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STRENGTHENING INTEGRATED ENVIRONMENTAL POLICIES THROUGH A GREEN AND CIRCULAR ECONOMY APPROACH TO ENCOURAGE MSME EMPOWERMENT AND POVERTY ALLEVIATION

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Abstract

This study aims to analyze the influence of integrated environmental policies through a green and circular economy approach in encouraging MSME empowerment and poverty alleviation. The research approach used is mixed methods, namely a combination of quantitative and qualitative methods. Quantitative data were analyzed using Partial Least Squares (PLS-SEM), while qualitative data were obtained through in-depth interviews and field observations. The results of the quantitative study indicate that integrated environmental policies have a significant effect on the green and circular economy, with a T-statistic of 4.663 and P-values of 0.000. The green and circular economy also has a significant effect on MSME empowerment and poverty alleviation with a T-statistic of 4.762 and P-values of 0.000. In addition, integrated environmental policies also have a direct effect on MSME empowerment and poverty alleviation, and are proven to have an indirect effect through the mediating variable of the green and circular economy. The research model shows an R-square value of 0.677 for the green and circular economy variable and 0.848 for the MSME empowerment and poverty alleviation variable, which indicates a strong explanatory power of the model. Qualitative results indicate that the implementation of a green and circular economy in MSMEs is still in the transition phase, with positive impacts in the form of business efficiency, increased revenue, and expanded market access. However, obstacles remain, including limited capital, low environmental literacy, and limited access to technology. Nevertheless, significant opportunities exist through government policy support, green financing, and MSME digitalization.

Keywords: Integrated Environmental Policy of Green Economy, Circular Economy, Empowerment of MSMEs and Poverty Alleviation

1. Background

Strengthening integrated environmental policies has become an increasingly pressing issue amidst increasing pressure on natural resources, climate change, and persistently high socio-economic inequality, particularly in developing countries like Indonesia. Conventional economic development models, which tend to be exploitative, have contributed to environmental degradation, such as pollution, deforestation, and increased carbon emissions, ultimately not only damaging ecosystems but also threatening the sustainability of people's livelihoods, particularly vulnerable groups such as Micro, Small, and Medium Enterprises (MSMEs). On the other hand, MSMEs play a strategic role in the national economy because they absorb a large workforce and serve as the backbone of the local economy. However, most MSMEs still face various obstacles, ranging from limited access to financing and environmentally friendly technology to low capacity to manage their businesses sustainably. This condition means that MSMEs have not been fully able to adapt to the demands of a modern economy that increasingly emphasizes sustainability and resource efficiency. The green economy and circular economy approaches present alternative solutions that offer a new paradigm in development, namely by balancing economic growth, environmental sustainability, and social welfare. The green economy emphasizes the efficient use of resources, low emissions, and social inclusiveness, while the circular economy focuses on waste reduction through the principles of reduce, reuse, and recycle. The integration of these two approaches is believed to be able to create a more sustainable economic system while opening new opportunities for MSMEs to increase

competitiveness and product added value. However, the implementation of policies that integrate environmental aspects, the green economy, and the circular economy still faces various challenges. One of the main problems is the suboptimal synchronization of policies across sectors and levels of government, as well as weak coordination in program implementation. Furthermore, the still low awareness and literacy of MSMEs regarding environmentally friendly business practices is a separate obstacle in driving the transformation towards a green and circular economy.

Table 1.2. Level of Adoption of Green Economy Practices by MSMEs

Environmentally Friendly Practice Indicators	Percentage of MSMEs (%)
Use of environmentally friendly raw materials	32%
Simple waste management	45%
Recycle products	28%
Energy efficiency	25%
Use of renewable energy	12%

Table 2 shows that the adoption of green economy practices by MSMEs remains relatively limited and uneven across various aspects. This reflects that the transformation toward an environmentally friendly production system is still in its early stages and faces various structural and technical obstacles. The indicator with the highest percentage is simple waste management, at 45%. This figure indicates that some MSMEs already have a basic awareness of the importance of managing business waste, even if it is still in a simple form, such as separate disposal or small-scale waste recycling. This high figure compared to other indicators may be due to the ease of implementation and the low technological requirements and costs. However, this practice does not yet fully reflect an integrated and sustainable waste management system.

Meanwhile, the use of environmentally friendly raw materials stands at 32%, indicating that approximately one-third of MSMEs have begun to shift to more sustainable production inputs. However, this figure remains low compared to sustainable development targets. Limited access to environmentally friendly raw materials, relatively high prices, and a lack of information are key factors hindering adoption in this area. Regarding the product recycling indicator, the adoption rate of 28% indicates that circular economy practices are not yet optimal. Recycling is a key pillar in reducing waste and increasing resource efficiency. This low figure may be due to the lack of supporting infrastructure, such as waste treatment facilities, and the lack of technical skills among MSMEs in reprocessing products or waste into something of economic value.

Energy efficiency, which only reaches 25%, indicates that most MSMEs still use energy-intensive production methods. This not only results in high operational costs but also contributes to increased carbon emissions. The low adoption of energy efficiency is generally influenced by limited capital for investment in energy-saving technologies and low awareness of the long-term benefits of such efficiency. The indicator with the lowest adoption rate is the use of renewable energy, at 12%. This figure indicates that the use of alternative energy sources such as solar power or biomass is still very minimal among MSMEs. This is understandable given the high initial investment costs, limited access to technology, and the lack of incentives and policy support from the government. Furthermore, limited public awareness of the benefits of renewable energy is also a major inhibiting factor.

Table 1.2 Potential Impact of Green Economy Implementation on MSMEs

Impact Indicators	Before Implementation	After Implementation
MSME Income	Low–Medium	Medium–High
Production efficiency	60%	75%
Waste reduction	20%	50%
Market access	Local	National/Global
Product competitiveness	Low	Tall

Table 6 illustrates significant changes in various MSME performance indicators following the implementation of green economy principles. In general, the data indicates that implementing a green economy not only impacts the environment but also provides economic benefits and increases overall business competitiveness. In terms of revenue, there has been a shift from the low-medium to medium-high category. This indicates that green economy practices can create added value for MSME products. This increase can be caused by several factors, such as increased resource efficiency, reduced long-term production costs, and increased consumer interest in environmentally friendly products that have a higher market value.

The production efficiency indicator increased from 60% to 75%. This increase demonstrates that the application of energy efficiency principles, raw material management, and production process optimization can reduce waste and increase productivity. In other words, MSMEs that adopt a green economy tend to be better able to maximize output with more controlled inputs, thus positively impacting business sustainability. Furthermore, waste reduction experienced a significant increase from 20% to 50%. This reflects the successful implementation of circular economy principles, such as reduce, reuse, and recycle, in MSME production activities. By reducing waste, not only can management costs be reduced but also negative impacts on the environment can be minimized. This condition also demonstrates that environmentally friendly practices can go hand in hand with economic efficiency.

In terms of market access, there has been a significant strategic shift, shifting from local to national and even global. This demonstrates that implementing a green economy can boost consumer confidence and open up broader market opportunities. Products that meet environmentally friendly standards are generally more readily accepted in modern markets, including export markets, which increasingly demand sustainability as a key requirement. Finally, product competitiveness has increased from low to high. This improvement is due to a combination of factors, such as improved product quality, cost efficiency, and a positive image as an environmentally conscious product. In the context of increasingly fierce market competition, sustainability is a crucial differentiating factor for MSMEs to survive and thrive.

The results in Table 6 show that the implementation of a green economy has a significant positive impact on increasing income, production efficiency, waste reduction, market access, and the competitiveness of MSMEs. This finding aligns with various previous studies that confirm that a green and circular economy approach can improve business performance sustainably. Research by Aponno and Siahaya (2026) found that a green economy has a significant influence on MSME growth, with the main factors being green innovation, digitalization, and human resource quality, which can explain 62.7% of the variation in MSME green economy growth. These results support the findings in the table that the increase in production efficiency and competitiveness of MSMEs after the implementation of a green economy is a consequence of innovation and increased internal capacity of business actors.

Furthermore, research by Afifah, Arisandy, and Indra (2026) shows that the implementation of a green economy plays a significant role in promoting circular economic practices, such as efficient use of raw materials and waste reduction. This finding is consistent with the data in Table 6, which shows an increase in waste reduction from 20% to 50%. This confirms that the integration of green and circular economic principles can create a more efficient and environmentally friendly production system. Another study by Fatwa and Hwihanus (2024) also concluded that the implementation of a green economy in MSMEs not only impacts the environment but also improves financial performance and business welfare. This is in line with the findings in this study, where MSME income increased from the low-medium to medium-high category. Thus, the green economy functions not only as an environmental strategy but also as an economic strategy that increases business profitability.

Furthermore, Rahmat et al. (2024) in their study of the circular economy in batik MSMEs showed that the application of open innovation and circular principles can improve organizational performance and expand market opportunities. This is relevant to the findings in the table, which shows that MSME market access is expanding from local to national and even global scales. This means that sustainability is a crucial factor in increasing product attractiveness in a broader market. Furthermore, research by Askiyanto et al. (2024) emphasized that the success of green economic transformation in MSMEs is greatly influenced by the readiness of human resources, including an understanding of the concept of sustainability and the ability to adapt to technology. This indicates that increasing product competitiveness, as seen in Table 6, is inseparable from factors such as increasing human resource capacity and technological support. However, while the findings of this study align with most previous research, there are differences in the level of implementation and speed of adoption. Several studies indicate that the main obstacles still lie in limited technology, access to financing, and low green economy literacy among MSMEs. This indicates that despite the very positive impact of the green economy, its implementation still

requires stronger and more integrated policy support. Overall, the comparison with previous research reinforces the finding that the green and circular economy is an effective approach to improving MSME performance while supporting sustainable development. This study provides an additional contribution by more concretely demonstrating the impact of implementation on economic and environmental indicators, thus providing a basis for formulating more applicable policies.

Formulation of the problem

1. How is the implementation of integrated environmental policies to encourage the implementation of a green and circular economy in MSMEs?
2. What is the role of the green and circular economy in increasing the empowerment of MSMEs?
3. What impact does the implementation of a green and circular economy have on poverty alleviation?
4. How does integrated environmental policy impact MSME empowerment and poverty alleviation through a green and circular economy approach?
5. What are the obstacles and opportunities in implementing integrated environmental policies based on a green and circular economy in the context of MSMEs?
6. Analyzing the implementation of integrated environmental policies in MSME practices.
7. Examining the application of green and circular economy principles as a business sustainability strategy.
8. Identifying the impact of green economy on MSME empowerment and poverty reduction.

2. Theoretical Basis

2.1 Integrated Environmental Policy

Integrated environmental policy is a policy approach that combines environmental, economic, and social aspects within a single sustainable development framework. In the context of modern development, this policy is no longer sectoral, but rather cross-sectoral and sustainability-based. This aligns with the concept of sustainable development, which emphasizes the balance between economic growth and environmental preservation. According to research by Aponno and Siahaya (2026), government policy plays a strategic role in encouraging green economic transformation in MSMEs through the integration of fiscal incentives, digitalization, and human resource capacity building. Integrated policies can increase the effectiveness of green economy implementation by up to 62.7% in encouraging sustainability-based MSME growth. Thus, integrated environmental policy functions not only as regulation but also as a strategic instrument in creating a sustainable and inclusive economic ecosystem.

2.2 Green Economy

A green economy is an economic development concept that aims to improve human well-being and social justice, while reducing environmental risks and resource scarcity. In practice, a green economy emphasizes resource efficiency, low carbon emissions, and the use of environmentally friendly technologies. Afifah, Arisandy, and Indra (2026) state that a green economy plays a key role in creating efficient production systems through energy savings, the use of sustainable raw materials, and waste reduction in the production process of MSMEs. This demonstrates that a green economy not only impacts the environment but also increases business efficiency and productivity. Furthermore, Fatwa and Hwihanus (2024) emphasize that the implementation of a green economy in MSMEs has a positive impact on financial performance and environmental well-being, thus becoming an important strategy in increasing business competitiveness. Thus, a green economy can be understood as an approach that integrates economic and environmental aspects to create sustainable growth.

2.3 Circular Economy

A circular economy is an economic concept that focuses on the efficient use of resources through the principles of reduce, reuse, and recycle. Unlike a linear economy that produces waste, a circular economy seeks to create a closed system that minimizes waste and maximizes the utility of resources. According to Irawan, Marita, and Nurcahyaningtyas (2024), the implementation of a circular economy has been proven to support sustainable development by increasing resource efficiency and contributing to economic, social, and environmental aspects. However, this implementation is still not optimal, especially in the aspects of resource management and environmental preservation. Meanwhile, Maulana et al. (2025) explain that the integration of a circular economy in MSME management can be achieved through innovation in products, production processes, and business models oriented towards sustainability. This shows that a circular economy plays a crucial role in increasing business efficiency and sustainability. Furthermore, Alfarizi (2023) emphasizes that the adoption of a circular economy in MSMEs is strongly influenced by policy support and innovative business models, which are key to increasing MSMEs' contribution to the sustainable development goals (SDGs).

2.4 Empowerment of MSMEs

Empowering MSMEs is an effort to increase the capacity, independence, and competitiveness of small businesses in facing global competition. In the context of a green economy, MSME empowerment focuses not only on economic aspects but also on the ability to adopt sustainable business practices. According to Aponno and Siahaya (2026), factors such as green innovation, digitalization, and the quality of human resources significantly influence the growth of green economy-based MSMEs. This indicates that MSME empowerment must be carried out comprehensively through increasing technological capacity, market access, and sustainability literacy. Thus, MSME empowerment in the context of a green and circular economy is a crucial strategy in creating resilient and highly competitive businesses.

2.5 Poverty Alleviation

Poverty alleviation is one of the primary goals of sustainable development, closely linked to improving public welfare. In the context of a green economy, poverty alleviation can be achieved through the creation of green jobs and increased community incomes. Implementing a green and circular economy in MSMEs has the potential to increase production efficiency, open broader market access, and increase product added value. This directly impacts business income and employment. As explained in various studies, the integration of a green and circular economy can contribute to inclusive and sustainable economic development, making it an effective instrument for poverty reduction.

3. Research Methods

3.1 Types and Approaches of Research

This research uses a mixed methods approach, a systematic and integrated approach that combines quantitative and qualitative methods in one study. This approach was chosen because it can provide a more comprehensive understanding of complex phenomena, particularly in examining the relationship between integrated environmental policies, the green and circular economy, and their impact on MSME empowerment and poverty alleviation.

According to John W. Creswell (2019), mixed methods is a research approach that combines quantitative and qualitative data simultaneously in a single study, resulting in a more robust understanding than using either method alone. This approach not only combines data but also integrates the analysis and interpretation processes thoroughly.

Furthermore, Abbas Tashakkori and Charles Teddlie emphasized that mixed methods research combines the collection, analysis, and integration of quantitative and qualitative data in a single study to produce more comprehensive conclusions. Therefore, a mixed methods approach is highly relevant for this research because it can explain causal relationships (quantitative) while simultaneously providing a deeper understanding of social phenomena (qualitative).

3.2 Research Design

The design used in this study is an Explanatory Sequential Mixed Methods Design, which is a design carried out sequentially, starting with the collection and analysis of quantitative data, then continuing with qualitative data to deepen and explain the quantitative results. According to Vicki L. Plano Clark (2018–2021), an explanatory sequential design is used when researchers want to explain statistical results through further exploration using qualitative data. This approach is very effective for understanding phenomena that have both numerical dimensions and social meaning.

In the context of this research:

1) The quantitative stage is used to measure the influence of variables X, Z, and Y.
2) The qualitative stage is used to explore the reasons, perceptions and experiences of MSME actors.

3.3 Population and Sample

The population in this study is all MSME actors who are registered and active in productive economic activities.

1) Quantitative Sample:
   Using purposive sampling techniques, namely selecting respondents based on certain criteria, such as MSMEs that have implemented environmentally friendly practices.
2) Qualitative Sample:
   Using the snowball sampling technique, namely taking informants in stages based on recommendations from previous informants.

3.4 Data Collection Techniques

Data collection was carried out through two approaches:

1. Quantitative Data
   1) Questionnaire
   2) Likert Scale (1–5)
   3) Measuring variables:
      - X: Environmental Policy
      - Z: Green & Circular Economy
      - Y: Empowerment of MSMEs & Poverty
2. Qualitative Data
   1) In-depth interview (in-depth interview)
   2) Field observation
   3) Documentation

According to Burke Johnson (2020), this combination of techniques allows researchers to obtain data that is both objective (numbers) and subjective (meaning and experience).

3.5 Data Analysis Techniques

1. Quantitative Analysis
   1) Validity and reliability test
   2) Regression analysis / path analysis
   3) Test of influence between variables (X → Z → Y)
2. Qualitative Analysis
   1) Data reduction
   2) Data presentation
   3) Drawing conclusions

According to Matthew B. Miles and A. Michael Huberman, qualitative data analysis is carried out through three main stages, namely data reduction, data display, and verification.

3.6 Data Integration Techniques (Data Mixing)

The main characteristic of mixed methods is data integration. In this study, integration was carried out at the stage of interpreting the results.

According to experts, data integration aims to:

1) Strengthening research results (triangulation)
2) Provides a broader understanding
3) Explaining quantitative results with qualitative data

Thus, the research results are not only statistical, but also contextual and in-depth.

3.7 Data Validity Test

1) Quantitative: Validity, reliability, classical assumption test
2) Qualitative:
   - Source triangulation
   - Triangulation method
   - Member check

3.8 Research Analysis Framework

The research model is:

X → Z → Y

X = Integrated Environmental Policy
Z = Green and Circular Economy
Y = Empowerment of MSMEs and Poverty Alleviation

This approach positions the green economy as a mediating variable that explains the relationship between policies and socio-economic impacts.

4. Quantitative Results and Discussion

4.1 Evaluation of the Measurement Model (Outer Model)

The measurement model (outer model) is a confirmatory factor analysis (CFA) that tests the validity and reliability of the latent constructs. The following are the results of the outer model evaluation in this study.

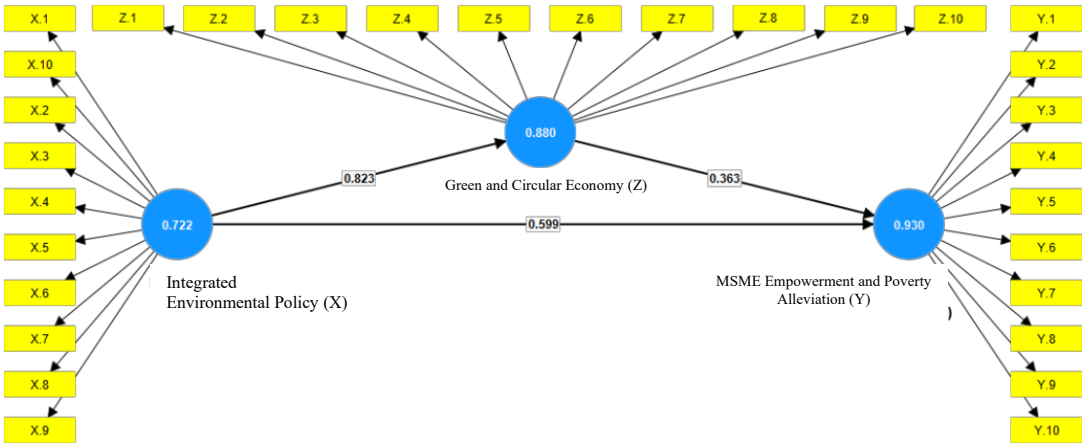

Figure 4.1. Outer Model

Convergent Validity

The convergent validity of the measurement model with the reflective indicator model is assessed based on the correlation between the item score/component score and the construct score calculated using PLS. The following are the results of the convergent validity measurement model test using loading factors:

Table 4.1
Results of Instrument Validity Test Using Loading Factor

	Green and Circular Economy (Z)	Integrated Environmental Policy (X)	Empowerment of MSMEs and Poverty Alleviation (Y)
X.1		0.725	
X.2		0.782	
X.3		0.731	
X.4		0.795	
X.5		0.773	
X.6		0.770	
X.7		0.700	
X.8		0.742	
X.9		0.781	
X.10		0.781	
Y.1			0.751
Y.2			0.747
Y.3			0.935
Y.4			0.583
Y.5			0.735
Y.6			0.796
Y.7			0.751
Y.8			0.797
Y.9			0.757
Y.10			0.802

Z.1	0.724		
Z.2	0.830		
Z.3	0.789		
Z.4	0.719		
Z.5	0.791		
Z.6	0.732		
Z.7	0.737		
Z.8	0.759		
Z.9	0.814		
Z.10	0.730		

Source :Primary data processed (2026)

Based on Table 4.1 above, all loading factor values have exceeded the 0.7 threshold, thus concluding that each indicator in this study is valid. Therefore, these indicators can be used to measure the research variables.

Reliability Test

An instrument can be considered reliable if its Average Variance Extracted value is greater than 0.5, Cronbach's Alpha value is greater than 0.6, and Composite Reliability value is greater than 0.7. The following table shows the results of the reliability calculations using Average Variance Extracted (AVE), Cronbach's Alpha, and Composite Reliability:

Table 4.2
Calculation of AVE, Cronbach Alpha, and Composite Reliability

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Green and Circular Economy (Z)	0.880	0.894	0.878	0.629
Integrated Environmental Policy (X)	0.722	0.760	0.712	0.688
Empowerment of MSMEs and Poverty Alleviation (Y)	0.930	0.937	0.931	0.579

Source :Primary data processed (2026)

Based on the presented reliability and construct validity test results, it can be explained that all variables in this study have met the criteria required in the measurement model analysis, especially in the SEM-PLS approach. Evaluation was carried out using Cronbach's Alpha, Composite Reliability (rho_a and rho_c), and Average Variance Extracted (AVE) indicators to ensure that the research instrument has good internal consistency and convergent validity.

For the Green and Circular Economy (Z) variable, the Cronbach's Alpha value of 0.880 indicates a very high level of reliability, exceeding the minimum threshold of 0.70. This indicates that the items used to measure this variable have strong internal consistency. The Composite Reliability values, both rho_a (0.894) and rho_c (0.878), also show excellent results and are above the threshold of 0.70. Thus, the green and circular economy construct can be said to be reliable in representing the concepts being measured. In addition, the AVE value of 0.629 (>0.50) indicates that this variable has good convergent validity, meaning that more than 50% of the indicator variance can be explained by the construct in question.

Furthermore, for the Integrated Environmental Policy variable (X), the Cronbach's Alpha value of 0.722 indicates that the construct's reliability is in the fairly good category and still meets the minimum standards. The Composite Reliability values rho_a (0.760) and rho_c (0.712) are also above 0.70, indicating that the indicators in this variable are quite consistent in measuring the environmental policy construct. Interestingly, the AVE value of 0.688 indicates a high level of convergent validity, meaning the indicators are able to explain the variable well. This indicates that although its reliability is not as high as other variables, the construct's quality remains good in terms of validity.

Meanwhile, the MSME Empowerment and Poverty Alleviation (Y) variable showed the strongest results among the three variables. The Cronbach's Alpha value of 0.930 indicates very high reliability, meaning all indicators in this variable have a very good level of consistency. The Composite Reliability values rho_a (0.937)

and rho_c (0.931) also strengthen these findings, indicating that this construct is very stable and reliable. Although the AVE value of 0.579 is slightly lower than variables X and Z, it remains above the threshold of 0.50, thus still meeting the criteria for convergent validity.

Overall, these results indicate that all variables in the study have met the criteria for reliability and convergent validity, making them suitable for further analysis, such as testing the structural model (inner model). The high reliability values for variables Z and Y indicate that the concepts of a green and circular economy, as well as the empowerment of MSMEs and poverty alleviation, have been measured very well. Meanwhile, variable X, despite having a relatively lower value, remains in the feasible and academically acceptable category.

Structural Model Evaluation (Inner Model)

Evaluation of the inner model can be seen from several indicators, including the coefficient of determination (R2), Predictive Relevance (Q2), and Goodness of Fit Index (GoF) (Hussein, 2015). The results of the structural model displayed by Smart PLS 3.0 in this study are as follows:

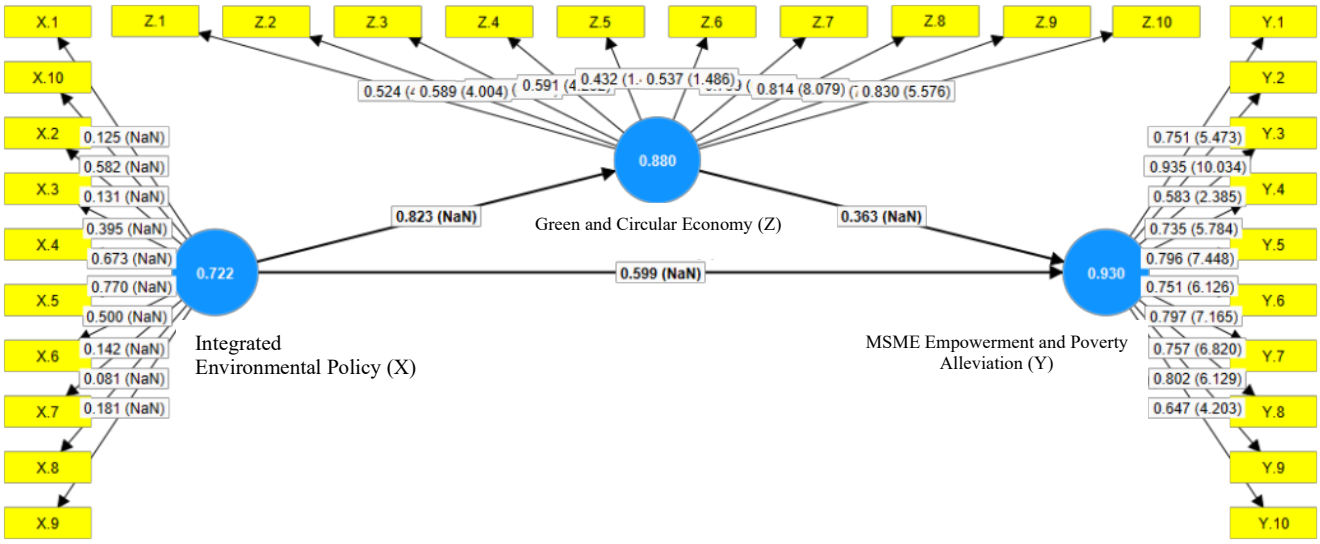

Figure 4.2 Structural Model (Inner Model)

R2 (R-square) results

In assessing a model using PLS, we begin by looking at the R-square for each dependent latent variable. The results of the r2 calculation in this study are as follows:

Table 4.3
Correlation Value (r2)

	R-square	R-square adjusted
Green and Circular Economy (Z)	0.677	0.668
Empowerment of MSMEs and Poverty Alleviation (Y)	0.848	0.840

Source :Primary data processed (2026)

Based on the results of the coefficient of determination (R-square) test, it can be explained that the research model has a fairly strong ability to explain the relationship between the variables studied. The R-square value indicates how much of the dependent variable can be explained by the independent variables in the model, while the adjusted R-square provides adjustments to the number of variables and samples so that it is more accurate in assessing the quality of the model. For the Green and Circular Economy variable (Z), the R-square value obtained was 0.677 and the adjusted R-square was 0.668. This indicates that 67.7% of the variation in the green and circular economy can be explained by the Integrated Environmental Policy variable (X). Meanwhile, the remaining 32.3% is influenced by other factors outside the research model, such as technological aspects, human resource readiness, access to financing, and market support. This value is included in the strong (substantial) category, which means that integrated environmental policies have a significant role in encouraging the implementation of a green and circular economy in MSMEs. Furthermore, for the MSME Empowerment and Poverty Alleviation (Y) variable, the R-square value was 0.848 and the adjusted R-square value was 0.840. This indicates that 84.8% of the variation in MSME empowerment and poverty alleviation can be explained jointly by the Integrated Environmental Policy (X) and Green and Circular Economy (Z) variables. The remaining 15.2% is influenced by

other variables not included in the model, such as fiscal policy factors, macroeconomic conditions, education levels, and access to markets and technology. The R-square value of 0.848 is included in the very strong category, indicating that the research model has excellent explanatory power. This also indicates that the integration of environmental policies and green and circular economy approaches is a major factor in increasing MSME empowerment while supporting poverty alleviation. The relatively small difference between the R-square and adjusted R-square values for both variables (Z and Y) indicates that the model used is quite stable and does not experience overfitting. This means that the variables included in the model are relevant and not excessive in explaining the phenomenon under study.

Goodness of Fit Model

Goodness of Fit (GoF) in Partial Least Square Structural Equation Modeling (PLS-SEM) is used to assess the overall level of model suitability, both in terms of the measurement model (outer model) and the structural model (inner model). According to Tenenhaus et al. (2005), GoF is a global index that describes how well a model is able to explain empirical data as a whole, taking into account construct validity and the model's predictive ability.

In this study, the Goodness of Fit value was calculated based on the square root of the product of the average AVE (Average Variance Extracted) and the average R-square (R^2). Based on the analysis results, the following values were obtained:

1) Average AVE = (0.629 + 0.688 + 0.579) / 3 = 0.632
2) Average R-square = (0.677 + 0.848) / 2 = 0.763

So the GoF calculation is:

GoF = $\sqrt{(0.632 \times 0.763)}$

GoF = $\sqrt{0.482}$

GoF = 0.694

Interpretation of Goodness of Fit Results

Based on the calculation results, the GoF value was obtained as 0.694. According to the criteria proposed by Wetzels et al. (2009), the GoF value is divided into three categories, namely:

1) 0.10 = small
2) 0.25 = medium
3) 0.36 = large

Thus, the GoF value of 0.694 is far above the large category limit (0.36), so it can be concluded that this research model has a very high level of suitability (very strong fit model).

Discussion of GoF Results

The high Goodness of Fit value indicates that the model developed in this study is able to explain the relationships between variables very well, both from a measurement and structural perspective. This indicates that:

1. The constructs of Integrated Environmental Policy (X), Green and Circular Economy (Z), and MSME Empowerment and Poverty Alleviation (Y) have been well defined by their indicators.
2. Structural models have strong predictive power in explaining the influence between variables.
3. The integration of environmental policies and a green-circular economy makes a significant contribution to increasing MSME empowerment and poverty alleviation.

Thus, this research model can be declared feasible, strong, and has high predictive capabilities, so that it can be used as a basis for drawing research conclusions and policy recommendations.

Hypothesis Testing

Based on the results of the inner model, all tested hypotheses met the requirements and can therefore be used as analysis models in this study. Hypothesis testing in this study used a 5% alpha, meaning that if the t-statistic value is ≥ 1.96 or the probability value is $\leq$ the level of significance ($\alpha = 5\%$).

The analysis in this study continued with testing the direct and indirect effects between variables in the structural model. This test was conducted to determine the extent of each independent variable's contribution to the dependent variable, both directly and through mediating variables.

Table 4.4
Direct Effect

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Green and Circular Economy (Z) -> Empowerment of MSMEs and Poverty Alleviation (Y)	0.115	0.113	0.024	4,762	0,000
Integrated Environmental Policy (X) -> Green and Circular Economy (Z)	0.183	0.172	0.039	4,663	0,000
Integrated Environmental Policy (X) -> Empowerment of MSMEs and Poverty Alleviation (Y)	0.130	0.129	0.029	4,422	0,000

Source :Primary data processed (2026)

Based on the results of the path coefficient test in the Partial Least Squares (PLS) structural model, it can be explained that the Integrated Environmental Policy variable (X) has a direct influence on the Green and Circular Economy (Z). This test uses T-statistics and P-values to determine the significance of the relationship between variables. A relationship is declared significant if the T-statistics value is > 1.96 and P-values < 0.05 at a significance level of 5%.

1. The analysis results show that the relationship between Integrated Environmental Policy (X) → Green and Circular Economy (Z) obtained a T-statistic value of 4.663 and P-values of 0.000. The T-statistic value is much greater than the critical limit of 1.96, while the P-value is smaller than 0.05. Thus, it can be concluded that the influence of Integrated Environmental Policy on Green and Circular Economy is positive and statistically significant.

   These results indicate that the stronger and more integrated the environmental policies implemented, the higher the level of green and circular economy implementation among MSMEs. Policies encompassing regulations, incentives, and government program support have proven to be key drivers in accelerating the transformation towards a more sustainable economic system.

   These findings also reinforce the assumption that public policy plays a strategic role in shaping the economic behavior of business actors, particularly MSMEs, to shift from conventional economic patterns to a more environmentally friendly and sustainability-based economy. In this context, a green and circular economy cannot develop optimally without strong, targeted, and integrated policy support. Therefore, the hypothesis stating that Integrated Environmental Policy has a significant effect on the Green and Circular Economy is accepted (H1 is accepted). This indicates that policy variables are key factors in driving sustainable economic transformation in the MSME sector.
2. The results of the analysis show that the relationship between Green and Circular Economy (Z) → MSME Empowerment and Poverty Alleviation (Y) obtained a T-statistics value of 4.762 and P-values of 0.000. The T-statistics value which far exceeds the critical limit of 1.96 and P-values which are smaller than 0.05 indicate that the influence of variable Z on Y is positive and statistically significant.

   These results indicate that the implementation of a green economy and a circular economy plays a crucial role in increasing the empowerment of MSMEs and contributing to poverty alleviation. The implementation of green economy principles, such as energy efficiency, the use of environmentally friendly raw materials, and emission reduction, as well as circular economy principles such as reduce, reuse, and recycle, have been proven to increase production efficiency, lower operational costs, and create added value for MSMEs.

   Furthermore, this increased efficiency has a direct impact on increasing the income and competitiveness of MSMEs, which ultimately strengthens the capacity of small businesses to survive and grow. In a broader context, strengthening MSMEs through a green and circular economy approach also contributes to the creation of new jobs and improving community welfare, thus playing a role in supporting the poverty alleviation agenda. Thus, the hypothesis stating that the Green and Circular Economy has a significant effect on MSME Empowerment and Poverty Alleviation is declared accepted (H2 is accepted). These results confirm that the green and circular economy is not only an environmental approach, but also a strategic instrument in inclusive and sustainable economic development.

3. The results of the analysis show that the relationship between Integrated Environmental Policy (X) → MSME Empowerment and Poverty Alleviation (Y) obtained a T-statistics value of 4.422 and P-values of 0.000. The T-statistics value is much greater than 1.96 and P-values are smaller than 0.05 indicating that the influence is positive and statistically significant.

   These findings indicate that integrated environmental policies play a crucial role in enhancing MSME empowerment while simultaneously supporting poverty alleviation. Policies encompassing environmental regulations, economic incentives, and empowerment programs have been shown to create a conducive ecosystem for MSMEs to develop sustainably.

   Furthermore, integrated policies not only have a direct impact but also create conditions that support the capacity building of small businesses, such as access to green financing, sustainable business training, and improved market access. These conditions indirectly strengthen the competitiveness of MSMEs and increase community incomes, thereby contributing to poverty reduction. Therefore, the hypothesis stating that Integrated Environmental Policy has a significant effect on MSME Empowerment and Poverty Alleviation is accepted (H3 is accepted). These results indicate that environmental policy functions not only as a regulatory instrument but also as a key driver of inclusive and sustainable economic development.

Table 4.5
Indirect Effect

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Integrated Environmental Policy (X) -> Green and Circular Economy (Z) -> Empowerment of MSMEs and Poverty Alleviation (Y)	0.591	0.582	0.139	4,252	0,000

Source :Primary data processed (2026)

Based on the results of the Indirect Effect test in the Partial Least Squares (PLS) structural model, it is known that the Integrated Environmental Policy variable (X) influences MSME Empowerment and Poverty Alleviation (Y) through the mediating variable Green and Circular Economy (Z). This test was conducted to see the role of mediation in bridging the relationship between research variables.

The results of the analysis show that the indirect path X → Z → Y obtained a T-statistics value of 4.252 and P-values of 0.000. The T-statistics value is greater than 1.96 and the P-values are smaller than 0.05, so it can be concluded that the indirect effect is positive and statistically significant. This finding indicates that the Green and Circular Economy (Z) plays a significant mediating variable in the relationship between Integrated Environmental Policy (X) on MSME Empowerment and Poverty Alleviation (Y). This means that environmental policies do not directly impact MSMEs and poverty alleviation, but first influence the implementation of the green and circular economy, which then has a further impact on improving the welfare of MSMEs and reducing poverty.

This mediating role demonstrates that the implementation of a green and circular economy is an important mechanism in bridging environmental policies with more inclusive economic development outcomes. Through the application of the principles of resource efficiency, waste reduction, and sustainable innovation, a green and circular economy can strengthen the impact of policies on MSME empowerment. Thus, it can be concluded that a Green and Circular Economy (Z) significantly mediates the effect of Integrated Environmental Policy (X) on MSME Empowerment and Poverty Alleviation (Y). These results indicate that the mediation model developed in this study is significant (partial mediation), meaning that policies can have both direct and indirect effects through green and circular economy variables.

5. Qualitative Results and Discussion

5.1What are the obstacles and opportunities in implementing integrated environmental policies based on a green and circular economy in the context of MSMEs?

Based on qualitative findings, the implementation of integrated environmental policies based on a green and circular economy in the context of MSMEs reveals a number of obstacles and opportunities that influence their success on the ground. These two aspects are interrelated and determine the extent to which the transformation towards a sustainable economy can be effectively implemented.

1. Implementation Constraints

The most common obstacle identified is the limited human resource capacity of MSMEs in understanding the concepts of a green and circular economy. Most MSMEs are still focused on short-term business continuity, so environmental sustainability is not a top priority. This results in low adoption of environmentally friendly practices such as energy efficiency, waste management, and the use of sustainable raw materials. Furthermore, limited business capital is also a significant barrier. Implementing a green and circular economy often requires initial investments, such as purchasing environmentally friendly technology or developing more efficient production systems. This is difficult for MSMEs, many of whom still have limited access to formal financing.

Another emerging obstacle is the lack of infrastructure and supporting technology. Many MSMEs lack access to recycling facilities, waste processing technology, or renewable energy-based production systems. This results in limited and suboptimal implementation of the circular economy. Furthermore, policy synchronization between government agencies remains a challenge. Existing environmental policies have not been fully integrated with MSME empowerment policies, resulting in inconsistent and sustainable implementation on the ground. The results of this study indicate that the implementation of integrated environmental policies through a green and circular economy approach plays a crucial role in encouraging MSME empowerment and poverty alleviation. These findings align with previous studies that emphasize the importance of policy integration, green financing, and technological innovation in supporting sustainable economic transformation.

Research by Harahap, Rajagukguk, and Arifin (2023) on green financing shows that green financing plays a significant role in driving green economic growth in the MSME sector in North Sumatra. Environmentally friendly products are a key output of this financing implementation, ultimately increasing the competitiveness of MSMEs in the market. This reinforces the findings of this study that policy support and green financial instruments are key factors in the success of a green and circular economy. Furthermore, research by Harahap, Rajagukguk, and Arifin, which examines the influence of green policies and environmentally friendly supply chain management, shows that integrated environmental policies can increase competitive advantage through the adaptation of green technology as an intervening variable. This finding is relevant to the results of this study, which demonstrates that the green and circular economy acts as a connecting mechanism between policies and their impacts on MSMEs.

2. Implementation Opportunities

Despite various obstacles, the implementation of integrated environmental policies based on a green and circular economy also offers significant potential to support the development of MSMEs. The primary opportunity lies in increasing global and national awareness of environmental sustainability issues. This opens up opportunities for MSMEs to develop environmentally friendly products with higher added value and greater competitiveness in both local and international markets. Furthermore, opportunities exist in the form of government policy support that increasingly aligns with the green economy, such as tax incentives, green MSME training programs, and access to sustainability-based financing.

This support is a crucial factor in accelerating the adoption of a green and circular economy among MSMEs. Another opportunity lies in the development of digital technology and production innovation, which enable MSMEs to increase efficiency, reduce waste, and expand market access through digital platforms. Digitalization also opens up opportunities to integrate the green economy with more adaptive modern business models. Furthermore, changing consumer preferences, which increasingly favor environmentally friendly products, present a strategic opportunity for MSMEs to transform their products and increase their competitiveness. Consumers today tend to choose products that are not only high-quality but also have a positive environmental and social impact.

Furthermore, research by Rajagukguk, Harahap, and Arifin (2023) on green human resource management (GHRM) practices confirms that implementing green HR practices can reduce the carbon footprint in industry and improve operational efficiency. This demonstrates that the transformation towards a green economy occurs not only in production but also in human resources, supporting business sustainability. This finding demonstrates

that green HR influences employee job satisfaction in the eco-friendly hotel industry, with the work environment as an intervening variable. These findings reinforce the concept that a green approach impacts not only the economic aspect but also the social and welfare aspects of the workforce, indirectly supporting the strengthening of sustainability-based MSMEs.

Overall, the results of this study reinforce previous research findings that the success of the transformation towards a green and circular economy depends heavily on the synergy between public policy, green financing, technological innovation, and human resource management. Thus, this study provides an additional contribution by confirming that the integration of environmental policies not only impacts the competitiveness of MSMEs but also contributes to sustainable poverty alleviation.

5.2Analyzing the implementation of integrated environmental policies in MSME practices

Qualitative findings indicate that the implementation of integrated environmental policies in MSME practices has essentially begun, but is still in the transition phase from a conventional approach to a sustainable approach. Existing environmental policies have provided normative direction for MSMEs to begin paying attention to sustainability aspects, although the level of implementation in the field remains uneven. In general, some MSMEs have begun adopting these policies through the implementation of simple practices such as reducing the use of hazardous materials, small-scale waste management, and efficient energy use in production processes. This indicates a growing awareness that environmental aspects cannot be separated from economic activities. However, this implementation remains partial and has not been fully integrated into the business management system.

In practice, integrated environmental policies are often perceived by MSMEs as mere recommendations, rather than as mandatory operational standards. This situation results in compliance with the policies remaining dependent on individual business awareness, rather than a structured system. Consequently, implementation varies across MSMEs, depending on their capacity, knowledge, and resources. Furthermore, findings also indicate that outreach and support from the government and relevant institutions are still suboptimal. Many MSMEs do not yet fully understand the concept of integrated environmental policies, particularly as they relate to the green and circular economy. This impacts MSMEs' low ability to translate these policies into sustainable, practical practices.

On the other hand, some MSMEs have begun to demonstrate more advanced practices, such as the use of environmentally friendly raw materials, reducing production waste, and reusing waste into products with economic value. MSMEs that have been exposed to training or mentoring programs tend to be better prepared to implement integrated environmental policies. Overall, it can be concluded that the implementation of integrated environmental policies in MSME practices is still in its early stages and is not yet fully optimized. Although there are positive indications of increased awareness and adoption of environmentally friendly practices, limited knowledge, lack of mentoring, and weak policy integration are the main factors hampering effective implementation in the field. Therefore, strengthened socialization, technical mentoring, and more operational policy integration are needed to ensure more effective and sustainable policy implementation.

5.3Examining the application of green and circular economy principles as a business sustainability strategy

Qualitative findings indicate that the application of green and circular economy principles in MSMEs is beginning to be understood as a crucial strategy for maintaining business sustainability amidst increasingly complex economic and environmental pressures. Some MSMEs have realized that business sustainability is not solely determined by financial gains, but also by the ability to manage resources efficiently and environmentally friendly. The application of a green economy in MSME practices is evident in efforts to efficiently use raw materials, conserve energy, and reduce production waste. Meanwhile, circular economy principles are beginning to be implemented through activities such as reusing production waste, recycling materials, and innovating products based on production residues. However, this implementation is still gradual and has not yet been fully integrated into the overall MSME business model.

These findings align with research by Brendzel-Skowera (2021), which explains that a circular economy in the MSME sector focuses on creating production systems that maximize the value of resources through reuse, recycling, and recovery approaches to support business sustainability. This demonstrates that a circular economy is not only an environmental concept but also a business strategy that can improve the efficiency and competitiveness of MSMEs. Furthermore, research by Saidani et al. (2020) confirms that a circular economy is closely linked to the concept of industrial ecology, which emphasizes the importance of a closed-loop production

system to reduce waste and increase resource efficiency in industrial activities. In the context of MSMEs, this is reflected in efforts to reuse production waste into economically valuable products, despite still being hampered by limited technology and human resource capacity. Furthermore, research by Nosratabadi et al. (2019) emphasizes that a sustainable business model is an approach that integrates economic, social, and environmental aspects to create long-term business value. This concept is relevant to the findings of this study, which show that MSMEs that have begun to adopt green and circular economy principles tend to be more stable in maintaining business sustainability compared to MSMEs that still use conventional business models. On the other hand, interview results also indicate that the implementation of a green and circular economy still faces obstacles such as limited knowledge, low environmental literacy, and limited access to environmentally friendly technologies. This results in some MSMEs being unable to fully optimize the potential of the circular economy in their production activities.

However, there are significant opportunities for developing business sustainability strategies through a green and circular economy, particularly with increasing market awareness of environmentally friendly products and government policy support that is beginning to shift toward sustainable development. This provides space for MSMEs to transform their business models toward a greener and more sustainable direction. Overall, it can be concluded that the application of green and circular economy principles has begun to become a crucial strategy for MSME business sustainability, although implementation is still in its early stages. Policy support, increased human resource capacity, and access to technology are key factors in accelerating the transformation toward a more sustainable economy.

5.4Identifying the impact of green economy on MSME empowerment and poverty reduction

Qualitative findings indicate that the implementation of a green economy has a significant positive impact on MSME empowerment and poverty reduction, although the level of implementation varies among business actors. This impact is seen through increased business efficiency, expanded market access, and increased added value of MSME products based on sustainability. From the perspective of MSME empowerment, a green economy encourages business actors to transform their production processes, such as energy efficiency, waste reduction, and the use of environmentally friendly raw materials. These changes not only impact operational costs but also increase product competitiveness in a market that is increasingly concerned about environmental issues. This finding aligns with research by Aponno and Siahaya (2026) which explains that green innovation, digitalization, and strengthening human capital have a significant contribution to green economic growth in MSMEs in Indonesia, with a model predictive capability level reaching 62.7%.

Furthermore, qualitative research findings also indicate that MSMEs that have adopted green economy principles tend to have greater opportunities to access broader markets, including modern markets and exports. This is due to increasing consumer demand for environmentally friendly and sustainable products. Thus, a green economy not only improves internal business efficiency but also strengthens the position of MSMEs within the broader economic value chain. From a poverty alleviation perspective, a green economy contributes through the creation of green jobs or environmentally-based employment opportunities that can absorb the local workforce. This increase in sustainability-based economic activity has a direct impact on increasing community incomes, especially for MSMEs and informal workers. This is in line with research by Nabila (2025) which states that a green economy has great potential in reducing poverty through increased green investment, resource efficiency, and sustainable job creation.

However, the findings also indicate several challenges in implementing a green economy, such as low environmental literacy, limited business capital, and limited access to environmentally friendly technologies. These conditions mean that the impact of the green economy has not been fully felt equally by all MSMEs, especially in rural areas and micro-enterprises. Nevertheless, there are significant opportunities in developing a green economy as an instrument for MSME empowerment and poverty alleviation, particularly through government policy support, green financing, and business digitalization. The integration of these factors is seen as capable of accelerating the transformation of MSMEs toward a more inclusive and sustainable economic system.

5. Conclusion

Based on the results of quantitative data analysis using the Partial Least Squares (PLS) method, it can be concluded that all relationships between variables in the research model show a positive and significant influence.

1. Integrated Environmental Policy (X) has a significant effect on the Green and Circular Economy (Z) with a T-statistics value of 4.663 and P-values of 0.000.
2. Green and Circular Economy (Z) has a significant effect on MSME Empowerment and Poverty Alleviation (Y) with a T-statistics value of 4.762 and P-values of 0.000.
3. Integrated Environmental Policy (X) has a significant direct effect on Y with a T-statistics value of 4.422 and P-values of 0.000.
4. The indirect effect of X on Y through Z is also significant with a T-statistic value of 4.252 and P-values of 0.000.

In addition, the R-square value of 0.677 (Z) and 0.848 (Y) indicates that the model has strong explanatory power, while the Goodness of Fit value of 0.694 indicates that the research model is in the very good fit category.

Based on the results of qualitative analysis, it was found that the implementation of integrated environmental policies in MSME practices is still at the development stage, but shows a positive direction towards a sustainable economy.

1. The implementation of a green and circular economy has begun through raw material efficiency, waste reduction, and product recycling, although it is not yet evenly distributed across all MSMEs.
2. The impact of the green economy is seen in increased business efficiency, expanded market access, and increased income for MSMEs.
3. In terms of poverty alleviation, the green economy contributes through the creation of new jobs (green jobs) and improving people's welfare.
4. The main obstacles found include limited capital, low environmental literacy, and minimal access to environmentally friendly technology.
5. However, there are significant opportunities through government policy support, green financing, and MSME digitalization.

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