Environmental management accounting and green practices as drivers of SME performance: evidence from an emerging economy

Grace Tianna Solovida✉, Khairina Nur Izzaty, Sendhy Ichza Nugraha
BPD University (STIE Bank BPD Jateng) Semarang, Central Java, Indonesia
✉tianna3186@gmail.com

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Abstract
Purpose – This study investigates the impact of environmental management accounting (EMA) on financial performance (FP), with environmental management practices (EMP) and operational performance (OP) serving as mediating variables. **Method** – This study used a quantitative survey approach; data were collected from 98 managers or owners of green SMEs in Central Java, Indonesia. Data collection used a structured questionnaire with snowball sampling due to the lack of an official database of green SMEs in the region. Data was analyzed using SEM-PLS via SmartPLS software. **Findings** – The results show that environmental management accounting (EMA) positively influences environmental management practices (EMP). However, environmental management practices (EMP) do not influence operational performance (OP), whereas operational performance (OP) positively influences financial performance (FP). Additionally, environmental management practices (EMP) cannot mediate the relationship between environmental management accounting (EMA) and operational performance (OP); operational performance (OP) also cannot mediate the link between environmental management practices (EMP) and financial performance (FP). **Implications** – This study contributes to literature by underscoring the limited mediating role of environmental management practices in green SMEs and the challenges in converting environmental initiatives into operational gains. The findings suggest that SMEs should better integrate environmental accounting with operational strategies to enhance financial outcomes. Policymakers should also support SMEs through improved access to environmental management training and resources.
Keywords: environmental management accounting, financial performance, green SMEs, environmental management practices, operational performance.

Introduction
The accelerating climate crisis and ongoing resource depletion have triggered global calls for systemic transitions toward more sustainable economic models. The circular economy has gained international momentum as a promising solution to these challenges (EMF 2019; UNEP 2021), promoting resource regeneration and minimizing environmental harm. The aim is to regenerate resources and minimize environmental harm. In line with this global movement, the Indonesian government's current development agenda emphasizes advancing a green economy while fulfilling commitments to the Sustainable Development Goals (SDGs). Adopting circular economy principles has become a central strategy to reduce environmental impact and enhance resource efficiency. By encouraging sustainable waste management and optimizing resource use, this model directly supports SDG goals, especially

those related to responsible consumption and production. Furthermore, its implementation targets high-impact sectors—such as food, electronics, plastic packaging, construction, and textiles—contributing significantly to environmental degradation. The initiative aims to reduce waste by up to 52% and significantly lower carbon emissions by 2030.

Beyond its environmental benefits, the circular economy creates sustainable economic opportunities for micro, small, and medium enterprises (SMEs). It encourages environmentally responsible business practices by developing "green SMEs" that prioritize sustainability in their operations. These green SMEs enhance business continuity by adopting eco-friendly strategies and contribute to Indonesia's economic development. A notable example is the "Central Java Waste-Free 2025" program, initiated by the provincial government, which aims to promote environmental management among SMEs. The initiative addresses pollution in 136 rivers across the province, which poses serious threats to human health and ecosystems. Environmental experts largely attribute this pollution to domestic waste and industrial activities, including those from SME production processes. These issues are often rooted in limited environmental awareness and the inadequate adoption of modern technologies in environmental health and sustainability (Purnamawati 2014; Thenu 2015).

Green SMEs play a dual role by promoting economic growth and enhancing environmental conditions. For example, textile SMEs that have implemented sustainable practices—such as using recycled materials and minimizing production waste—reported a 15% increase in revenue compared to the previous year. In addition, their operational costs decreased by approximately 10% due to improved resource efficiency (Judith 2021). Despite these positive developments, many SMEs still face financial difficulties. According to the Asian Development Bank, around 48.6% of SMEs in Indonesia reported declining revenue due to pandemic-related disruptions (ADB 2021). During the COVID-19 pandemic, most green SMEs in Indonesia suffered revenue losses, with 27% experiencing a decline of over 60%, highlighting their financial vulnerability (Yoshio 2021).

Enhancing SME financial performance requires effective eco-efficient management (Majid et al. 2023). Organizations that deliver high-value products or services while minimizing environmental impact tend to achieve better financial outcomes (Rifai, Ningrum, and Wahyudi 2024). Environmental management accounting (EMA) and environmental management practices (EMP) enable this eco-efficiency. EMA provides relevant environmental cost information, allowing SMEs to make better-informed resource allocation decisions (Asnita, Khalid, and Salam 2024) while also facilitating the implementation of environmental management systems that depend on EMP adoption (Alfarizi, Ngatindriatun, and Firmansyah 2024).

Although many studies support the importance of EMA and EMP, recent evidence suggests that their financial benefits are not always direct or consistent. For instance, Deb, Rahman, and Rahman (2023) found that EMA enhances environmental and financial performance in Bangladeshi manufacturing firms. However, Kong et al. (2022) argued that EMA's effectiveness may vary depending on external pressures and environmental uncertainty. These mixed findings highlight the need for further investigation into how EMA and EMP affect organizational performance across different settings. These practices can enhance operational management and improve financial outcomes (Tjahjadi et al. 2023).

Although interest in green business practices is growing, previous research on environmental management accounting (EMA), environmental management practices (EMP), and firm performance has produced mixed and sometimes contradictory findings. Some scholars have found that EMA enhances innovation and operational strategies, improving organizational outcomes (Chaudhry et al. 2020). Others, however, report no significant impact of EMA on performance unless supported by institutional factors or organizational readiness (Kong et al. 2022). Similarly, while EMP has been associated with improved social and

environmental outcomes, its financial implications are not always clear-cut. Obamen et al. (2021) identified a positive link between EMP and sustainability in Nigerian manufacturing firms but noted that resource limitations among SMEs may hinder these benefits. Furthermore, Jamil et al. (2023) emphasized that EMP adoption in SMEs is often influenced by external pressures—such as regulatory bodies, customers, and supply chains—yet the resulting business performance outcomes remain inconsistent, mainly due to limited resources and internal constraints. These discrepancies underscore a lack of consensus in literature and indicate the need for a more integrated and context-sensitive investigation, particularly within SME contexts.

Despite the substantial body of research on environmental management, only a limited number of studies have examined environmental management accounting (EMA), environmental management practices (EMP), and operational performance (OP) within a unified framework. Most existing research has focused on large corporations or has explored only partial mediating relationships. For example, Fuzi et al. (2020) investigated the mediating role of environmental management systems (EMS) between EMP and performance but did not consider the influence of EMA. Similarly, Solovida and Latan (2017; 2021) emphasized the role of EMA in sustainability but did not explore its indirect effects through EMP and OP. More recent studies, such as that of Chaudhry et al. (2020), have begun investigating how environmental strategies mediate the relationship between EMA and performance; however, operational mechanisms remain underdeveloped. Consequently, our understanding of how these tools interact in practice, particularly in resource-constrained SMEs, remains limited.

Although previous research has acknowledged the value of EMA and EMP, few studies have examined how environmental accounting capabilities translate into financial performance. While EMA may provide the necessary data and EMP the corresponding actions, their impact is likely transmitted through improvements in operational performance, yet this pathway remains underexplored. Chaudhry et al. (2020); Kong et al. (2022) suggest that strategic and contextual factors moderate these relationships, but neither study explicitly investigates operational performance as a mediating factor. This gap is particularly relevant in contexts in developing countries, where SMEs often face resource constraints. A more comprehensive model that includes EMA, EMP, and OP could help clarify the conditions under which environmental initiatives lead to improved financial outcomes. Therefore, a significant gap remains in understanding how environmental accounting capabilities are converted into financial performance through operational mechanisms within SMEs that operate under limited resources.

This study offers a novel contribution by integrating EMA, EMP, OP, and FP into a comprehensive mediation model, which, so far, has not been empirically tested in the context of green SMEs in Indonesia. This research extends prior models that have focused solely on direct or partially mediated relationships by examining the dual mediating roles of EMP and OP. Furthermore, by adopting both the RBV and NRBV, this study provides a theoretically grounded explanation of how environmental capabilities are transformed into performance outcomes. This approach has rarely been applied in SME-focused research. Aligned with this objective, the study investigates the influence of EMA and EMP on financial performance, with OP and EMP serving as mediating variables. This research is significant because it addresses the practical need among green SMEs to understand how environmental strategies can enhance business outcomes. In the Indonesian context, where many SMEs operate under resource constraints, identifying effective pathways to improve performance through sustainable practices is both timely and valuable. The findings are expected to provide practical insights for managers and policymakers striving to promote more environmentally responsible business models.

Literature review

Resource-based view (RBV) theory

The resource-based view (RBV) of the firm emerged as a response to the limitations of the industrial organization (I/O) perspective, which primarily emphasized external market conditions as the main determinants of firm performance. Over time, this externally focused view came to be seen as insufficient for explaining differences in performance among firms operating within the same industry. In contrast, the RBV highlighted the strategic importance of internal resources and capabilities for achieving sustainable competitive advantage (Wernerfelt 1984). Recent developments in strategic management research continue to support the idea that firms gain and maintain superior performance by leveraging resources that are valuable, rare, inimitable, and non-substitutable (Barney, Ketchen, and Wright 2021). When aligned with external opportunities, these capabilities enable firms to build resilient and adaptive strategies in dynamic environments (Quansah, Hartz, and Salipante 2022). Furthermore, how firms acquire, integrate, and deploy their resources is critical in shaping strategic decisions and outcomes—from improved efficiency and cost savings to enhanced product quality, market share, and profitability (Dasuki 2021). In today's competitive landscape, the effective orchestration of resources remains central to long-term organizational success.

Natural resource-based view (NRBV) theory

A company's efforts to implement sustainable environmental management through environmentally related activities can improve financial performance, particularly in profitability and increased market responsiveness. However, this relationship has not been clearly explained regarding how environmental activities function as mediators within the environmental management system (Klassen and McLaughlin 1996). This study refers to the theoretical frameworks of the RBV and the natural resource-based view (NRBV). The theory proposed by Hart and Dowell (2011) emphasizes that "corporate strategy (environmental strategy) and competitive advantage (corporate environmental performance) must be rooted in capabilities that facilitate eco-friendly economic activities," in line with the firm's natural resource-based view. Hart (1995) proposed that NRBV comprises three interrelated strategies: pollution prevention, product stewardship, and sustainable development. The NRBV provides a framework for companies to understand and address environmental challenges by adopting environmental strategies and implementing environmental management practices.

Financial performance

Financial performance refers to the ability of an organization to generate profits and manage its resources effectively and efficiently over a specific period. It reflects the financial health of a company. It is commonly measured using indicators such as profitability, return on assets (ROA), return on equity (ROE), and net profit margin (Brigham and Houston 2019). In the context of small and medium enterprises (SMEs), financial performance is influenced by internal operational efficiency and the adoption of sustainable and environmentally responsible practices. According to recent studies, integrating environmental considerations into business operations—such as through environmental management accounting (EMA) and green innovation—can enhance financial performance by improving resource efficiency and reducing operational costs (Tjahjadi et al. 2023; Rifai, Ningrum, and Wahyudi 2024). Studies have shown that SMEs adopting green practices—such as eco-design, energy-efficient technologies, waste minimization, and sustainable sourcing—can achieve superior financial

outcomes by reducing operational costs, mitigating environmental risks, and enhancing productivity (Li and Sarkis 2022).

Government policies and regulatory pressures have also played a critical role in encouraging SMEs to transition towards sustainability. Support mechanisms—such as green financing, tax incentives, and eco-certification programs—have improved financial performance among SMEs that proactively implement sustainability initiatives (Dias, Lavaredas, and Esteves 2024; Zameer et al. 2024). Overall, there is growing empirical evidence that environmental commitment in SMEs is not merely a cost burden but a strategic lever for enhancing financial performance and achieving competitive advantage in the green economy.

Environmental management accounting

Environmental management accounting (EMA) integrates environmental considerations into conventional management accounting. It provides essential tools that support sustainable development goals and enhance oversight of environmental activities. EMA adoption is influenced by organizational culture, structure, disclosure quality, and performance, offering strategic insight into financial and environmental outcomes (Aman and Lucianetti 2025). Companies' adoption of EMA is also influenced by corporate environmental strategies, which are integrated into their broader business strategies. EMA assists companies in fulfilling environmental responsibilities while identifying economic benefits to improve environmental and financial performance (Hanif, Ahmed, and Younas 2023).

Moreover, EMA adoption is shaped by external pressures, including environmental regulations, stakeholder demands, and increasing public awareness of sustainability issues. These factors push companies to enhance transparency and accountability in managing environmental impacts. EMA supports strategic decision-making by providing relevant information for evaluating green investments and improving resource efficiency. Recent studies highlight that regulatory frameworks and stakeholder engagement significantly influence the integration of EMA into corporate practices, reinforcing its role in achieving economic and environmental objectives (Zatini, Porta, and Za 2025).

Environmental management practices

Environmental management practices (EMP) encompass production-related activities carried out by management, including eco-friendly production processes and sustainable value chains (Ali, Kausar, and Amir 2023). Companies must implement effective environmental management to enhance green supply chain practices, such as fostering interdepartmental collaboration for environmental improvement, training employees in green practices, and adopting a green management system (Alvin and Santosa 2023). Effective implementation of EMP is also driven by organizational commitment and leadership support, which is pivotal in embedding sustainability into core business operations. EMP contributes to long-term organizational performance by fostering innovation, enhancing operational efficiency, and strengthening environmental compliance. Recent studies indicate that when environmental practices are integrated into strategic planning, companies are more likely to achieve both competitive advantage and sustainability goals (Mustafi et al. 2024).

Operational performance

Operational performance is commonly categorized into four dimensions: quality, cost, delivery, and flexibility (Siefan et al. 2024). Operational performance measures improvements in product quality, reductions in production costs, the speedy delivery of end-products, rapid restructuring of production systems and enhancements in operational dependability and flexibility (Opoku and Li 2025). In addition to these dimensions, recent research emphasizes

the significant role of sustainability-oriented practices in enhancing organizational performance. Integrating green initiatives into daily operations—such as improving energy efficiency, minimizing waste, adopting renewable resources, and utilizing eco-friendly materials—not only supports environmental protection but also improves cost efficiency, product quality, and customer satisfaction. These sustainable practices contribute to long-term business value by increasing process agility, enhancing supply chain resilience, and enabling firms to better respond to dynamic market demands. This comprehensive approach aligns environmental responsibility with strategic performance objectives (Rothenberg, Pil, and Maxwell 2001).

Hypothesis development

Based on the RBV, organizations gain competitive advantage through valuable, rare, and inimitable internal resources, including environmental capabilities (Barney 1991). The NRBV extends this perspective by emphasizing environmental sustainability as a strategic resource (Hart 1995). EMA practices serve as tools to generate relevant environmental information, while EMP reflects the firm's capability to implement sustainable strategies. Thus, EMA and EMP are considered strategic resources that align with the RBV and NRBV frameworks to achieve superior environmental performance (Schaltegger and Burritt 2005). EMA and EMP are closely linked to environmental concerns as both aim to enhance the implementation of environmental management. Albelda (2011) demonstrated that EMA implementation is associated with developing environmental management systems. EMP supports EMA by offering financial information related to environmental aspects and aligning with corporate goals. An effective environmental management system helps organizations manage EMA more efficiently. EMP is crucial in enhancing EMA by refining procedures, regulations, and structures within corporate environmental management. Ismail, Ramli, and Darus (2014); Prajogo, Tang, and Lai (2014); Campos et al. (2015) found that EMA positively influences environmental management systems, signifying alignment with EMP adoption. Based on these findings, the following hypothesis is proposed:

H1: environmental management accounting has a positive influence on environmental management practices.

The NRBV theory explains that resources owned by organizations which cannot be easily imitated by competitors can create competitive advantages, including environmental strategies that lead to sustainable competitive advantages (Hart 1995; Klassen and Whybark 1999; Hart and Dowell 2011). Famiyeh et al. (2018) classified operational performance into four aspects: cost, quality, delivery, and flexibility. Their study found that EMP positively impacts cost reduction and contributes to cost advantages (Christmann 2000). Organizations that have adopted EMP focus on eco-friendly product quality, including using green raw materials. This supports the findings of Melnyk, Sroufe, and Calantone (2003); Famiyeh et al. (2018) that EMP positively correlates with quality improvement. EMP also positively influences delivery performance, as Lambert and Cooper (2000) noted, by promoting corporate activities aimed at environmental improvement, including more efficient delivery systems. Optimizing delivery routes for efficiency and fuel consumption reduction further supports these efforts. Based on these findings, the following hypothesis is proposed:

H2: environmental management practices have a positive influence on operational performance.

According to the RBV, operational capabilities are strategic resources that can lead to sustained competitive advantage (Barney 1991). The NRBV Hart (1995) extends this by emphasizing environmental responsiveness as a pathway to superior performance. Environmental management practices that enhance operational performance—such as cost efficiency, quality, and flexibility—reflect valuable internal capabilities that improve financial

outcomes (Klassen and McLaughlin 1996; Stoss 1996). Thus, improved operations serve as a strategic bridge to financial performance. Famiyeh et al. (2018) demonstrated that EMP enhances operational performance by reducing costs, improving quality, and increasing delivery efficiency and flexibility. Operational performance resulting from environmental management practices helps minimize adverse environmental impacts (Klassen and McLaughlin 1996; Stoss 1996; Rothenberg, Pil, and Maxwell 2001). Resource savings in operational performance contribute to cost reductions and improved financial performance. Several studies have confirmed a significant relationship between competitive costs and environmental performance (Stoss 1996). Consumption reductions also contribute to cost efficiency, as evidenced in the study by Kumar, Teichman, and Timpernagel (2012). Using eco-friendly raw materials helps reduce environmental impact while lowering operational costs and improving financial performance. Enhancing product quality reduces rework costs. Evaluating supply chains and improving raw material quality strengthen consumer trust, enhancing financial performance. Delivery efficiency further signals minimal resource usage, reducing costs and significantly impacting financial performance (Rao, Rao, and Muniswamy 2011). Increased operational flexibility enables companies to respond effectively to high-volume orders and product development changes, ultimately driving sales growth and financial performance. Based on these findings, the following hypothesis is proposed:
H3: operational performance has a positive influence on financial performance.

From the RBV perspective, internal capabilities such as environmental management and accounting systems are strategic assets that enhance performance (Barney 1991). The NRBV further emphasizes environmental practices as vital for achieving long-term competitive advantage (Hart 1995). EMA provides accurate and relevant environmental cost information, while EMP translates this information into actionable practices. Together, they function as organizational capabilities that enhance operational outcomes such as efficiency, quality, and resource utilization (Fuzi et al. 2020), thereby reinforcing the strategic alignment between EMA, EMP, and operational performance. EMP mediates the relationship between EMA and operational performance. EMP is a crucial tool in environmental management within an organization (Fuzi et al. 2020). Prajogo, Tang, and Lai (2014) indicated that EMP strengthens the relationship between EMA and operational performance. In other words, EMP supports the development and sustainability of EMA within organizations. Studies by Feng, Zhao, and Su (2014); Jalil, Abar, and Dadashian (2016); Neves, Salgado, and Beijo (2017) provide empirical evidence that EMA and EMP significantly enhance operational performance. The implementation of EMP encourages organizations to adopt EMA and enhance operational performance through cost reduction, improved quality of environmental management, reduced consumption of raw materials and energy, and systematic evaluations of environmental impacts. Based on these findings, the following hypothesis is proposed:
H4: environmental management accounting positively influences operational performance through environmental management practices.

The RBV suggests that superior performance stems from internal capabilities that are valuable, rare, and well-organized (Barney 1991). When effectively embedded into operations, EMP functions as a strategic capability that drives process improvements, resource efficiency, and cost control—key components of operational performance (Klassen and McLaughlin 1996). According to the NRBV, environmental responsiveness and sustainability initiatives are essential for long-term competitiveness (Hart 1995; Stoss 1996). EMP strengthens a firm's ability to reduce its environmental footprint and enhances operational outcomes such as delivery efficiency, quality, and flexibility (Hanna, Newman, and Johnson 2000; Montabon, Sroufe, and Narasimhan 2007). These operational improvements translate into financial benefits—such as cost savings and revenue growth—as organizations become more agile and environmentally responsible, attracting positive stakeholder

responses (Djuitaningsih and Ristiawati 2011). The adoption of EMP minimizes environmental impact across all aspects of operational performance, thereby influencing financial performance by providing relevant environmental information for each operational activity (Klassen and McLaughlin 1996; Stoss 1996; Hanna, Newman, and Johnson 2000; Rothenberg, Pil, and Maxwell 2001; Montabon, Sroufe, and Narasimhan 2007). Furthermore, Djuitaningsih and Ristiawati (2011) found that environmental performance positively impacts financial performance, as stakeholders respond favorably to corporate environmental efforts, leading to long-term revenue growth. Operational performance supported by EMP indirectly enhances financial performance. Thus, the following hypothesis is proposed:
H5: environmental management practices positively influence financial performance through operational performance.

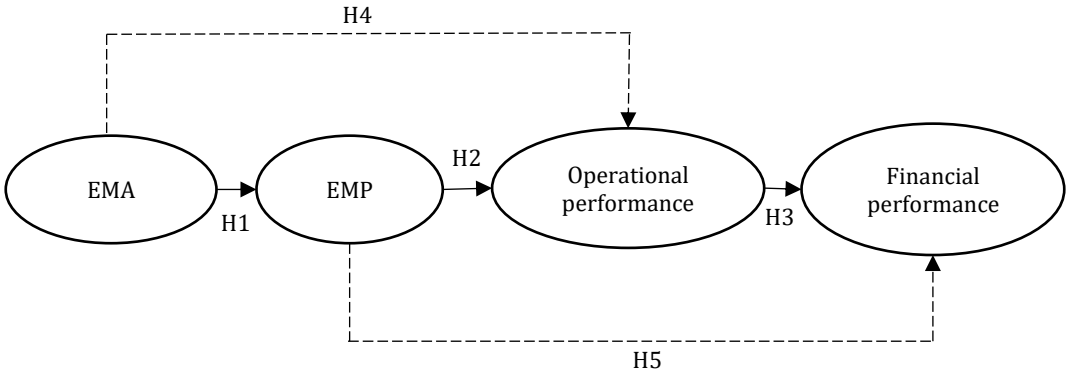

Figure 1 research framework

Method

This study adopts a quantitative research approach aimed at examining the relationships among environmental management accounting (EMA), environmental management practices (EMP), operational performance (OP), and financial performance (FP). The study population consists of small and medium-sized enterprises (SMEs) operating in Central Java, Indonesia, particularly those implementing environmentally oriented operations using green or recycled raw materials. Due to the absence of a centralized database, the exact number of such SMEs is unknown. Given the niche characteristics of the target population and the lack of a centralized registry, a non-probability sampling method—specifically snowball sampling—was adopted. Although snowball sampling is more commonly associated with qualitative research, it is deemed appropriate for reaching hard-to-identify respondents who meet the specific criteria of environmentally oriented SMEs (Sarstedt et al. 2018).

Due to these constraints, the sample size was determined based on the minimum requirement for multivariate analysis, which is at least 30 respondents, to meet the normality assumption (Wahyuni 2020). 107 SMEs participated in the study; however, only 98 respondents were included in the final sample and analyzed, while 9 responses were excluded because the SMEs did not meet the green criteria. Primary data were collected through a structured questionnaire distributed directly to business owners or managers. The questionnaire includes items adapted from previously validated studies and employs a Likert scale to measure the constructs. Data collection was conducted over three months, ensuring confidentiality and voluntary participation.

For data analysis, this study employs partial least squares structural equation modeling (PLS-SEM) using the SmartPLS software. PLS-SEM was chosen for its ability to estimate complex models with relatively small sample sizes and address issues such as inadmissible solutions and factor indeterminacy (Tenenhaus et al. 2005). The analysis

includes both measurement model assessment (validity and reliability of indicators) and structural model evaluation (hypothesis testing), aligning with recommendations for variance-based SEM approaches (Ghozali 2021). Table 1 outlines the operationalization of the variables, including the indicators and measurement scales used in the study.

Table 1 operational variables

Variables	Indicators	Statements	Scale
Financial performance (FP)	1. The organization's ability to increase profits, 2. Its ability to maintain financial stability, 3. Its ability to meet its obligations. (Wijayanti 2016)	The SME I manage demonstrates consistent profit growth. The SME I manage practices effective financial management. The SME I manage is financially capable of meeting its obligations.	1-5 1 = "very poor" 5 = "very good."
Environmental management accounting (EMA)	1. Identification of environmental costs, 2. Classification of environmental costs, 3. Allocation of environmental costs for the production process, 4. Improvement of environmental management costs, 5. Use of environmental cost accounts. (Solovida and Latan 2017; Fuzi et al. 2020)	The SME I manage consistently identifies environmental costs. The SME I manage consistently classifies environmental costs. The SME I manage allocates environmental costs to the production process. The SME I manage has improved its environmental cost management. The SME I manage has implemented environmental cost accounts.	1-5 1 = "not done at all" 5 = "significantly done."
Environmental management practices (EMP)	1. Raw material consumption, 2. Energy consumption, 3. Water consumption, 4. Conservation of natural resources, 5. Pollution prevention (Famiyeh et al. 2018)	The SME I manage has reduced the use of raw materials. The SME I manage has reduced energy consumption. The SME I manage has reduced water consumption. The SME I manage has contributed to managing the surrounding environment. The SME I manage has taken actions to prevent pollution in its operations.	1-5 1 = "not done at all" 5 = "significantly done."
Operational performance (OP)	*Operational cost reduction:* 1. Increased capacity utilization, 2. Reduced transportation costs *Competitive operational delivery performance:* 1. Delivery reliability, 2. Faster delivery speed, 3. Increased production time, improved on-time shipment quantity 4. Timely and Accurate Delivery	 The SME I manage has utilized its production capacity to the fullest in manufacturing products. The SME I manage applies delivery standards to minimize delivery delays. The SME I manage applies clear standards to minimize shipping delays The SME I manage always delivers products on time as requested by customers The SME I manage produces products quickly to meet customer demand without compromising quality. The SME I manage ensures the right	1-5 1 = "strongly disagree" 5 = "strongly agree."

Variables	Indicators	Statements	Scale
		quantity of products is delivered on time.	
	Flexibility performance:		
	1. Rapid changes in design,	The SME I manage frequently makes rapid changes or improvements to its products.	
	2. Reduced transition or setup time	The SME I manage easily adapts to changes in market demand.	
	Quality improvement performance:		
	1. Reduction of organizational imperfections,	The SME I manage has minimized the number of defective products.	
	2. Product reliability,	The SME I manage has minimized product failures.	
	3. Reduction in customer complaints,	The SME I manage has minimized customer complaints.	
	4. Implementation of quality management systems.	The SME I manage has implemented standard practices to ensure product quality.	
	(Famiyeh et al. 2018)		

Results and discussion

Table 2 profile of respondent

Demographic	Category	Frequency (n)	Percentage (%)
Gender	Female	58	59
	Male	40	41
Age	< 20 years	2	2
	20-40 years	58	59
	Over 40 years	38	39
Length of time in business	0-10 years	79	81
	11-20 years	10	10
	Over 21 years	9	9
Employees	1 – 5	89	91
	6 -20	8	8
	Over 20	1	1
Income	1-12 million	62	64
	13-24 million	22	22
	> 25 million	14	14

Source: primary data (processed, 2025)

Table 2 presents the demographic profile of the respondents, including variables such as gender, age, education level, and business characteristics. The subjects of this study are the managers of green SMEs in Central Java. The total number of respondents was 98 SMEs. Based on the research results, the gender distribution of green SME managers is as follows: 59% are female, and 41% are male. Therefore, the respondents in this study are predominantly female. In terms of age, most respondents are between 20 and 40 years old, followed by those over 40 years old. This indicates that the owners of green SMEs are generally in the mature and experienced age group. The smallest group is under 20 years old. Most respondents employ 1 to 5 employees, followed by 8 respondents who employ 6 to 20 employees, and only one respondent employs more than 21 employees. Regarding turnover, 63% of the green SMEs generate revenue from IDR 1 to 12 million. 22% have a turnover between IDR 13 and 24 million, and 14% have more than IDR 25 million. Therefore, the respondents are

predominantly green SMEs with an IDR of 1 to 12 million turnover. Regarding business duration, 81% of the respondents have been operating for 0 to 10 years, 10% for 11 to 20 years, and 9% for more than 21 years. Hence, the respondents are predominantly green SMEs operating for 0 to 10 years.

Table 3 presents the results of the validity and reliability testing for all constructs in this study. Convergent validity was assessed using the average variance extracted (AVE) and item loading values. The results show that all AVE values exceeded the recommended threshold of 0.50, and all item loadings were above 0.70, indicating that the indicators are well-correlated with their respective constructs.

Table 3 validity and reliability results

Variables	Indicators	Outer loadings	Cronbach's alpha	Composite reliability	AVE
Financial performance (FP)	FP1	0.824	0,856	0,913	0,777
	FP2	0.911			
	FP3	0.907			
Environmental management accounting (EMA)	EMA1	0.944	0,962	0,970	0,868
	EMA2	0.935			
	EMA3	0.930			
	EMA4	0.949			
	EMA5	0.899			
Environmental management practices (EMP)	EMP1	0.863	0,939	0,953	0,804
	EMP2	0.907			
	EMP3	0.908			
	EMP4	0.898			
	EMP5	0.906			
Operational performance (OP)	OPC.1	0.724	0,940	0,948	0,605
	OPC.2	0.753			
	OPD.1	0.798			
	OPD.2	0.783			
	OPD.3	0.769			
	OPD.4	0.791			
	OPF.1	0.750			
	OPF.2	0.803			
	OPQ.1	0.722			
	OPQ.2	0.823			
	OPQ.3	0.769			
	OPQ.4	0.838			

Source: primary data (processed, 2025)

Discriminant validity was evaluated through cross-loading analysis. Each item showed a higher loading on its associated construct than on other constructs, confirming adequate discriminant validity. Reliability was tested using Cronbach's alpha and composite reliability. All constructs demonstrated Cronbach's alpha values above 0.70 and composite reliability values exceeding 0.80, confirming that the measurement model is internally consistent and reliable.

The results of hypothesis testing using the SEM-PLS approach are summarized in Table 4. The findings provide empirical support for several proposed relationships. Hypothesis 1, which posits that environmental management accounting practices (EMAP) positively influence environmental management practices (EMP), H1 is supported. The path coefficient

is 0.801 with a t-statistic of 19.205 > 1.96 and a p-value of 0.000 < 0.05, indicating a strong and statistically significant relationship. Hypothesis 2, which proposes that environmental management practices do not influence operational performance (OP), H2 is not supported. The path coefficient is 0.237 with a t-statistic of 1.582 < 1.96 and a p-value of 0.114 > 0.05, which does not meet the threshold for significance. Hypothesis 3, showing that operational performance positively influences financial performance (FP), H2 is supported with a path coefficient of 0.520, a t-statistic of 6.444 > 1.96, and a p-value of 0.000 < 0.05.

Table 4 hypothesis results

Hypothesis	Original Sample	T-statistics	P-Values	Results
H1: EMA → EMP	0.801	19.205	0.000	Accepted
H2: EMP → OP	0.237	1.582	0.114	Not supported
H3: OP → FP	0.520	6.444	0.000	Accepted
H4: EMA → EMP → OP	0,189	1.571	0,116	Not supported
H5: EMP → OP → FP	0.123	1.473	0,141	Not supported

Source: primary data (processed, 2025)

Hypothesis 4, which examines the mediating effect of EMP on the relationship between EMAP and OP, H4 is not supported. The indirect effect has a coefficient of 0.189 with a t-statistic of 1.571 < 1.96 and a p-value of 0.116 > 0.05, suggesting that the mediation is not statistically significant. Similarly, Hypothesis 5, which suggests that operational performance mediates the relationship between EMP and financial performance, H5 is not supported. The coefficient is 0.123 with a t-statistic of 1.473 < 1.96 and a p-value of 0.141 > 0.05. These findings indicate that while EMAP has a direct and strong influence on EMP, and operational performance contributes significantly to financial performance, the expected mediating effects do not hold in this study's context. Based on Table 4, Hypotheses 4 and 5 are not supported, indicating that the mediating variables do not significantly mediate the relationship between the independent and dependent variables, and therefore, mediation testing using VAF is unnecessary.

Environmental management accounting and environmental management practices

These results provide robust support for the acceptance of Hypothesis 1, confirming that implementing EMA practices substantially enhances the environmental management practices adopted by green SMEs. These empirical findings align with the NRBV theory outlined in this study and are consistent with the foundational principles of the RBV as articulated in Barney (1991) work, which posits that competitive advantage is derived from valuable company resources and capabilities. The NRBV emphasizes strategic capabilities for environmental stewardship, such as stewardship product strategies. One such strategy encourages companies to be environmentally productive, beginning with selecting raw materials and components from suppliers, aiming to minimize environmental impacts throughout the supply chain. Hart (1995) similarly argues that firms within growing markets are inclined to advance their environmental strategies to reduce product system life-cycle costs. By engaging in strategic product procurement, firms can disengage from environmentally damaging operations, restructure current product systems to minimize environmental liabilities and innovate new offerings that incur lower costs throughout their life cycles.

From an accounting perspective, this relationship also emphasizes the strategic role of EMA as a management accounting system specifically designed to capture, measure, and communicate environmental costs and performance. EMA enables green SMEs to systematically integrate environmental considerations into their accounting processes, such as budgeting, performance evaluation, and cost control. This integration reflects the essence

of strategic management accounting, where environmental data becomes an integral part of business decision-making and resource allocation. All EMA practices contribute to improving EMP, including energy savings (electricity, fuel, or gas), selecting production sites that do not negatively impact on the environment, safe waste disposal, and appropriate water usage. As a result, the company's operational and financial performance are expected to improve.

This result aligns with prior studies that demonstrate a strong positive association between EMA implementation and corporate sustainability performance improvements. By adopting EMA, companies can improve their environmental performance (Huynh and Nguyen 2024). Furthermore, adopting EMA can enhance environmental management practices (Christ and Burritt 2013) and be an important tool for achieving corporate sustainability goals (Jamil et al. 2023). Through EMA implementation, research demonstrates improved environmental performance (Gunarathne and Lee 2015). This study also aligns with Solovida and Latan (2021), who explored the relationship between sustainable supply chain management and EMA and proposed directions for future research in this field. This study is relevant to previous research and signifies the benefits of EMA practices in enhancing EMP across sectors and countries. Adopting EMA can be a practical step for green SMEs aiming to strengthen their environmental management practices. This implies a need for greater support from policymakers and industry stakeholders in encouraging the use of EMA to improve environmental performance and sustain business competitiveness.

Environmental management practices and operational performance

Hypothesis 2, which posits that EMP positively influences OP, is not supported in this study. Although green SMEs have adopted environmental management practices, these practices have not yet contributed to improvements in their operational performance. While these environmentally conscious SMEs care about the environment, they have not been able to reduce their operational costs effectively. The reduction in operational costs has not led to increased profits for these green SMEs, even though many strive to cut costs to achieve profitability. Adopting environmental management practices could be a solution for reducing operational costs, such as minimizing potential liability costs, legal expenses, and insurance costs resulting from their business activities. Moreover, implementing environmental management practices may help save resources, which can reduce green SMEs' operational costs.

Theoretically, the insignificant findings can be interpreted using the RBV and its extension, the NRBV. RBV suggests that a firm's sustainable competitive advantage derives from possessing and deploying valuable, rare, inimitable, and non-substitutable (VRIN) resources. EMPs, when deeply embedded into a firm's operations and culture, may qualify as such resources. However, in the context of green SMEs, these practices may still be nascent and not yet sufficiently developed or integrated to influence operational outcomes. NRBV builds upon RBV by emphasizing the strategic potential of capabilities that address environmental concerns, particularly when they foster innovation, efficiency, and regulatory compliance. The findings of this study suggest that while EMPs hold promise from a strategic standpoint, their operational impact may be contingent upon the maturity of implementation, organizational learning, and the availability of complementary resources—factors that may still be evolving among SMEs.

This study contrasts with the research conducted by Liu et al. (2023), which investigated how green innovation practices, responsible leadership, and green human resource management (Green HRM) contribute to sustainable business performance. That study demonstrated that such practices positively impact operational performance. Evidence also showed that green innovation and responsible leadership significantly contributed to sustainable operational performance by mediating pro-environmental behavior. Another

study found that green supply chain management practices, such as waste reduction and renewable energy, significantly improved companies' operational performance through increased efficiency and reduced operational costs (Abdallah and Al-Ghwayeen 2019). Additionally, implementing environmental management and green innovation was found to positively correlate with operational performance, emphasizing the importance of such innovations in improving operational efficiency and reducing environmental costs.

Previous studies have shown that EMP benefits environmental sustainability and provides operational advantages for companies by improving efficiency, reducing costs, and ensuring compliance with environmental regulations. However, this study does not yet prove that EMP affects OP. The findings indicate that while environmental management practices are being adopted, they may not yet be fully integrated or optimized to yield operational benefits for green SMEs. This highlights the need for practical guidance, training, and stronger institutional support to help SMEs realize the operational value of their environmental efforts.

Operational performance and financial performance

Hypothesis 3, which states that operational performance positively affects financial performance, is supported. Competitive operational performance—reflected in cost efficiency, quality improvement, timely delivery, and operational flexibility—positively influences financial outcomes. In this study, many green SMEs have adopted operational cost-reduction strategies, such as utilizing natural raw materials, producing environmentally friendly quality products, meeting delivery standards, and improving adaptability in their operations. These practices have helped improve overall operational performance, which in turn has contributed to stronger financial results.

This finding aligns with previous studies by Kumar, Teichman, and Timpernagel (2012); Famiyeh et al. (2018), highlighting that operational efficiency can generate resource savings and lower costs, leading to better financial performance. From a theoretical perspective, this result is consistent with the RBV, which emphasizes that firms gain a competitive advantage when they develop and utilize internal resources and capabilities that are VRIN. Operational performance, when developed through continuous improvement and embedded in routines, can become a strategic resource that enhances a firm's financial strength. The NRBV further extends this by recognizing that environmentally oriented capabilities—such as eco-efficient operations or sustainable sourcing—can contribute to environmental and financial performance when aligned with the firm's long-term strategy. In this context, green SMEs that effectively integrate environmental considerations into their operations are reducing costs and creating value in a way that is difficult for competitors to replicate, thus strengthening their financial position.

Improving operational performance through sustainable practices is a practical strategy for green SMEs aiming to strengthen their financial outcomes. When efficiency, quality, and flexibility are embedded into day-to-day operations, businesses are better positioned to reduce costs and enhance value creation. This underlines the strategic importance of investing in eco-efficient capabilities.

The mediating role of environmental management practices in the relationship between EMA practices and operational performance

Hypothesis 4, which proposes that environmental management practices (EMP) mediate the relationship between environmental management accounting (EMA) practices and operational performance, is not supported. Theoretically, EMA practices are expected to enhance operational performance through the strategic implementation of EMP. EMA provides relevant and accurate information regarding environmental costs and impacts, enabling firms to develop and implement environmentally sound practices—such as waste

minimization, energy efficiency, and resource optimization (Burritt and Schaltegger 2010; Christ and Burritt 2013). However, the absence of a significant mediating effect in this study suggests that the translation from EMA insights into tangible EMP actions may not occur effectively. In particular, EMP implementation may remain symbolic or superficial for smaller enterprises such as SMEs due to resource limitations, managerial capacity, or lack of environmental expertise (Christ and Burritt 2013).

This finding can be interpreted through the resource-based view (RBV) and the natural resource-based view (NRBV). According to RBV, information systems like EMA can only serve as strategic resources when actively leveraged to develop valuable, rare, inimitable, and non-substitutable capabilities. However, if the environmental data generated by EMA is not operationalized into effective practices, its strategic value remains latent. NRBV further extends this view by emphasizing that the ability to convert environmental knowledge into operational benefits depends on the firm's capacity to integrate sustainability into its core processes and routines. In the context of this study, the weak mediation effect implies that while EMA may provide a foundation for EMP, the lack of integration, institutional support, or strategic alignment may inhibit these practices from delivering improved operational outcomes.

Moreover, this result reinforces the idea that information availability alone cannot improve performance. As recent research suggests, the performance impact of EMA depends on an organization's readiness and commitment to implementing environmental strategies (Gerged, Zahoor, and Cowton 2024). Thus, achieving operational benefits from EMA requires accurate environmental information and complementary resources, organizational capabilities, and a culture that supports proactive environmental management. The lack of a mediating effect highlights the need for stronger integration between environmental accounting and management practices. For green SMEs, moving beyond data collection toward actionable strategies is crucial. Strengthening internal capabilities and aligning environmental goals with daily operations may unlock the full potential of EMA.

The mediating role of operational performance in the relationship between environmental management practices and financial performance

Although environmental management accounting (EMA) provides accurate information regarding environmental costs and impacts, the empirical findings do not support Hypothesis 5, which proposes that operational performance mediates the relationship between environmental management practices (EMP) and financial performance. The indirect effect is not supported. Based on RBV, the absence of a mediating effect suggests that EMP has not yet evolved into strategic capabilities that can enhance operational performance. Without transforming practices into embedded routines and efficiencies, the pathway from EMP to financial performance via operational outcomes remains limited for green SMEs.

This may reflect a misalignment between the formulation and execution of environmental strategies, where firms cannot translate EMA data into effective EMP that improves operations. From the RBV, this suggests that although EMP could be considered a valuable internal capability, it must be fully integrated into operational routines to generate performance outcomes. Meanwhile, the NRBV posits that environmental capabilities only yield competitive advantage when supported by complementary organizational factors such as culture, leadership, and innovation. EMP implementation may still be symbolic or constrained by limited resources in many SMEs or less regulated sectors.

Additionally, as Khan and Yu (2021) noted, environmental initiatives often deliver benefits over a longer time horizon. Hence, short-term empirical studies may underestimate the mediating role of EMP in enhancing performance. External pressures such as regulatory demands, stakeholder expectations, or economic uncertainty may also exert a more direct

influence on operational performance, overshadowing the gradual internal impact of EMP. These findings reinforce the idea that strategic environmental practices need to be deeply embedded, adequately supported, and sustained over time before they can significantly contribute to financial outcomes through improved operations.

Conclusions

This study highlights the important role of environmental management accounting (EMA) in encouraging green SMEs in Indonesia to adopt improved environmental management practices (EMP). However, despite adopting these practices, the expected improvements in operational performance were not evident. This suggests that achieving operational gains from environmental initiatives may take time or require better alignment with the firm's internal strategies and resources. Interestingly, operational performance remains a key driver of financial outcomes, reinforcing that operational excellence is essential for financial sustainability. These findings suggest that while environmental practices are crucial, their benefits may not be immediately observable, and their success may depend on broader organizational or contextual factors.

The findings enrich the current body of knowledge by confirming that EMA functions as an accounting tool and a strategic lever to drive environmental initiatives within small and medium-sized enterprises. While prior studies suggest a linear link between environmental practices and performance, this research indicates that the pathway may be more complex and indirect—particularly in SMEs operating in emerging markets like Indonesia, where formal systems and environmental infrastructure are still evolving. This calls for a reconsideration of how the role of environmental practices is conceptualized within performance models.

For SME owners and managers—especially those aiming to operate more sustainably—this study offers a clear message: adopting environmental management accounting can significantly improve environmental practices, which, over time, may lead to better financial outcomes. Although the link to operational performance is not immediate, investing in environmental strategies and aligning them with long-term business goals is still important. Policymakers and SME support agencies should also consider providing technical assistance and practical tools to help SMEs better translate their environmental efforts into operational improvements.

This research was conducted with certain limitations. Due to the lack of a formal registry for green SMEs in Indonesia, respondents were identified through a snowballing method, which may introduce bias. Furthermore, the study relied on a structured questionnaire, which may not fully capture the scope and diversity of EMA and EMP across different industries. Future research could explore these dynamics further—perhaps over a longer time horizon or across different sectors—to better understand how environmental efforts contribute to long-term performance. A case study or interview-based approach could also be adopted to explore the underlying mechanisms and contextual factors that influence how environmental strategies are implemented and their eventual impact on business performance.

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