

# Environmental Management Accounting, Environmental Performance, and the Moderating Role of Female Leaders: Empirical Evidence in Indonesian MSMEs

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## ABSTRACT

This study is motivated by the increase in environmental degradation and the fact that Indonesian MSMEs, despite being key contributors to the national economy, still have relatively low awareness and implementation of sustainability practices. In this context, environmental management accounting becomes an important mechanism to help MSMEs monitor, manage, and improve their environmental performance in a more structured way. At the same time, there are still gaps in the literature related to the role of gender, especially how female leaders can influence the effectiveness of sustainability-oriented management practices within organizations. Therefore, this study focuses on examining the moderating role of female leaders in the relationship between environmental management accounting implementation and environmental performance in Indonesian MSMEs. The analysis is based on survey data obtained from 743 MSMEs and tested using Moderated Regression Analysis to capture both the direct effect of environmental management accounting and its interaction with female leadership. The empirical results show that environmental management accounting implementation is positively associated with better environmental performance. In addition, the presence of female leaders strengthens this positive relationship, indicating that gender-inclusive leadership can enhance the impact of environmental management accounting. These findings imply that encouraging MSMEs to adopt environmental management accounting, while simultaneously promoting female leadership, can be an effective strategy for improving environmental performance and supporting more sustainable business practices.

**Keywords:** Female Leaders, Environmental Management Accounting, Environmental Performance, MSMEs, Indonesia.

## INTRODUCTION

The challenge for business organizations in addressing increasingly concerning environmental issues has become urgent today (Cai & Li, 2018; Ronaldo & Suryanto, 2022; Yu et al., 2020). In recent times, the massive use of industry resources has become a major cause of environmental damage (Armadani & Zarefar, 2023; Oyinlola, 2025; Yahya, 2025). The conversion of forests for industrial purposes, uncontrolled waste disposal, and water and environmental degradation have become central issues directly related to companies (Fitriani, 2022; Gueddari, 2024; Kumala & Siregar, 2020). Furthermore, Indonesia itself has experienced massive destruction. Indonesia's forests decreased by over 1,000 hectares between 2016 and 2020. Furthermore, forest destruction will undoubtedly negatively impact other aspects, such as declining air and water quality. Ultimately, human life will also be threatened (Hanif et al., 2023; S. K. Singh et al., 2020).

The real threat of environmental degradation has led to increased attention from stakeholders and companies. It is because the dangers caused by industrial activities, such as the mining sector, concern not only environmental aspects but also human aspects, as mentioned previously. A small example is the criminalization of society, where 69 people were criminalized and 700,000 hectares of land were damaged in South Sulawesi. Things like this are what bring awareness to stakeholders throughout the world, including in Indonesia (Heubeck, 2024; Huang et al., 2024). The community, investors, and the government are demanding that industry implement practices that prioritize environmental sustainability (Faqera & Abdul Manaf, 2024).

A company's environmental performance is crucial for its survival. They will gain a positive image from investors and customers when they focus on addressing environmental issues related to their operations. Conversely, if they ignore it, it can pose a financial threat (Al Kerdawy, 2019; Awan & Arnold, 2020). Not only large corporations, but also MSMEs, as a vital part of the business world, are among the organizations that must address environmental issues throughout their business processes. Interestingly, in Indonesia, MSMEs play a significant economic role. More than half of Indonesia's Gross Domestic Product (GDP) is contributed by MSMEs. In fact, the MSME workforce absorption rate reaches 99 percent. Consequently, MSMEs use a significant amount of resources and must consider environmental sustainability. The current status quo is that approximately 69 percent of MSMEs do not yet understand sustainability. This fact certainly requires serious attention, academically through research and in practice, later in the form of policy.

Several studies have been conducted on factors influencing corporate environmental performance. Several previous studies have identified several determinants, including transformational leadership (Faqera & Abdul Manaf, 2024), strategic planning and management (Sari & Alfarizi, 2024), technological innovation (Figueiredo et al., 2024), digital innovation (Tariq et al., 2024), and other factors. Existing research reveals a gap in the application of management accounting moderated by female leaders. This research is important to conduct, given the gender diversity element in the Sustainable Development Goals (SDGs). This research will empirically demonstrate its role in addressing environmental issues. Environmental management accounting is essential for improving an organization's environmental performance. Environmental management accounting helps improve a company's financial performance without compromising the environment.

Furthermore, environmental management accounting is essential for making informed decisions by managing non-financial and financial information that improves environmental performance and organizational well-being (Burritt & Christ, 2016; Latan et al., 2018). In addition, female leaders sensitive to ethical issues, including the environment, are more likely to encourage the implementation and operational practices that support sustainability (Muttakin & Subramaniam, 2013). Therefore, they will strengthen the relationship between the application of environmental management accounting and environmental performance.

This study aims to examine the moderating role of female leadership on the relationship between the implementation of environmental management accounting and the environmental performance of MSMEs. The advantage of this study compared to previous research is the model used. We suspect a moderating variable exists between the independent and dependent variables because of inconsistent results in previous studies. We used the role of women as leaders in MSMEs, which has not been explored before; this also makes our approach to analyzing the factors driving improved environmental performance more comprehensive. We also used the MRA approach, referring to (Sharma et al., 1981), which is still rarely used in previous studies.

## LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

### Environmental Management Accounting and Environmental Performance

The current business landscape has changed how we view the environment (Mkadmi & Daafous, 2023; Truong, 2024; Zharfpeykan & Bai, 2025). There are various reasons why businesses, including MSMEs, are adopting and implementing environmental management accounting. One driving force behind implementing environmental management accounting for MSMEs is stakeholder pressure (Gunarathne & Lee, 2015). This pressure comes from legislators, customers, the public, and the government. Furthermore, MSMEs also have a unique incentive to maintain their reputation in the eyes of the public. MSMEs have a social contract that requires them to operate according to societal norms and expectations (Gracia & Siregar, 2021).

Legitimacy theory argues that improving environmental performance by implementing environmental management accounting provides a positive reputation for MSMEs (Baldini et al., 2018; Deegan, 2002; Dong et al., 2022; Doni et al., 2021; Erin et al., 2021; Ghardallou, 2022; S. Singh & Mittal, 2019). MSMEs will gain legitimacy from the public and stakeholders (Lee, 2019). The public will perceive that MSMEs are concerned about environmental issues. Stakeholders have a positive view of MSMEs due to their concrete actions in implementing environmental management towards their responsibility for environmental sustainability (Elsayed & Ammar, 2020; Latan et al., 2018). It will provide a competitive advantage for MSMEs and ensure their business continuity.

The application of environmental management accounting in MSMEs is useful for measuring, identifying, analyzing, and making decisions related to activities that impact the environment (Ariffin, 2016). Applying environmental management accounting will result in more efficient and environmentally friendly decisions, such as waste management systems, energy efficiency, and shifting operational activities to those that support environmental sustainability (Ariffin, 2016; Gunarathne & Lee, 2015; Hanif et al., 2023; Latan et al., 2018). Furthermore, environmental management accounting practices have a concrete impact on improving environmental performance by becoming a structured system for budget execution and evaluation. It means that environmental management accounting is not merely a financial allocation tool but has become part of the strategic decision-making system to reduce the negative impact of MSME activities on the environment.

H1. The application of environmental management accounting improves environmental performance.

### Environmental Management Accounting, Women Leaders, and Environmental Performance

The implementation of environmental management accounting in MSMEs will improve environmental performance. This positive impact will be strengthened by the role of female leaders in MSMEs. Women are seen as highly sensitive to environmental and sustainability issues (Cambrea et al., 2024; Khemakhem et al., 2022; Liao et al., 2015). Furthermore, they also demonstrate high compliance with regulations and ethics (Mensah & Onumah, 2022). Female leaders will support the implementation of environmental management accounting. With this support from leaders, implementing environmental management accounting will be more widespread (Carpenter et al., 2004; Liu, 2020; Luanglath et al., 2019; Velte, 2020; Zhao et al., 2020). Evaluation to continuously improve the implementation system will also be encouraged to achieve environmental sustainability.

Furthermore, from the perspective of upper echelons theory, organizational leaders, particularly MSMEs, have significant power in determining the nature of their business operations (Bouzouitina et al., 2021; Elia et al., 2021; Luanglath et al., 2019; Velte, 2020). They will make strategic decisions that prioritize the implementation of environmental management accounting because it aligns with their fundamental nature and values (Hambrick & Mason, 1984). They are crucial in directing and monitoring their implementation for improved environmental performance.

H2. Female leaders strengthen the positive influence of environmental management accounting on environmental performance.

## RESEARCH METHODOLOGY

### Data Type and Source

The type of data used in this study is primary data. The data source used in this study was collected using a questionnaire from MSMEs in Indonesia. The population of this study was MSMEs throughout Indonesia. The sample was determined using a purposive sampling method, with the following criteria:

- a. Having assets and/or sales classified as MSMEs based on Government Regulation No. 7 of 2021
- b. Having information that meets all research variables

After distributing the questionnaire, we received responses and conducted a sample selection, with a final result of 743 valid respondents.

### Operational Definition and Measurement of Variables

This study uses environmental performance (ENVP) as the dependent variable. Environmental performance is measured using a scale consisting of seven items, measured on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), referring to previous research (Kim et al., 2019). The independent variable used is environmental management accounting (ENVP). To measure ENVP, a scale developed by Latan et al. (2018) with 4 question items was used. The moderating variable in this study was female leaders, measured by the ratio of women to total leaders in MSMEs (Almarayeh et al., 2024; Bennouri et al., 2018). The control variable in this study was the size of the MSME, measured by the total assets owned by the MSME (Diaz & Armadani, 2024). The following are the indicators and measurements for each research variable (see Table 1).

**Table 1.** Indicators and Measurements

Variable	Indicator	Measurement
1. Environmental Performance (ENVP)	a. Environmental management within our company has reduced waste. b. Environmental management within our company has saved water usage. c. Environmental management within our company has saved energy usage.	Likert scale 1-5

	d. Environmental management within our company has reduced the purchase of non-renewable materials, chemicals, and components. e. Environmental management within our company has reduced overall costs. f. Environmental management within our company has improved its market position. g. Environmental management within our company has helped enhance our hotel's reputation.	
2. Environmental Management Accounting (ENVP)	a. My company is involved in identifying environmental costs. b. My company estimates contingent liabilities related to the environment. c. My company allocates environmental costs related to production processes. d. My company has implemented environmental cost management.	Likert scale 1-5
3. Female Leaders (FEMLEAD)	The number of women divided by the total leaders in MSMEs	Ratio
4. Size of MSMEs (MSMEs)	Natural logarithm of total assets	

### Analysis Techniques

The analysis techniques we used were descriptive analysis and hypothesis testing. Descriptive analysis was conducted to describe data characteristics through mean, standard deviation, minimum, and maximum values. Before conducting the hypothesis testing, validity and reliability tests were conducted. After that, we conducted validity and reliability tests. Hypothesis testing was conducted using the MRA approach. The MRA test is used to identify the significance and type of moderating variables. This MRA test was conducted based on previous research (Truong, 2024). The hypothesis is accepted when the calculated t-value is greater than the table t-value and the p-value is less than 0.10. The following is the empirical model for this study:

$$\text{ENVP} = \alpha + \beta_1 \text{ENVP} + \beta_2 \text{FEMLEAD} + \beta_3 \text{ENVACC} * \text{FEMLEAD} + \beta_4 \text{SMES} + \epsilon \dots\dots\dots (1)$$

## RESULTS AND DISCUSSION

The demographics of this study's respondents indicate that 58.9% were male, with the remainder female. This data indicates that men still dominate MSMEs. The highest age group was 35 to 44, reaching 26%. The lowest age group was over 55 years old (9.3%). The remaining age groups were spread across 18.1%, 45 to 54 years old (22.8%), and 25 to 34 years old (23.9%). Initial data analysis was conducted based on previous research by Ronaldo & Suryanto (2022). Descriptive statistics for the data are presented in Table 1. At this stage, we evaluated data errors related to missing values and outliers. Based on Table 1, the average total observations in this study came from 743 respondents. Their average answers ranged from 3.5 to 4.05, with a minimum score of 1 and a maximum score of 5 for the ENVP and ENVACC variables. Meanwhile, the average percentage of female leaders was 67.8%.

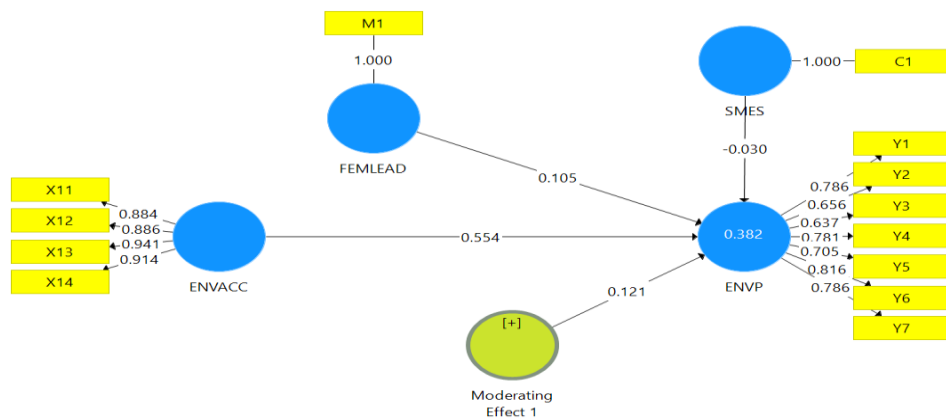
**Table 2.** Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ENVP1	7743	4.192	.861	1	5
ENVP2	7743	4.362	.784	1	5
ENVP3	7743	4.231	.829	1	5
ENVP4	7743	4.062	.913	1	5
ENVP5	7743	4.207	.754	1	5
ENVP6	7743	3.983	.956	1	5
ENVP7	7743	4.012	1.042	1	5
ENVACC11	7743	3.45	1.25	1	5
ENVACC12	7743	3.75	.985	1	5
ENVACC13	7743	3.59	1.135	1	5
ENVACC14	7743	3.587	1.121	1	5
M1	7743	.678	.467	0	1

C1	7743	2.962	.935	1	4
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The statistical analysis in this study was conducted based on previous research using Partial Least Squares (PLS) (Hair et al., 2018). Before testing the influence of the variables, we first conducted reliability and validity tests. Confirmatory factor analysis (CFA) tests were conducted and presented in Figure 2 and Table 2. The Kinerja Lingkungan UMKM (ENVP) scale consists of seven items. All items have factor loadings between 0.637 and 0.816. Akuntansi manajemen lingkungan (ENVACC) is measured through four items with factor loadings between 0.884 and 0.941. This study used a factor loading threshold of 0.5 as the basis for determining whether an item is valid or not. Therefore, all items in these variables have met the requirements.

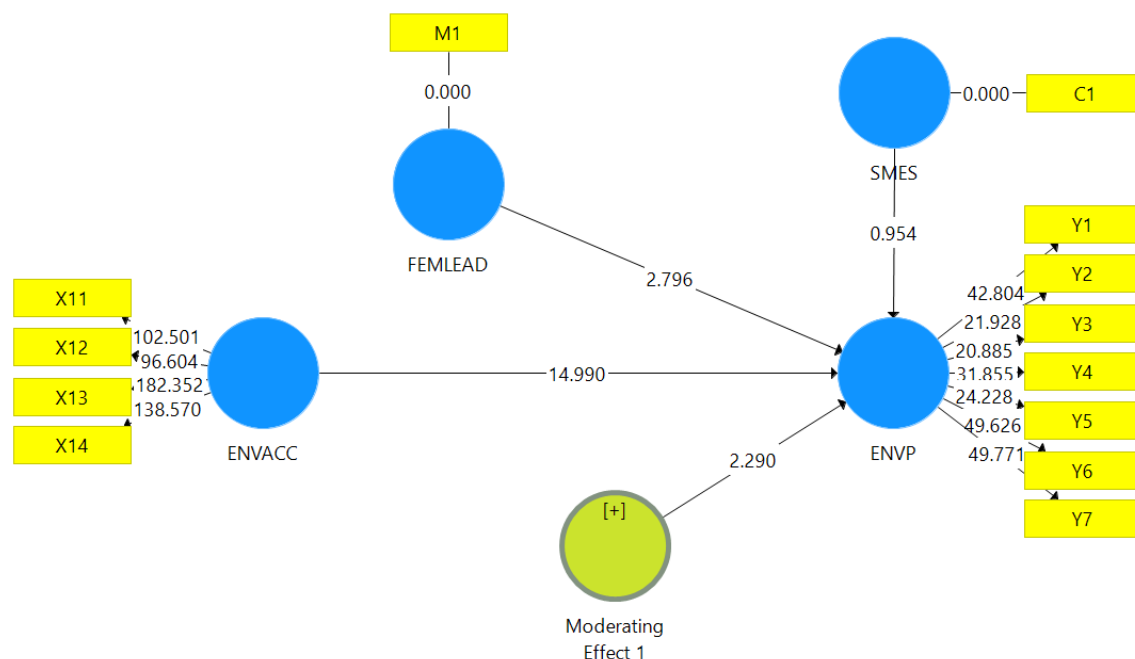
In addition, we also tested convergent validity by testing composite reliability (CR) and average variance extracted (AVE). The threshold for CR is 0.7 and AVE is 0.5 (Hair et al., 2018). The results of CR and AVE are shown in Figure 2 and Table 2, showing that the results have met all requirements. We also tested reliability by looking at the Cronbach's Alpha value with a threshold of 0.7 and rho\_A with a threshold of 0.7. Based on Table 3, it can be seen that all elements have been met. Furthermore, the discriminant validity of Jörg Henseler et al. (2014) was achieved with the help of the Heterotrait Monotrait ratio presented in Table 4.



**Figure 1.** Measurement Model

**Table 3.** Validity and Reliability Test

Variabel	Item	Loadings	CA	rho_A	CR	AVE
Kinerja Lingkungan	ENVP1	0.786	0.866	0.888	0.894	0.549
	ENVP2	0.656				
	ENVP3	0.637				
	ENVP4	0.781				
	ENVP5	0.705				
	ENVP6	0.816				
	ENVP7	0.786				
Akuntansi Lingkungan	ENVACC1	0.884	0.928	0.928	0.949	0.822
	ENVACC2	0.886				
	ENVACC3	0.941				
	ENVACC4	0.914				
Pemimpin perempuan	FEMLEAD1	0.879	1.000	1.000	1.000	1.000
Ukuran UMKM	SMES1	0.859	1.000	1.000	1.000	1.000



**Figure 2.** Structural Model

**Table 4.** HTMT

	ENVACC	ENVP	FEMLEAD	Moderating Effect 1	SMES
ENVACC	0.907				
ENVP	0.606	0.741			
FEMLEAD	0.357	0.273	1.000		
Moderating Effect 1	0.110	0.136	-0.305	1.000	
SMES	-0.112	-0.098	-0.086	0.021	1.000

The hypothesis's results are presented in Table 5. This study's findings reveal that environmental management accounting positively affects corporate environmental performance, supporting H1. Implementing environmental management accounting can contribute to improved environmental performance due to the identification, measurement, and analysis processes associated with budgeting for environmental sustainability. MSMEs implementing environmental management accounting will map the allocation of funds for operational activities that may impact the environment.

From a legitimacy theory perspective, the implementation of management accounting also represents an effort by MSMEs to maintain their standing with stakeholders (Cheng & Feng, 2023; Garas & ElMassah, 2018). Implementing management accounting is a crucial way to gain and maintain societal legitimacy. The public will evaluate MSME actions that impact society and the environment. Society is highly critical and has even demanded that companies prioritize environmental issues for attention and protection by every business entity. The implementation of management accounting serves as a tool for MSMEs to provide transparency, regulatory compliance, and a commitment to achieving sustainable environmental performance. It will undoubtedly strengthen the legitimacy of MSMEs and build stakeholder trust in the company. Furthermore, strong public legitimacy will support the long-term sustainability of MSME businesses.

**Table 5.** Hypothesis testing

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ( O/STDEV )	P Values
ENVACC -> ENVP	0.554	0.555	0.037	14.990	0.000
FEMLEAD -> ENVP	0.105	0.106	0.038	2.796	0.005
Moderating Effect 1 -> ENVP	0.121	0.127	0.053	2.290	0.022
SMES -> ENVP	-0.030	-0.031	0.031	0.954	0.341

Furthermore, this study revealed that female leaders' role in strengthening the positive influence of environmental management accounting on environmental performance was empirically proven, and H2 was accepted. This finding aligns with the upper echelons theory, which states that leaders' characteristics significantly influence their decision-making. They encourage the implementation of environmental management accounting to improve environmental performance. Their inherent sensitivity to ethical issues makes them more likely to instruct their subordinates to practice environmental sustainability.

Female leaders who comply with regulations and understand public expectations are more likely to encourage the MSMEs they lead to implement sustainable practices, in this case, environmental management accounting. They will create structured systems, appoint competent individuals, and direct and oversee all management accounting processes. Their leadership actions will undoubtedly significantly impact company operations, thereby improving environmental performance. In other words, they play a crucial role in creating an organizational culture that supports high environmental performance.

Finally, we conducted a predictive relevance ( $Q^2$ ) test to ensure the model's quality. The standard for predictive relevance is that it must be at least zero. Table 5 shows that environmental performance has a predictive relevance of 0.195, indicating that the research model is of good quality.

**Tabel 5.** Predictive relevance ( $Q^2$ )

	SSO	SSE	$Q^2 (=1-SSE/SSO)$
ENVACC	2.972.000	2.972.000	
ENVP	5.201.000	4.186.311	0.195
FEMLEAD	743.000	743.000	
Moderating Effect 1	743.000	743.000	
SMES	743.000	743.000	

## CONCLUSION, LIMITATION, AND FUTURE RESEARCH

Environmental issues, which have increasingly attracted attention from various groups worldwide, have become interesting to study and seek solutions. Increasingly critical stakeholders regarding sustainability issues implemented by business entities have made sustainability practices increasingly important for these entities, including MSMEs. This study examines the application of environmental management accounting to environmental performance, considering the role of women as leaders. The survey method used was a questionnaire distributed to MSMEs in Indonesia. After receiving responses and selecting samples, the final sample size was 743. The findings of this study reveal that the application of environmental management accounting improves the environmental performance of MSMEs. Furthermore, female leaders strengthen environmental management accounting to improve MSME environmental performance.

This research contributes to both theory and practice. Theoretically, this study contributes to the development of the literature by providing empirical evidence regarding the moderating effect of female leadership on the relationship between environmental management accounting and MSME environmental performance. These findings enrich the literature, as no previous research has addressed this issue. In practice, this research provides input for stakeholders, such as regulators, who require MSMEs to implement environmental management accounting and encourage gender diversity in company leadership, particularly within MSMEs.

This study has limitations, particularly because the sample size is still limited. Future research could expand the sample size to obtain more comprehensive results. Furthermore, this study used a survey approach, resulting in inaccurate information. Future research is recommended to employ additional methods, such as in-depth interviews, in addition to the survey method. This opportunity would expand the scope of this study.

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