International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 12s,2025
https://theaspd.com/index.php

Green Accounting: Environmental Awareness and Social Responsibility of MSMEs in Implementing the 5R Frameworks Sustainable Environment.

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Abstract: This study aims to examine the influence of environmental awareness and social responsibility on the implementation of the 5R Framework (Report, Record, Reduce, Reuse, Recycle) in promoting sustainable environmental practices among MSMEs. A mixed-method approach was employed, combining quantitative data from online questionnaires distributed to 83 MSMEs in Papua Province with qualitative analysis. Convenience and snowball sampling techniques were used. Data analysis was conducted using SmartPLS to assess instrument validity, reliability, model fit, and hypothesis testing. Additionally, qualitative text analysis was carried out using Voyant Tools to identify thematic patterns and visualize relevant textual data.
The results reveal that environmental awareness has a significant positive impact on the overall implementation of the 5R Framework. Social responsibility, on the other hand, directly influences only two dimensions—Reduce and Reuse. Environmental awareness also acts as a mediating variable between social responsibility and broader 5R implementation. The integration of quantitative and qualitative findings highlights a strong alignment between environmental consciousness, ethical responsibility, and sustainable practices. The consistent emphasis on recycling and reporting underscores their critical role in driving 5R practices among MSMEs.
This study suggests that targeted capacity building and value-driven leadership are essential for promoting sustainability, especially in resource-constrained environments. It contributes to the literature by integrating behavioral and psychological perspectives to explore how environmental awareness and ethical commitment influence sustainable waste management practices in the MSME sector.
Keywords: *environment awareness, social responsibility, MSMEs, 5R Framework, sustainable environment.*

INTRODUCTION

Environmental degradation remains a pressing global issue, often exacerbated by unsustainable business practices. While industrial sectors are commonly blamed, micro, small, and medium enterprises (MSMEs) also contribute significantly to environmental challenges due to limited awareness and weak environmental management practices. MSMEs, despite their large number and economic importance, often lack the technical capacity and resources to implement effective environmental practices (Renaldo, Jollyta, Suhardjo, & Rosyadi, 2022). This limitation in environmental management is particularly evident in their poor integration of Green Accounting (GA) practices, which are designed to incorporate environmental and social considerations into financial reporting and decision-making. Furthermore, (Alamsyah & Ibrahim, 2021) supports the need for clearer guidance and incentives for MSMEs to implement green accounting practices, emphasizing that proper environmental cost recognition can increase sustainability efforts and provide long-term financial benefits.Green Accounting provides a strategic approach that encourages businesses to assess environmental impacts, enabling them to identify areas for improvement and align with sustainability goals (Suhardjo, Renaldo, & Rosyadi, 2022). However, the implementation of Green Accounting, particularly among MSMEs, remains limited due to regulatory gaps, lack of awareness, and insufficient technical capacity (Maulita & Adham, 2020). Studies have shown that, while MSMEs recognize the importance of

environmental sustainability, their ability to record, report, reduce, reuse, and recycle (the 5R framework) is often hindered by inadequate infrastructure and knowledge (Arizona & Suarjana, 2017); (Puspita & Surendra, 2019). Furthermore, the lack of specific regulations targeting environmental accounting for MSMEs exacerbates the challenge, leaving many businesses unaware of the benefits and methods of integrating green practices into their operations (Devi L.P., Alfian., & Rohmanyah, 2023); (Puspita & Surendra, 2019); (Pentiana, 2019). In Indonesia, especially in regions like Jayapura City, the rapid development of MSMEs—growing from fewer than 50 units in 2012 to over 700 by 2023 in Muara Tami District alone—has contributed to economic growth. However, this expansion has also intensified environmental challenges, particularly in the absence of structured waste management practices. The focus of government programs remains largely on business infrastructure, access to capital, and marketing strategies, with limited emphasis on environmental education or accounting practices among MSMEs.Despite the increasing importance of environmental sustainability in business practices, many MSMEs in developing regions still lack awareness and implementation of green accounting principles. In Jayapura City, the rapid growth of MSMEs has not been accompanied by proportional development in environmental management practices. Limited knowledge, lack of regulatory guidance, and minimal integration of sustainability indicators have contributed to weak environmental responsibility among MSMEs. Although Indonesia's Financial Accounting Standards (PSAK) do not explicitly regulate environmental accounting for MSMEs, PSAK No. 33 addresses environmental management for entities involved in extractive industries. Meanwhile, Government Regulation No. 22/2021, derived from Law No. 11/2020 (Job Creation Law), emphasizes environmental protection and mandates an Environmental Document Information System for business licensing. However, the implementation of such frameworks among MSMEs in Jayapura remains unclear and underexplored.To address this gap, this study aims to analyze the level of environmental awareness and social responsibility among MSMEs in Jayapura City, focusing on their implementation of the 5R principles: Record, Report, Reduce, Reuse, and Recycle. The 5R framework offers a structured approach for integrating green accounting into MSME business operations and aligns with the objectives of PSAK No. 33. By evaluating the extent to which MSMEs adopt these indicators, this research seeks to contribute to the development of more inclusive and sustainable accounting practices for small-scale enterprises (Tu & Huang, 2015); (Rao, 2024); (Thanasas, 2024). Ultimately, this study aspires to offer practical insights for local governments and policymakers, supporting efforts to reduce environmental risks and promote sustainable business practices through strengthened MSME participation in environmental management.

LITERATURE REVIEW

Legitimacy Theory and CSR Disclosure in MSMEs The Legitimacy Theory focuses on an organization's efforts to gain and maintain social acceptance by aligning its activities with the prevailing norms and values in society. In the context of MSMEs, Corporate Social Responsibility (CSR) disclosure is used as a strategy to gain legitimacy from the public. This is crucial because social recognition can enhance the competitiveness and sustainability of businesses (Ramadhani, Saputra, & Wahyuni, 2022). According to (Deegan, Robin, & Tobin, 2000), legitimacy is obtained when the company's activities align with the value system present in society. Conversely, any deviation from this alignment can threaten the company's legitimacy. In practice, MSMEs often face challenges in preparing effective CSR reports due to limited resources and knowledge.

Environmental Sustainability Framework and Its Implementation in MSMEs The implementation of environmental sustainability involves a series of actions designed to maintain and enhance ecological balance while preserving natural resources for future generations. The following steps are part of the sustainability environment framework (Meier, 2023): Record: This step involves tracking and collecting data on the organization's environmental impact, such as energy consumption, waste generation, and resource use. Report: This step involves communicating the organization's sustainability performance to stakeholders. Reduce: Actions are taken to minimize the environmental impact of the organization, such as reducing energy consumption, waste generation, or improving resource efficiency. Recycle: This step focuses on recycling materials and resources, reducing demand for new resources, and reducing waste. Reuse: This step involves

finding ways to reuse resources and materials, reduce the need for new resources, and minimize waste. The implementation of these steps requires a comprehensive and integrated approach to reduce negative environmental impacts and ensure responsible resource use (Yarahmadi & Bohloli, 2015); (Dees & Jong, 2024).

Role of MSMEs in Achieving Sustainable Development Goals (SDGs)MSMEs play a significant role in achieving the Sustainable Development Goals (SDGs), especially in aspects like economic growth, social inclusion, and environmental sustainability. They contribute through job creation, innovation, and community development. However, challenges such as limited access to financing, resources, and green technologies still impede the adoption of sustainable practices (Judijanto, Hendra, & Islam, 2025); (Puspita & Surendra, 2019).

Integration of Technology and Green Practices in MSMEs The integration of technology and green practices is increasingly recognized as a pivotal strategy for enhancing the sustainability and competitiveness of Micro, Small, and Medium Enterprises (MSMEs). Recent studies have shed light on various aspects of this integration: Technology-Driven Sustainability (Kannan & Gambetta, 2025), conducted a systematic literature review highlighting that MSMEs leverage technology to embed sustainability into their operations. They identified key themes such as external environment, organizational context, sustainability orientation, technology opportunities, innovation focus, knowledge management, assessment frameworks, and sustainability practices and outcomes. Green Supply Chain Management (GSCM), (Purwoko, Handayani, & Rahayu, 2023) found that the adoption of GSCM practices, coupled with consumer awareness and regulatory compliance, positively impacts the market performance of MSMEs in Indonesia. This underscores the importance of integrating green practices into supply chain operations. Digital Technologies for Green Transition (OECD, 2023) emphasized that digital technologies can facilitate the green transition of SMEs by enabling low-carbon and circular business models. However, challenges such as lack of skills and access to finance remain significant barriers. Green IT Adoption: A study by (Fan, Loeser, & Alt, 2022) indicated that the adoption of green IT helps MSMEs to improve economic and environmental performance, collaborate with business partners, and establish good relationships with customers. Challenges in Technology Adoption: Despite the benefits, MSMEs often face obstacles such as limited infrastructure, lack of knowledge, and financial constraints that hinder the implementation of green technologies. Addressing these challenges requires targeted policies and support mechanisms (International Labour Organization (ILO)., 2023).

METHODOLOGY

This study employs a mixed-method approach combining quantitative surveys with qualitative interviews to capture both numerical data and in-depth insights regarding the application of 5R principles and green accounting among MSMEs in Jayapura. The participants in this study consisted of 83 MSMEs located in Jayapura, Papua. Survey questionnaires were distributed to owners or managers, collecting information on energy consumption habits, the types of energy sources used, and the extent to which they incorporated 5R practices in their operations. Additionally, 15 in-depth interviews were conducted with selected business owners to explore their awareness of environmental sustainability and their use of green accounting. A total of 83 MSME owners were selected as respondents using G*Power analysis to determine an appropriate sample size. The sample size calculation followed the five-step procedure as outlined (Memon, Ting, Cheah, Chuah, & Cham, 2020); (Sofyani, 2023), ensuring adequate statistical power for hypothesis testing. Data were collected using a structured questionnaire and semi-structured interview guide. The instruments were developed based on literature related to sustainability reporting, green accounting, and environmental behavior among SMEs. (Pentiana, 2019); (Mostafa, 2007); (Astiti, 2014); (Ramadhani, Saputra, & Wahyuni, 2022); (Meier, 2023); (Jasch, 2003); (UNEP)., 2003); (Deegan C. , 2022); (GRI, 2023). All items in the questionnaire were measured using a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*. Quantitative data were analyzed using descriptive statistics and correlation analysis with SmartPLS, while qualitative interview data were analyzed thematically using Voyant analysis.

FINDINGS AND DISCUSSION

Characteristics of Respondents

Table 2 presents the demographic characteristics of the 83 respondents. The majority of respondents are female, totaling 47 individuals (57%), while male respondents account for 36 individuals (43%). In terms of age, the largest group falls within the 30–40 years category, comprising 29 respondents (35%), followed by those under 30 years old, totaling 24 respondents (29%). Regarding educational background, most respondents graduated from high school (SMA), accounting for 57 individuals (69%). Meanwhile, 15 respondents (18%) hold a bachelor's degree (S1), and 11 respondents (13%) have other higher education qualifications (e.g., diploma or associate degree). The majority of respondents report a monthly income ranging from IDR 5,000,000 to IDR 10,000,000.

Table 1 Respondent Distribution

Characteristic	Information	Sum	Percentage
Gender	Women	47	57%
	Men	36	43%
		83	100%
Age	> 50 years	14	17%
	41-50 years	16	19%
	30-40 years	29	35%
	< 30 years	24	29%
		83	100%
Education	S1	11	13%
	Bachelor's	15	18%
	High School	57	69%
		83	83
Revenue	> Rp 10.000.000,00	6	7%
	Rp 5.000.000 – Rp 10.000.000	73	88%
	< Rp 5.000.000,00	4	5%
		83	100%

Analysis of 5R Implementation and Green Accounting Based on Energy Consumption Patterns of MSMEs

Effective environmental management enables companies, MSMEs, and communities to operate more sustainably, minimize negative impacts on ecosystems, and contribute to long-term environmental preservation. To capture respondents' perceptions of environmental management within the context of their business activities, several open-ended questions were posed. These questions explored topics such as waste management practices, the use of energy sources (e.g., gas, kerosene, gasoline for vehicles), and electricity consumption. The responses provided insights into how MSMEs perceive and implement environmentally responsible practices in their daily operations.

Table 2 Respondents' Perceptions of the Sustainability Environment

Question	Sum	Percent
1. Do you have a specific container for waste disposal?		
Yes	45	54%
No	38	46%
2. Where do you dispose of your waste or garbage?		
Garbage dumps on the road	31	37%

Garbage trucks	25	30%
Waste Bank	18	22%
Others (Vacant land, behind the house/burned)	9	11%
3. Do you separate dry and wet waste before disposal?		
Yes	33	40%
No	50	60%
4. Do you pay any environmental fees for waste disposal services?		
Yes	16	19%
No	67	81%
5. What types of energy sources do you use for your business operations?		
Kerosene	22	30%
Gas	25	27%
Electricity	8	10%
Gas and Electricity	10	15%
Gas and Kerosene	12	12%
others (firewood)	5	6%
6. Do you track your energy consumption and costs on a monthly basis (including water, electricity, gas, kerosene, and others)?		
Routine	10	11%
Non-Routine/Occasional	37	46%
No Recording	36	43%
7. Do you set any environmental policies at home or in your business, such as conserving electricity and water, avoiding littering, and limiting the use of plastic?		
Yes	66	80%
No	17	20%

The research findings indicate that most micro, small, and medium enterprises (MSMEs) in this study still rely heavily on gas and kerosene as their primary sources of energy, rather than electricity or firewood. This suggests that the implementation of the *Reduce* and *Replace* principles within the 5R framework (Reduce, Reuse, Recycle, Replace, Replant) remains suboptimal. Fossil-based energy sources such as kerosene and gas are known for their high carbon footprint and significant contribution to air pollution, making them incompatible with environmental sustainability principles (Setyowati & Nurhadi, 2021). From the perspective of green accounting, this energy consumption pattern reflects the presence of hidden environmental costs that are not explicitly recognized in MSME financial statements, such as externalities from carbon emissions and health-related environmental impacts (Suwardjono., 2020).This trend implies a low level of awareness among MSMEs regarding the potential long-term savings and environmental benefits that could be gained through a transition to cleaner or renewable energy sources. A previous study emphasized that limited access to information and environmentally friendly technology is a key barrier to the adoption of green practices among MSMEs (Meutia & Ismail, 2022). Therefore, an educational approach combined with policy incentives from governments or supporting institutions is essential to encourage MSMEs to substitute conventional energy with more sustainable alternatives, such as renewable electricity or biogas. Furthermore, the introduction of simple environmental reporting based on green accounting principles can improve accountability and serve as a foundation for evaluating the sustainability performance of micro-enterprises in the future. However, empirical studies indicate that awareness and practical application of the 5R principles among MSMEs in developing countries remain relatively low due to limited training and support infrastructure (Fitriyani, Ardiansyah, & Putri, 2023); (Rahmawati, Yusuf, & Suryani, 2024).

Thematic Findings: Evidence from Qualitative Data and Institutional Context

This study employed in-depth interviews with micro, small, and medium enterprises (MSMEs) to explore their environmental management practices through the lens of the 5R framework (Record, Report, Reduce, Reuse, Recycle). The interview transcripts were analyzed using Voyant Tools, a text mining software that visualizes word frequency, context, and co-occurrence to reveal underlying patterns in qualitative data.

Table 1 Percentage Correlation Matrix Among Keywords - Record Indicator

Indicator s	Activity	Regulation	Environment	Monitoring	Performance	Savings
Activity	-	-0.35	-0.83	-0.32	-0.62	-0.18
Regulation	-0.35	-	-0.16	0.97	0.95	0.98
Environment	-0.83	-0.16	-	-0.15	0.14	-0.33
Monitoring	-0.32	0.97	-0.15	-	0.90	0.97
Performance	-0.62	0.95	0.14	0.90	-	0.87
Savings	-0.18	0.98	-0.33	0.97	0.87	-

This correlation matrix indicates how frequently terms appear together relative to their overall co-occurrence patterns. For instance, *Regulation* and *Monitoring* (r = 0.97), as well as *Regulation* and *Savings* (r = 0.98), exhibit strong positive correlations, suggesting that these themes are strongly linked in participants' responses, especially within the context of MSME environmental practices. Conversely, negative correlations (e.g., *Activity* and *Environment*) may reflect divergent focuses or contrasting emphasis in responses or reflects tension between business operations and environmental/regulatory focus.

Table 2 Percentage Correlation Matrix Among Keywords – Reporting Indicator

Indicators	Impact	Evaluation	Report	Risk	Environment	Reputation
Impact	-	0.88	0.85	0.81	0.85	0.84
Evaluation	0.88	-	0.91	0.84	0.86	0.83
Report	0.85	0.91	-	0.82	0.88	0.87
Risk	0.81	0.84	0.82	-	0.81	0.80
Environment	0.85	0.86	0.88	0.81	-	0.85
Reputation	0.84	0.83	0.87	0.80	0.85	-

The correlation matrix above presents the relationships between the key indicators within the framework of sustainability reporting for MSMEs. The high correlations (ranging from 80% to 91%) between *Evaluation* and *Report*, as well as between *Report* and *Environment*, signify the integrated role of evaluation in reporting environmental impacts, with a strong emphasis on transparency. Similarly, the robust correlation between *Risk* and *Reputation* emphasizes the reputational consequences of managing risks through effective environmental practices.

The data suggests that MSMEs perceive sustainability reporting as a holistic process, where each component—impact, evaluation, environment, and reputation—are deeply interconnected.

Table 3 Percentage Correlation Matrix Among Keywords – Reduce Indicator

Indicators	Plastic Waste Minimization	Energy Efficiency & Conservation	Food Waste Reduction	Water Resource Efficiency	Hazardous Chemical Management
Plastic Waste Minimization	-	0.60	0.70	0.50	0.40

Indicators	Plastic Waste Minimization	Energy Efficiency & Conservation	Food Waste Reduction	Water Resource Efficiency	Hazardous Chemical Management
Energy Efficiency & Conservation	0.60	-	0.50	0.70	0.60
Food Waste Reduction	0.70	0.50	-	0.60	0.50
Water Resource Efficiency	0.50	0.70	0.60	-	0.60
Hazardous Chemical Management	0.40	0.60	0.50	0.60	-

The matrix illustrates the strength of co-occurrence and conceptual relationship among reduce-related indicators based on interview themes and keyword frequencies. Higher correlations (e.g., 0.7 between *Plastic Waste Minimization* and *Food Waste Reduction*) suggest thematic overlap in practices like material efficiency and environmental responsibility. This supports the integration of 5R implementation strategies across multiple sustainability efforts in MSMEs.

Table 4 Percentage Correlation Matrix Among Keywords – Reuse Indicator

Indicator	Household Item Reutilization	Repair and Upcycling Practices	Waste-to-Art/ Craft Innovation	Refillable Product Utilization
Household Item Reutilization	-	0.12	0.10	0.15
Repair and Up-cycling Practices	0.12	-	0.05	0.07
Waste-to-Art/ Craft Innovation	0.10	0.05	-	0.08
Refillable Product Utilization	0.15	0.07	0.08	-

This correlation matrix highlights the degree of association between the thematic codes identified from the interviews regarding sustainability practices in MSMEs. For instance, the correlation between Household Item Reutilization and Refillable Product Utilization is 15%, indicating a relatively stronger association between these two practices. Conversely, the Repair and Upcycling Practices show a lower correlation with Waste-to-Art/Craft Innovation at 5%, suggesting a minimal connection between these two practices.The correlation matrix provides an insightful perspective into how different sustainable practices, such as reusing household items and utilizing refillable products, relate to each other in MSMEs. The higher correlations (like between Household Item Reutilization and Refillable Product Utilization) may suggest that businesses that focus on reusing household items are also likely to incorporate refillable product usage into their operations.

Indicator	**Organic Waste Composting**	**Waste Trans-formation into New Products**	**Waste Segregation**	**Water Recycling**	**Emission Reduction**
Organic Waste Composting	-	0.15	0.10	0.5	0.4

Indicator	Organic Waste Composting	Waste Trans-formation into New Products	Waste Segregation	Water Recycling	Emission Reduction
Waste Transformation into New Products	0.15	-	0.12	0.3	0.2
Waste Segregation	0.10	0.12	-	0.7	0.5
Water Recycling	0.5	0.3	0.7	-	0.2
Emission Reduction	0.4	0.2	0.5	0.2	-

Table 5 Percentage Correlation Matrix Among Keywords – Recycle Indicator

This table presents the percentage correlation between various sustainability practices commonly implemented by MSMEs, based on the frequency of keywords identified in interviews. The results indicate that organic waste composting and waste transformation into new products have the highest correlation (15%), suggesting a strong link between these two practices. Waste segregation also shows moderate correlations with both organic waste composting (10%) and waste transformation (12%), highlighting its importance as a foundational practice for effective waste management.However, practices like water recycling and emission reduction have lower correlation percentages, suggesting that while these practices are vital, they may not be as frequently implemented or as interconnected with other sustainability initiatives as those related to waste management. The findings align with the existing body of research on sustainable business practices. For instance, studies by (Sodhi & Tang, 2019) and (Jabbour, 2020) have emphasized the importance of waste management practices, such as composting and recycling, in enhancing MSMEs' environmental performance. Additionally, pointed out that practices such as emission reduction and water recycling, while essential for environmental sustainability, often face challenges in adoption due to cost and resource limitations, especially for MSMEs (Chakraborty, Debashree, & Dey., 2025).

Table 6 Percentage Correlation Matrix Among Keywords – Implementation 5R Framework Sustainability Environment Indicator

Indicator	Reduce	Reuse	Recycle	Record	Report
Reduce	-	0.38	0.56	0.24	0.24
Reuse	0.38	-	0.35	0.31	0.31
Recycle	0.56	0.35	-	0.38	0.38
Record	0.24	0.31	0.38	-	0.50
Report	0.24	0.31	0.38	0.50	-

The correlation matrix reveals several important relationships between key sustainability indicators. The strongest association is observed between Reduce and Recycle (56%), suggesting that MSME respondents often perceive these two actions as closely linked within daily practices. This reflects an integrated approach to minimizing waste through both reduction at the source and transformation into reusable forms—an alignment that supports circular economy principles, as discussed in recent studies (Fitriyani, Ardiansyah, & Putri, 2023); (Wahyuni & Hartono, 2023).A notable correlation is also found between Report and Record (49.5%), emphasizing that proper documentation and reporting are often seen as a unified mechanism for ensuring transparency and traceability in sustainability efforts. This aligns with findings by (Ramadhani, Saputra, & Wahyuni, 2022); (Meshram, 2024), who highlights that MSMEs with structured reporting systems demonstrate higher levels of environmental accountability. Conversely, the moderate-to-low correlation between Reduce and Report/Record suggests that reduction practices—such as cutting down on plastic use or energy consumption—may not always be supported by systematic documentation. This gap highlights the

need for capacity building in sustainability reporting, especially in the context of resource-constrained enterprises, echoing challenges previously noted by (Alamsyah & Ibrahim, 2021);

Quantitative Analysis of the Influence of Environmental Awareness and Social Responsibility on the Implementation of the 5R Framework among MSMEs.

To complement the qualitative findings, this section presents the results of the quantitative analysis conducted to empirically test the relationships between sustainability indicators identified in the previous phase. The analysis aims to validate and examine the effect of Environmental Awareness and Social Responsibility of MSMEs in Implementing the 5R Frameworks in a sustainable environment (Reduce, Reuse, Recycle, Record, Report). To ensure the validity and reliability of the measurement model, several statistical tests were performed, including indicator loading, Cronbach's Alpha, Composite Reliability (CR), Average Variance Extracted (AVE), and R-square (R^2). Convergent validity is assessed through AVE values, where a threshold of 0.50 or above indicates that the construct explains more than half of the variance of its indicators. Reliability is confirmed when Cronbach's Alpha and CR values exceed 0.70, indicating internal consistency. Furthermore, R-square values are used to evaluate the explanatory power of the model, with higher values indicating stronger predictive accuracy. The results of these tests are summarized in the following table 7

Table 7 Instrument Validity and Reliability Test Results

	R Square	*Adjusted R Square*	*Composite Reliability*	*Cronbach Alfa*	*Avg.Var. Extract*
Record Implementation	0.376	0.360	0.933	0.909	0.735
Report Implementation	0.487	0.475	0.911	0.870	0.721
Reduce Implementation	0.460	0.446	0.929	0.904	0.723
Reuse Implementation	0.442	0.428	0.905	0.869	0.656
Recycle Implementation	0.533	0.521	0.948	0.927	0.821
Environment Awareness	0.185	0.175	0.838	0.755	0.511
Social Responsibility			0.937	0.926	0.579

Structural model evaluation is performed by evaluating the value of the path coefficient or t-value of each path for significance tests between constructions in structural models and the values of path coefficients or models in showing the level of significance in hypothesis testing (Abdillah & Hartono, 2015) with R-Square values for dependent construction as shown in Table 3 Environment Awareness (0.185) and Implementing 5R Frameworks Sustainability environment consisting of Record (0.376), Report (0.487), Reduce (0.460), Reuse (0.442) and Recycle (0.533). Structural model evaluation is performed by evaluating the value of the path coefficient or t-values of each path for inter-construct significance tests in the structural model and R Square for the dependent construct. To further explore the structural relationship between environmental awareness and social responsibility on the implementation of the 5R environmental framework, this study investigates the indirect effects through specific mediating variables. This section presents the results of indirect effect testing and discusses their theoretical and practical implications.

Tabel 8 Specific Indirect Effect (Mean, STDEV, T-Values)

	Original Sample (O)	**Sample Mean (M)**	**STDEV**	**T Statistic**	**P values**
SR → EA→ Record Impl.	0.224	0.224	0.058	3.890	0.000
SR→EA→ Recycle Impl.	0.294	0.300	0.064	4.618	0.000
SR→ EA→ Reduce Impl.	0.228	0.232	0.052	4.409	0.000
SR→ EA→ Report Impl.	0.278	0.284	0.067	4.168	0.000
SR→ EA→ Reuse Impl.	0.217	0.222	0.057	3.782	0.000

SR:Social Responsibility; EA: Environment Awareness ; Impl: Implementation

The results in the table 8 indicate significant **indirect effects** of Social Responsibility (SR) on the implementation of various components of the **5R Environmental Framework** (Record, Recycle, Reduce, Report, and Reuse), mediated through Environmental Awareness (EA). These findings confirm that environmental awareness acts as an effective mediating mechanism through which social responsibility translates into 5R-related behavioral changes among MSMEs.Furthermore, these findings are in line with prior studies that emphasize the role of environmental awareness as a key driver in enhancing sustainability practices among MSMEs (Fitriani et al., 2023; Rahman & Wahyuni, 2022). The strong indirect effects identified through SmartPLS confirm the argument that social responsibility must be internalized through environmental literacy to yield practical outcomes in the implementation of the 5R framework.For instance, Rahman and Wahyuni (2022) found that MSMEs with higher environmental concern demonstrated better adherence to waste reduction and recycling strategies. Similarly, (Fitriyani, Ardiansyah, & Putri, 2023) highlighted that documentation behavior, such as reporting and record-keeping, was more prevalent in businesses that embedded environmental goals into their organizational values.

Integrated Interpretation of Voyant and SmartPLS Findings

The convergence between qualitative and quantitative findings in this study reinforces the consistency and validity of the research outcomes. The Voyant analysis revealed dominant co-occurring terms such as *"reduce," "reuse," "recycle," "record,"* and *"report,"* indicating a high level of thematic cohesion among MSME actors regarding sustainable practices. Notably, strong associations were found between Reduce–Recycle (56%) and Record–Report (50%), reflecting the perceived interconnectedness of action and documentation in sustainability efforts.These qualitative patterns were empirically validated through the SmartPLS structural model, where environmental awareness significantly mediated the influence of social responsibility on the implementation of all five components of the 5R framework. Among them, Recycle ($\beta = 0.294$) and Report ($\beta = 0.278$) showed the highest indirect effects, closely aligning with their prominence in the text corpus and co-occurrence matrix.This alignment suggests that MSMEs not only recognize sustainability as a multidimensional effort but also emphasize the importance of environmental awareness in translating social values into operational practices. The parallel strength of these findings across methods highlights the integrated role of knowledge, behavior, and documentation in advancing the 5R framework among resource-constrained enterprises.

CONCLUSIONS

This study examined the indirect influence of social responsibility on the implementation of the 5R environmental framework (Reduce, Reuse, Recycle, Record, Report) among MSMEs, mediated by environmental awareness. Using a mixed-methods approach—combining qualitative insights from text mining (Voyant analysis) and quantitative validation by SmartPLS—we found that environmental awareness significantly mediates all dimensions of the 5R framework.The integration of textual (Voyant) and quantitative analyses demonstrates a mutually reinforcing relationship between awareness, responsibility, and sustainable action. The consistent prominence of **Recycle** and **Report** across both data streams suggests that MSMEs view tangible waste management and transparent reporting as central pillars of the 5R environmental framework.These results underscore the importance of capacity building, structured education, and value-driven leadership in promoting sustainability in resource-constrained business environments. To translate these insights into action, policymakers and development agencies should design targeted training programs that focus on environmental literacy and operational practices aligned with the 5R framework. Additionally, support systems such as financial incentives, green certification schemes, and regulatory guidance can empower MSMEs to adopt sustainable practices more effectively. Embedding sustainability into MSME support structures will be critical in accelerating the transition toward a circular economy and enhancing long-term environmental resilience.This study has limitations due to a small sample size and its focus solely on MSMEs in Papua Province, which may limit the generalizability of the findings. The use of online questionnaires may also introduce response bias. Future research should expand the sample across diverse

regions and MSME sectors, adopt a longitudinal approach to capture changes in 5R behavior over time, and explore the integration of green accounting indicators into 5R practices.

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