Management Accounting	Green Innovation	Environmental Performance
Environmental Management Accounting			
Green Innovation	0.357		
Environmental Performance	0.487	0.506	

Source: Data processed using SmartPLS 4, 2026

Discriminant validity was further assessed using the Heterotrait–Monotrait Ratio (HTMT), as presented in Table 5. The results show that all HTMT values are below the recommended threshold of 0.90, indicating that the requirement for discriminant validity has been satisfied (Henseler et al., 2015). These findings suggest that each construct exhibits stronger relationships with its own indicators than with those associated with other constructs. In other words, the measurement items align more closely with their intended variables rather than overlapping with unrelated ones. Therefore, the model demonstrates satisfactory discriminant validity, confirming that the constructs examined in this study are both conceptually distinct and empirically separable.

Construct Reliability

Construct reliability can be assessed using two commonly applied measures, namely Cronbach's Alpha and Composite Reliability. Both indicators serve to evaluate the internal consistency of the measurement items within a construct. Through these measures, the extent to which the indicators consistently represent the underlying variable can be determined. These can be seen in Table 6.

Table 6.
Construct reliability & validity

	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
Environmental Management Accounting	0.892	0.913	0.567
Green Innovation	0.880	0.905	0.577
Environmental Performance	0.855	0.889	0.572

Source: Data processed using SmartPLS 4, 2026

Based on Table 6. It can be seen that cronbach's alpha and composite reliability values for all constructs are >0.70, so it can be said that the constructs in this study have good reliability, and for AVE values have met all >0.50 (Ghozali & Kusumadewi, 2023)

Evaluation of the Structural Model (Inner Model)

Structural model evaluation was carried out to test the hypothesis regarding the influence between variables. This evaluation process is carried out through 4 stages. The first stage is to ensure that there is no problem of multicollinearity between variables by using the internal VIF measure. The inner VIF value below 5 indicates that multicollinearity does not occur (Hair et al., 2019). The next stage examines the R-square and F-Square values and determines whether the research hypothesis is accepted or rejected. This is assessed through the T statistic and P value, which must meet the minimum limit of > 1.96 and < 0.05 (Ghozali & Kusumadewi, 2023).

Table 7.
Inner VIF

	Environmental Management Accounting	Green Innovation	Environmental Performance
Environmental Management Accounting		1.000	1.142
Green Innovation			1.142
Environmental Performance			

Source: Data processed using SmartPLS 4, 2026

Based on table 7. above shows that all the inner values of VIF are below 5, so it can be concluded that the level of multicollinearity of variables is relatively low. This condition reinforces that parameter estimation in SEM-PLS is unbiased.

Table 8.
R-Square Test

	R-Square	R-Square Adjusted
Green Innovation	0.124	0.109
Environmental Performance	0.342	0.319

Source: Data processed using SmartPLS 4, 2026

R-square test results showed that the green innovation variable obtained an R-Square value of 0.124 and an R-Square Adjusted of 0.109. This shows that the independent variable in the model is able to explain 12.4% of the variation in the green innovation variable. Meanwhile, the rest is explained by other variables outside the research model. Based on criteria (Chin, 1998), R value^2 0.124 is in the low category, so the model's predictive ability on green innovation is still relatively limited. Meanwhile, the environmental performance variable obtained an R-Square value of 0.342 and an R-Square Adjusted of 0.319, which shows that the model is able to explain 34.2% of environmental performance variations with a moderate level of predictive ability, so that the research model has a better ability to explain environmental performance compared to green innovation.

Table 9.
F-Square Test

	Environmental Management Accounting	Green Innovation	Environmental Performance
Environmental Management Accounting		0.142	0.128
Green Innovation			0.210
Environmental Performance			

Source: Data processed using SmartPLS 4, 2026

According to Cohen, (1988), classifies F-square values of 0.02, 0.15, and 0.35 as indicating small, medium, and large effect sizes, respectively. Referring to this guideline, the effect of environmental management accounting on green innovation produces an F^2 value of 0.142, placing it close to the moderate category. Although the relationship is statistically significant, its practical impact can be described as meaningful but not dominant. A similar pattern appears in the relationship between environmental management accounting and environmental performance, where the F^2 value of 0.128 also reflects a moderate effect. This suggests that environmental management accounting contributes to improving environmental performance, yet it is not the primary driving factor. By comparison, green innovation shows an F^2 value of 0.210 in explaining environmental performance. While still within the medium range, this effect is stronger than that of environmental management accounting. Substantively, these results underscore the importance of green innovation as a mechanism that converts internal capabilities into more tangible and measurable environmental improvements.

Table 10.
Hypothesis Results

Hypothesis	Original Sample (O)	Sample Mean (M)	Standar Deviation (STDEV)	T Statistics	P Values	Result
Environmental Management Accounting → Environmental Performance	0.311	0.317	0.116	2.671	0.004	H_1 Accepted
Environmental Management Accounting → Green Innovation	0.353	0.394	0.123	2.877	0.002	H_2 Accepted
Green Innovation → Environmental Performance	0.398	0.415	0.128	3.118	0.001	H_3 Accepted
Environmental Management Accounting → Green Innovation → Environmental Performance	0.140	0.161	0.069	2.025	0.021	H_4 Accepted

Source: Data processed using SmartPLS 4, 2026

Based on the SEM-PLS analysis, all proposed hypotheses were supported, as they met the required criteria for statistical significance, namely a t-statistic greater than 1.96 and a p-value below 0.05. The first hypothesis states that environmental management accounting has a positive effect on environmental performance is proven to be significant, with a coefficient value of 0.311, a t-statistical value of 2.671, and a p-value of 0.004. The second hypothesis regarding the influence of environmental management accounting on green innovation was also accepted, with a coefficient value of 0.353, a t-statistical value of 2.877, and a p-value of 0.002. The third hypothesis also states that green innovation has a positive effect on environmental performance with a coefficient value of 0.398, a t-statistical value of 3.118, and a p-value of 0.001. Similarly, the fourth hypothesis states that green innovation is able to mediate the

influence of environmental management accounting on environmental performance. Taken together, these results suggest that the effective implementation of environmental management accounting contributes to environmental performance not only through a direct pathway but also indirectly by stimulating green innovation, which further strengthens environmental outcomes.

Discussion

The Influence of Environmental Management Accounting on Environmental Performance

This result can be understood from the way environmental management accounting brings environmental costs into the core of managerial decision-making (Burritt et al., 2019). When expenses related to waste, energy consumption, and emissions are systematically identified and measured, managers are prompted to seek greater production efficiency and reduce unnecessary resource use. By embedding environmental information into planning and control systems, companies are able to improve environmental performance in a more structured and deliberate manner (Qian et al., 2018). Theoretically, these findings are consistent with the Natural Resource-Based View (Hart, 1995), which posits that the capability to manage environmental resources effectively can become a source of sustainable competitive advantage. However, prior studies also note that environmental management accounting does not automatically yield significant results when it is treated merely as an administrative exercise rather than being integrated into broader business strategy (Burritt et al., 2019). This variation suggests that its effectiveness depends greatly on organizational context and managerial commitment. In Batik MSMEs, where production processes often involve chemicals and generate liquid waste, tighter environmental cost control directly influences environmental performance, making its impact more visible and substantive.

The Influence of Environmental Management Accounting on Green Innovation

These findings show that environmental management accounting drives green innovation through organizational learning mechanisms and the identification of resource efficiency opportunities (Christ & Burritt, 2013). Information on material and energy inefficiencies creates managerial awareness to look for more environmentally friendly process and material alternatives (Qian et al., 2018). Thus, environmental management accounting serves as a knowledge driver that facilitates the emergence of green innovation. These findings also support the theoretical perspective *Natural Resource-Based View* (Hart, 1995), green innovation is a form of internal capability development towards the pollution prevention and sustainable development stage. In addition, Porter & Linde, (1995) emphasized that regulations and environmental pressures can encourage innovation that increases efficiency and competitiveness of companies. However, studies in several developing countries show that limited financial and technological resources often hinder the transformation of environmental information into real innovation (Singh et al., 2020). The fact that Batik MSMEs in this study showed significant influence indicates that market pressure and environmental awareness have encouraged the conversion of environmental management accounting information into actual innovation.

The Influence of Green Innovation on Environmental Performance

These findings indicate that green innovation contributes to environmental performance, as changes in products and production processes can directly reduce waste generation and energy consumption (Chen et al., 2006). The adoption of cleaner technologies and environmentally friendly materials has also been empirically shown to enhance a firm's environmental outcomes (Rehman et al., 2021). Such results align with Stakeholder Theory (Freeman & McVea, 1984), which suggests that firms responding proactively to stakeholder concerns regarding environmental issues are more likely to pursue sustainability-oriented

innovation. In this sense, green innovation reflects a concrete commitment to meeting the expectations of governments, communities, and consumers for more responsible business practices. However, prior research also cautions that green innovation does not automatically translate into improved performance, particularly when it is not supported by sufficient technological readiness (Chen et al., 2006). In the case of Batik MSMEs, initiatives such as adopting natural dyes and improving liquid waste management systems have a visible and direct impact on environmental indicators. Consequently, the influence of green innovation on environmental performance in this context appears relatively strong and tangible.

Green Innovation can mediate the influence of Environmental Management Accountability on Environmental Performance

The findings indicate that green innovation serves as a partial mediator in the relationship between environmental management accounting and environmental performance. Conceptually, environmental management accounting supplies the information base and analytical foundation for managerial decisions, while green innovation translates those decisions into concrete operational changes that directly enhance environmental outcomes (Christ & Burritt, 2013). This suggests that the impact of environmental management accounting on environmental performance operates through two pathways: a direct effect and an indirect effect via green innovation. Although environmental management accounting independently contributes to improved performance, its influence becomes more pronounced when it is accompanied by the implementation of green innovation initiatives. These results reinforce the integration of the Natural Resource-Based View and Stakeholder Theory. Internal capabilities, reflected in the effective use of environmental management accounting, stimulate innovation as a strategic response to environmental pressures and stakeholder expectations. Through this dynamic, firms are better positioned to achieve sustained improvements in environmental performance.

CONCLUSION

This study concludes that Environmental Management Accounting (EMA) functions as a strategic capability that enhances Environmental Performance both directly and indirectly through Green Innovation as a partial mediator. EMA should not be viewed merely as a cost-recording mechanism, but as a strategic information system that enables firms to identify inefficiencies, reduce environmental impact, and stimulate innovation. By clarifying the mediating role of Green Innovation, this study explains how environmental accounting practices are transformed into measurable environmental outcomes. Theoretically, the findings strengthen the integration of the Natural Resource-Based View and Stakeholder Theory. The study demonstrates that internal environmental capabilities can generate sustainable competitive advantage even within MSMEs operating in traditional industries. Green Innovation serves as the mechanism that connects internal resource management with external stakeholder expectations, reinforcing the strategic nature of sustainability practices. Practically, the findings suggest several targeted actions. Local governments should complement wastewater infrastructure support with structured EMA training programs and incentive-based environmental schemes for MSMEs that demonstrate measurable improvements. At the cluster level, shared environmental advisory services and collaborative green innovation initiatives could reduce costs and enhance collective environmental performance. Furthermore, facilitating access to sustainability certifications (such as eco-labels or ISO 14001) would help MSMEs convert environmental improvements into market advantages. At the managerial level, embedding EMA into routine decision-making through systematic tracking of material flows, energy use, and environmental targets can ensure that sustainability initiatives are both environmentally and economically viable. Overall, this study highlights that sustainability in traditional MSMEs is not merely a compliance issue, but a strategic transformation process

driven by internal capabilities, innovation, and supportive policy frameworks.

Despite its contributions, this study is not without limitations, which should be taken into account when interpreting the findings. First, the research adopts a cross-sectional design, meaning the data were collected at a single point in time. As a result, it does not capture potential changes or long-term developments in the implementation of environmental management accounting, green innovation, or environmental performance. In addition, the variables examined may not fully represent other relevant factors that could influence environmental performance, such as regulatory pressure, top management commitment, organizational culture, or specific industry characteristics. These elements may also shape how environmental strategies are formulated and implemented. Accordingly, future research is encouraged to employ a longitudinal design to better observe dynamic changes over time. Expanding the model by incorporating additional contextual variables and combining quantitative with qualitative approaches could also provide a more comprehensive and nuanced understanding of how companies can strengthen their environmental performance.

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