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Eco-Innovation as a Bridge between Green Economy Practices and Sustainable Performance of Tourism MSMEs in Lake Toba

Radempta Elfrida Panjaitan[1*], Roy Sahputra Saragih[2], Hendri Abdiel Simbolon[3], Hengki Mangiring Parulian Simarmata[4]
[1-3]Finance and Banking, Politeknik Bisnis Indonesia, Simalungun, 21151, Indonesia,
[4]Computerized Accounting, Politeknik Bisnis Indonesia, Simalungun, 21151, Indonesia
Email: elfridapanjaitan034@gmail.com[1], roysahputra31@gmail.com[2], henryabdielsimbolon@gmail.com[3], hengkisimarmata.mm@gmail.com[4]

Corresponding author: elfridapanjaitan034@gmail.com

Abstract*. Environmental pressures have increased the need for tourism-based micro, small, and medium enterprises (MSMEs) to translate green economy practices into sustainable business outcomes. However, the mechanism through which such practices improve Sustainable MSME Performance' remains insufficiently understood in emerging tourism destinations. This study examined whether eco-innovation mediated the relationship between green economy practices and sustainable MSME performance in Lake Toba, Indonesia. A quantitative cross-sectional survey was conducted among 300 owners and managers of culinary, local craft, and tourism-service MSMEs. The proposed relationships were tested using partial least squares structural equation modeling (PLS-SEM). Green economy practices were positively associated with eco-innovation ($\beta = 0.719$, $p < 0.001$) and sustainable MSME performance ($\beta = 0.337$, $p < 0.001$), while eco-innovation was positively associated with sustainable MSME performance ($\beta = 0.620$, $p < 0.001$). Eco-innovation significantly mediated the relationship between green economy practices and Sustainable MSME Performance' ($\beta = 0.446$, $p < 0.001$), indicating complementary partial mediation. The model explained 79.8% of the variance in sustainable MSME performance. Although its cross-sectional and destination-specific design limited causal inference and broader generalizability, the study identified eco-innovation as a conversion mechanism through which environmentally responsible practices generated economic, social, and environmental value. The findings extend sustainable entrepreneurship research by integrating the Natural Resource-Based View and Dynamic Capabilities Theory and provide practical guidance for MSME owners, destination managers, and policymakers in developing sustainable tourism destinations.*

Keywords*: Eco-Innovation; Green Economy Practices; Lake Toba; Sustainable MSME Performance; Tourism-Based MSMEs.*

1. INTRODUCTION

Sustainable development has become an increasingly important strategic issue for micro, small, and medium enterprises (MSMEs) operating in tourism destinations. Tourism-based MSMEs contribute to employment creation, regional income, cultural preservation, and destination attractiveness. At the same time, their production and service activities may increase material consumption, energy use, waste generation, and environmental degradation. These competing outcomes require MSMEs to balance economic continuity with social responsibility and environmental protection. Sustainability is therefore no longer viewed merely as a voluntary social initiative but as an essential business strategy for strengthening operational efficiency, stakeholder legitimacy, organizational resilience, and long-term performance. Within this context, green economy practices and eco-innovation have emerged as complementary approaches through which MSMEs can transform environmental responsibility into sustainable business value (Megawati et al., 2024; Yin et al., 2023).

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Green economy practices refer to integrated business activities that emphasize resource efficiency, environmental responsibility, waste reduction, energy and water conservation, sustainable production, and long-term sustainability orientation. At the MSME level, these practices may involve selecting environmentally responsible materials, minimizing production waste, reusing resources, reducing energy consumption, adopting cleaner production methods, and incorporating environmental considerations into strategic and operational decisions. Circular economy practices, green human resource management, sustainable supply chain management, environmentally responsible leadership, and green business strategies represent important components of this broader transition. A meta-analysis by Yin et al. (2023) demonstrated that circular economy practices were positively associated with Sustainable MSME Performance'. Evidence from Indonesian culinary MSMEs also showed that circular economy and social protection policies contributed to green business innovation, although digital economy policies and internal innovation capability did not consistently produce significant effects (Megawati et al., 2024). These findings suggest that adopting environmental practices is important, but the benefits obtained from such practices depend on the capacity of MSMEs to translate them into meaningful organizational and market outcomes.

Sustainable MSME performance reflects the capacity of an enterprise to maintain economic viability while generating social and environmental value. Economic performance includes revenue development, operational efficiency, customer satisfaction, market growth, and business continuity. Social performance concerns employee welfare, employment creation, community involvement, cultural preservation, and responsible stakeholder relationships. Environmental performance encompasses efficient resource use, waste management, energy conservation, pollution reduction, and environmentally responsible production. Previous studies have shown that sustainable supply chain practices can improve MSME performance when they are supported by appropriate governance and clearly defined performance metrics (Nyamah et al., 2026). Circular economy practices can also strengthen financial, environmental, and social performance by reducing resource dependence, recovering materials, minimizing waste, and encouraging more responsible product and process designs (Rodríguez-Espíndola et al., 2022; Yin et al., 2023).

Nevertheless, empirical evidence concerning the direct contribution of environmental practices to sustainable MSME performance remains inconclusive. Alraja et al. (2022) found that the adoption of certain green supply chain activities did not significantly improve the sustainable performance of SMEs during the COVID-19 crisis. The disruptive conditions surrounding the crisis may have limited the capacity of enterprises to convert technological

innovation and green practices into measurable performance outcomes. Green human resource management has also been found to have no significant direct effect on MSME business performance when it was not translated into green product innovation (Siddiqi et al., 2025). Similarly, internal innovation capability failed to strengthen the relationship between integrated circular–digital policies and green business innovation among Indonesian culinary MSMEs (Megawati et al., 2024). These mixed findings indicate that environmental practices alone may be insufficient to produce Sustainable MSME Performance', particularly when MSMEs face financial constraints, limited technological capabilities, inadequate environmental knowledge, weak market access, and restricted human resources.

Eco-innovation provides a potential mechanism for explaining these inconsistent outcomes. Eco-innovation refers to the development and implementation of environmentally oriented products, production processes, organizational systems, marketing practices, and business models that reduce environmental impacts while creating economic and social value. Product eco-innovation may involve environmentally responsible materials, recyclable components, sustainable packaging, and green product design. Process eco-innovation includes cleaner production, energy-efficient technologies, resource conservation, and waste reduction. Organizational eco-innovation involves redesigning managerial procedures, responsibilities, and internal systems to support environmental objectives. Marketing eco-innovation communicates environmental value through branding, packaging, promotion, and customer engagement. Unlike routine environmental compliance, eco-innovation enables MSMEs to convert sustainability principles into differentiated products, efficient processes, improved organizational arrangements, and market offerings that respond to changing stakeholder expectations (Bag et al., 2022; Tegethoff et al., 2025).

Empirical research has generally demonstrated a positive relationship between eco-innovation and sustainable MSME performance. Oduro (2024) meta-analysis of 99 studies involving 134,841 MSMEs confirmed that the average effect of eco-innovation on Sustainable MSME Performance' was positive and significant, although moderate. The findings further indicated that organizational eco-innovation produced the strongest effect, followed by process, product, and marketing eco-innovation. Eco-innovation also contributed to all three dimensions of the triple bottom line, with its largest effect observed in social performance. Evidence from Colombian SMEs showed that eco-innovation improved environmental performance through greater resource efficiency, emissions reduction, and responsible waste management (Tegethoff et al., 2025). Similarly, green innovation adoption strengthened the economic, social, and environmental performance of SMEs in Saudi Arabia (Wasiq et al.,

2023). These findings demonstrate that eco-innovation is not merely an environmental activity but a strategic organizational capability through which MSMEs can create multidimensional business value.

However, the effectiveness of eco-innovation depends on organizational and contextual conditions. Industry characteristics, culture, industrial intensity, technological capacity, market turbulence, government support, and internal resources can alter the strength of the relationship between eco-innovation and Sustainable MSME Performance' (Oduro, 2024). Market turbulence, characterized by rapid technological development, intensive competition, and changing customer demand, can strengthen the economic contribution of product and organizational eco-innovation (Larbi-Siaw et al., 2022). Conversely, perceived environmental volatility may weaken the indirect relationship between corporate social responsibility and MSME performance through green process innovation (Achi et al., 2022). Digitalization has also not consistently produced a direct performance effect among tourism MSMEs, although its contribution to innovation has been supported (Zuñiga-Collazos et al., 2025). Thus, examining eco-innovation only as an independent predictor may not fully explain how environmentally responsible practices are converted into Sustainable MSME Performance'.

The relationship between green economy practices and eco-innovation is particularly important because environmental practices can provide the operational foundation required for innovation. Resource efficiency can motivate MSMEs to identify alternative materials and energy-saving technologies. Waste reduction can stimulate cleaner production and circular product design. Environmental responsibility can encourage sustainable packaging, green branding, and environmentally oriented business models. Bag et al. (2022) showed that eco-innovation was positively connected with green supply chain management, circular economy capability, and SME performance. Rodríguez-Espíndola et al. (2022) similarly found that circular economy implementation supported sustainability-oriented innovation, which subsequently improved financial, environmental, and social performance. These findings suggest that green economy practices and eco-innovation operate complementarily: green economy practices provide the environmental resources and operational routines, while eco-innovation converts those resources and routines into competitive and sustainable business outcomes.

Growing empirical evidence supports the mediating function of environmentally oriented innovation. Green process innovation mediated the relationship between corporate social responsibility and MSME performance, demonstrating that responsible organizational commitments generated stronger outcomes when transformed into process improvements

(Achi et al., 2022). Green product innovation also mediated the relationship between green human resource management and business performance among Indonesian MSMEs (Siddiqi et al., 2025). In the context of developing economies, green innovation and green knowledge sharing acted as partial mediators between green supply chain management and sustainable MSME performance (Junejo et al., 2025). Technological innovation similarly mediated the relationship between green supply chain management practices and operational performance (M. T. Khan et al., 2022). These findings consistently indicate that environmentally responsible practices may not automatically improve performance unless they are transformed into market-relevant products, production processes, organizational systems, or technological innovations.

Despite this progress, four research gaps remain. First, previous studies have commonly examined particular environmental practices, including circular economy implementation, green supply chain management, green human resource management, corporate social responsibility, or environmental leadership, rather than conceptualizing green economy practices as an integrated construct encompassing resource efficiency, environmental responsibility, sustainable production, waste reduction, and long-term sustainability orientation. Second, eco-innovation has frequently been treated as an outcome or an independent determinant of performance, whereas its specific role in transmitting the effect of integrated green economy practices to sustainable MSME performance remains insufficiently explained. Third, mixed findings concerning the direct effects of green practices indicate the need to distinguish between a direct efficiency pathway and an indirect innovation pathway. Fourth, much of the available evidence has been derived from manufacturing and supply chain settings, while tourism-based MSMEs remain underrepresented, despite their close dependence on environmental quality, cultural identity, community relationships, and destination attractiveness (Bag et al., 2022; Junejo et al., 2025; M. T. Khan et al., 2022; Rodríguez-Espíndola et al., 2022).

Lake Toba, Indonesia, provides a relevant context for addressing these gaps. Tourism activities in this destination depend on culinary enterprises, local cultural crafts, accommodation, transportation, and other tourism services managed largely by MSMEs. These businesses generate income, employment, visitor experiences, and opportunities to preserve local cultural values. Nevertheless, increasing tourism activities can intensify waste generation, energy consumption, material use, and pressure on natural resources. Culinary MSMEs must address food waste, energy efficiency, and sustainable packaging; craft MSMEs must consider renewable, recycled, or responsibly sourced materials; and tourism-service MSMEs must reduce disposable materials while developing more environmentally responsible visitor

experiences. Evidence from Indonesian culinary MSMEs has already demonstrated that circular economy policies can stimulate green business innovation (Megawati et al., 2024). However, the mechanism through which integrated green economy practices contribute to Sustainable MSME Performance' among tourism-based MSMEs in Lake Toba has not been adequately examined.

This study builds on the Natural Resource-Based View and Dynamic Capabilities Theory as complementary perspectives. The Natural Resource-Based View positions environmental knowledge, resource efficiency, sustainable production routines, and environmental responsibility as strategic organizational resources. Dynamic Capabilities Theory explains how MSMEs recognize environmental and market changes, reorganize their resources, and transform sustainability commitments into innovative products, processes, marketing practices, and business models. In this framework, green economy practices provide the environmental resource foundation, whereas eco-innovation operates as a conversion capability through which those resources generate measurable value. The paper's main argument is that green economy practices can improve sustainable MSME performance directly through efficiency, cost control, resource conservation, and environmental legitimacy, but their overall contribution becomes stronger when they are converted into eco-innovation. Sustainable MSME Performance' is therefore expected to emerge through two complementary mechanisms: a direct efficiency pathway and an indirect innovation pathway.

The study makes three contributions. First, it integrates Green Economy Practices, Eco-Innovation, and Sustainable MSME Performance into a single structural model. This integration moves beyond fragmented assessments of individual green practices and explains how a comprehensive environmental orientation can generate multidimensional performance outcomes. Second, it positions Eco-Innovation as a conversion mechanism rather than merely an independent predictor of performance. This perspective clarifies why adopting environmental practices may produce limited results when they are not transformed into marketable products, efficient processes, improved organizational systems, and responsible marketing practices. Third, the study provides evidence from tourism-based MSMEs in Lake Toba, thereby extending the green economy and eco-innovation literature to an emerging tourism destination in which business competitiveness is closely connected to environmental resources, local culture, and destination sustainability.

This study aimed to examine the relationships among Green Economy Practices, Eco-Innovation, and Sustainable MSME Performance and to assess whether Eco-Innovation mediated the relationship between Green Economy Practices and Sustainable MSME

Performance among tourism-based MSMEs in Lake Toba, Indonesia. The study addressed the following central research question: To what extent does Eco-Innovation transmit the relationship between Green Economy Practices and Sustainable MSME Performance in an emerging tourism destination? More specifically, the study evaluated the relationship between Green Economy Practices and Eco-Innovation, the direct relationship between Green Economy Practices and Sustainable MSME Performance, the relationship between Eco-Innovation and Sustainable MSME Performance, and the indirect relationship transmitted through Eco-Innovation. The remainder of the paper develops the theoretical framework and hypotheses, describes the methodology, presents the measurement and structural model results, discusses the theoretical and practical implications, and concludes with the study's limitations and directions for future research.

2. LITERATURE REVIEW

Theoretical Foundation

The relationships among Green Economy Practices, Eco-Innovation, and Sustainable MSME Performance are explained through the complementary perspectives of the Natural Resource-Based View (NRBV) and Dynamic Capabilities Theory (Elia et al., 2021; Teece, 2018). The NRBV considers environmental knowledge, resource efficiency, waste reduction, sustainable production routines, and managerial commitment as strategic resources that can improve efficiency, legitimacy, and long-term competitiveness. From this perspective, Green Economy Practices provide MSMEs with an environmental resource foundation. However, possessing environmentally responsible resources and routines does not necessarily produce superior performance unless they are converted into valuable organizational and market outcomes (Elia et al., 2021).

Dynamic Capabilities Theory explains this conversion process by emphasizing an enterprise's capacity to recognize environmental changes, reorganize its resources, and respond through product, process, organizational, and marketing innovation (Siddiqi et al., 2025; Teece, 2018). Previous research has shown that green innovation and strategic change contribute to sustainable SME performance, particularly when enterprises possess adequate technological and analytical capabilities (Aslam et al., 2025; Bag et al., 2022). Accordingly, this study interprets Eco-Innovation as a dynamic conversion capability that transforms Green Economy Practices into economic, social, and environmental value.

Integrating the two perspectives extends existing theoretical knowledge by distinguishing two complementary performance mechanisms. The first is a direct efficiency pathway through which Green Economy Practices reduce resource consumption, waste, and operating costs. The second is an indirect innovation pathway through which those practices stimulate Eco-Innovation, which subsequently creates product differentiation, operational improvements, stakeholder value, and Sustainable MSME Performance'. This distinction explains why similar environmental practices may produce different outcomes across MSMEs.

Green Economy Practices

Green Economy Practices refer to business activities that support economic value creation while reducing environmental harm and promoting social well-being. At the MSME level, they include resource efficiency, energy conservation, waste reduction, sustainable materials, environmentally responsible production, circular resource use, and the integration of sustainability into long-term business decisions. These practices encourage MSMEs to move beyond short-term financial objectives and recognize environmental responsibility as part of their competitive strategy (Chaaben et al., 2022; Megawati et al., 2024).

A considerable body of research has associated circular economy practices, sustainable supply chains, green human resource management, and environmental leadership with stronger sustainability outcomes. Circular economy practices can extend product life cycles, reduce waste, recover resources, and support responsible product design (Rodríguez-Espíndola et al., 2022; Yin et al., 2023). Sustainable supply chain practices can also improve MSME performance when supported by effective governance and clearly defined performance metrics (Nyamah et al., 2026). Evidence from Indonesian culinary MSMEs further indicates that circular economy and social protection policies support green business innovation (Megawati et al., 2024).

However, the literature has not produced entirely consistent results. Certain green supply chain activities did not significantly improve SME Sustainable MSME Performance' during the COVID-19 crisis (Alraja et al., 2022). Green human resource management also failed to influence MSME performance directly when green product innovation was absent (Siddiqi et al., 2025). These findings suggest that Green Economy Practices may provide an important environmental foundation but may not automatically generate economic, social, and environmental outcomes. Their effectiveness depends on implementation quality, financial capacity, technological resources, organizational knowledge, and the ability to convert environmental responsibility into innovation.

Eco-Innovation

Eco-Innovation refers to the development or meaningful improvement of products, production processes, organizational systems, marketing practices, and business models that reduce environmental impacts while creating economic and social value. Product Eco-Innovation involves environmentally responsible materials, recyclable components, sustainable packaging, and low-impact product designs. Process Eco-Innovation includes cleaner production, energy-efficient technologies, resource conservation, and waste reduction. Organizational Eco-Innovation restructures managerial routines and systems to support environmental objectives, while marketing Eco-Innovation communicates sustainability value through branding, packaging, promotion, and customer engagement (Díaz Duarte et al., 2025; Larbi-Siaw et al., 2022; Tegethoff et al., 2025).

Numerous studies have demonstrated that Eco-Innovation contributes positively to sustainable MSME performance. Oduro (2024) meta-analysis of 99 studies involving 134,841 MSMEs found a positive and significant relationship between Eco-Innovation and Sustainable MSME Performance'. Organizational Eco-Innovation produced the strongest contribution, followed by process, product, and marketing innovation. Tegethoff et al. (2025) found that Eco-Innovation improved environmental performance through resource efficiency, emissions reduction, and waste management. Similarly, Wasiq et al. (2023) showed that green innovation adoption strengthened the economic, social, and environmental performance of SMEs.

Nevertheless, the effects of Eco-Innovation are context-dependent. Industry characteristics, culture, technological capacity, market turbulence, government support, and internal resources can strengthen or weaken its performance effects (Oduro, 2024). Market turbulence may amplify the economic contribution of product and organizational Eco-Innovation, whereas limited resources can restrict an MSME's ability to commercialize environmental innovation (Larbi-Siaw et al., 2022). Eco-Innovation should therefore be understood as a strategic capability whose value depends on both organizational readiness and environmental conditions.

Sustainable MSME Performance

Sustainable MSME Performance is the capacity of an enterprise to achieve economic, social, and environmental outcomes consistently over time. Economic performance encompasses revenue development, cost efficiency, customer satisfaction, market growth, and business continuity. Social performance includes employment creation, employee welfare, community contributions, cultural preservation, and responsible stakeholder relationships. Environmental performance includes resource efficiency, waste management, energy

conservation, pollution reduction, and sustainable production (Fitria, 2026; Taufiq Noor Rokhman et al., 2026).

This multidimensional perspective is especially relevant to tourism-based MSMEs because their economic viability depends on the environmental quality and cultural identity of the destination. Culinary, craft, and tourism-service MSMEs must generate income while preserving natural resources, supporting local communities, and maintaining destination attractiveness. Sustainable MSME Performance therefore reflects not only enterprise competitiveness but also the ability of the business to contribute to the long-term sustainability of the tourism ecosystem (Aprilani et al., 2023).

Hypothesis Development

Green Economy Practices and Eco-Innovation

Green Economy Practices can stimulate Eco-Innovation by increasing organizational awareness of environmental problems and creating incentives to identify innovative solutions. Resource efficiency may encourage alternative materials and energy-saving technologies, while waste reduction can stimulate cleaner production, sustainable packaging, and circular product design. Environmental responsibility may also encourage MSMEs to develop green branding and sustainability-oriented business models (Anggraeni et al., 2024; Chaaben et al., 2022; Pangarso et al., 2022).

Previous research supports this relationship. Rodríguez-Espíndola et al. (2022) found that circular economy practices encouraged sustainability-oriented innovation, while Bag et al. (2022) demonstrated that Eco-Innovation was positively connected with green supply chain management and circular economy capability. Green Economy Practices therefore provide the resources and operational routines from which Eco-Innovation develops. Accordingly:

H1: Green Economy Practices positively influence Eco-Innovation.

Green Economy Practices and Sustainable MSME Performance

Green Economy Practices can directly improve Sustainable MSME Performance by reducing resource consumption, controlling operating costs, minimizing waste, and strengthening stakeholder legitimacy. Circular economy practices and sustainable supply chain management have been associated with stronger financial, environmental, and social outcomes (Nyamah et al., 2026; Rodríguez-Espíndola et al., 2022; Yin et al., 2023).

However, the relationship is not universally strong. Green practices may produce limited performance benefits when they are adopted symbolically, implemented inconsistently, or separated from the enterprise's core strategy (Alraja et al., 2022; Siddiqi et al., 2025). Despite

this variation, the efficiency and legitimacy benefits of environmental practices provide a theoretical basis for expecting a positive direct relationship. Accordingly:

H2: Green Economy Practices positively influence Sustainable MSME Performance.

Eco-Innovation and Sustainable MSME Performance

Eco-Innovation converts environmental concerns into marketable products, efficient processes, improved organizational systems, and responsible marketing practices. Product innovation can improve differentiation and customer value, while process innovation can reduce energy consumption, production costs, waste, and environmental damage. Organizational and marketing innovations can strengthen environmental management, business reputation, and communication with environmentally conscious customers (Díaz Duarte et al., 2025; Larbi-Siaw et al., 2022).

Empirical evidence has consistently associated Eco-Innovation with economic, social, and environmental performance (Oduro, 2024; Tegethoff et al., 2025; Wasiq et al., 2023). For tourism-based MSMEs, Eco-Innovation may also improve destination image and strengthen relationships with tourists and local communities. Accordingly:

H3: Eco-Innovation positively influences Sustainable MSME Performance.

The Mediating Role of Eco-Innovation

Green Economy Practices may improve performance directly, but their contribution can become stronger when environmental practices are converted into innovation. Previous studies have demonstrated that green process innovation mediated the relationship between corporate social responsibility and MSME performance (Achi et al., 2022). Green product innovation mediated the relationship between green human resource management and business performance (Siddiqi et al., 2025). Green innovation and green knowledge sharing also acted as partial mediators between green supply chain management and sustainable MSME performance (Junejo et al., 2025).

These findings indicate that Eco-Innovation functions as a bridge between environmental responsibility and sustainable value creation. Green Economy Practices establish the environmental resource foundation, whereas Eco-Innovation transforms that foundation into differentiated products, efficient processes, organizational improvements, and market value. Accordingly:

H4: Eco-Innovation positively mediates the relationship between Green Economy Practices and Sustainable MSME Performance.

3. RESEARCH METHODOLOGY

Research Design

We employed a quantitative, cross-sectional survey to examine the direct and indirect relationships among Green Economy Practices, Eco-Innovation, and Sustainable MSME Performance. The study followed a deductive approach within a positivist paradigm because the theoretically derived hypotheses were tested using data collected from respondents exact data-collection dates. We selected partial least squares structural equation modeling (PLS-SEM) because the model involved latent constructs measured reflectively and sought to explain variance and test mediation simultaneously. Although covariance-based SEM could be used for strict model confirmation, PLS-SEM was more consistent with the study's explanatory and prediction-oriented purpose. The cross-sectional design, however, restricted causal and temporal interpretation (F. Hair Jr et al., 2014; Sabol et al., 2023).

Population and Sampling

The target population comprised owners and managers of tourism-based MSMEs operating in the Lake Toba area, Indonesia. We used purposive sampling to recruit respondents with direct knowledge of their enterprises' resource use, environmental practices, innovation activities, and performance. Eligibility required that the enterprise: (1) had operated for at least two years; (2) belonged to the culinary, local craft, or tourism-service sector; (3) conducted activities with environmental implications; and (4) was represented by an owner or manager involved in business decisions. After screening incomplete, inconsistent, and ineligible responses, 300 valid questionnaires were retained. The sample included 147 culinary MSMEs (49.0%), 91 craft MSMEs (30.3%), and 62 tourism-service MSMEs (20.7%).

Measurement Instrument

Data were gathered using a structured questionnaire informed by previous studies of green business practices, circular economy implementation, Eco-Innovation, and sustainable MSME performance (Bag et al., 2022; Oduro, 2024; Rodríguez-Espíndola et al., 2022; Wasiq et al., 2023). The final model contained 29 reflective indicators. Green Economy Practices was measured using nine indicators (GE1–GE6 and GE8–GE10) covering resource efficiency, waste reduction, energy efficiency, environmental responsibility, sustainable production, and long-term sustainability orientation. GE7 was not retained in the final model. Eco-Innovation was measured using ten indicators (EI1–EI10) representing product, process, organizational, marketing, and business-model innovation. Sustainable MSME Performance was measured using ten indicators (SP1–SP10) covering economic, social, and environmental outcomes. Responses were recorded on a five-point Likert scale ranging from 1 (strongly disagree) to 5

(strongly agree). No control variables were included because the proposed model focused on estimating the explanatory and mediating roles of the three focal constructs (Malhotra et al., 2017).

Data Collection and Ethical Procedures

We administered the questionnaire to eligible owners and managers in the Lake Toba area. Before participation, respondents received information about the academic purpose of the study, voluntary participation, and response confidentiality. They were instructed to answer according to the actual conditions of their businesses. We screened the returned questionnaires for completeness, response consistency, and compliance with the eligibility criteria before entering the data into SmartPLS 4 (Sarstedt et al., 2019).

Data Analysis

We analyzed the data in two stages. First, the measurement model was evaluated using outer loadings, Cronbach's alpha, rho_A, composite reliability (rho_C), average variance extracted (AVE), and the heterotrait–monotrait ratio (HTMT). Loadings and reliability values above 0.70, AVE above 0.50, and HTMT below 0.90 indicated acceptable measurement quality. Second, the structural model was evaluated using path coefficients, R^2, adjusted R^2, and effect sizes (f^2). Values of 0.02, 0.15, and 0.35 represented small, medium, and large effects, respectively. Nonparametric bootstrapping was used to test direct and indirect effects at a 5% significance level; relationships were considered significant when $t > 1.96$ and $p < 0.05$. SmartPLS outputs reported as $p = 0.000$ were presented as $p < 0.001$ (F. Hair Jr et al., 2014; G. F. Khan et al., 2019; Sabol et al., 2023).

Mediation Model

Mediation was assessed through the indirect path Green Economy Practices → Eco-Innovation → Sustainable MSME Performance. Complementary partial mediation was established when the direct and indirect effects were significant and pointed in the same direction. The empirical model tested four hypotheses: Green Economy Practices → Eco-Innovation (H1), Green Economy Practices → Sustainable MSME Performance (H2), Eco-Innovation → Sustainable MSME Performance (H3), and the indirect effect through Eco-Innovation (H4). Purposive sampling, self-reported measurements, the absence of control variables, and the cross-sectional design were recognized as methodological limitations.

4. RESULT AND DISCUSSION

Respondent Profile

Table 1 summarizes the characteristics of the 300 owners and managers of tourism-based MSMEs. Female respondents constituted 58.0% of the sample, while male respondents accounted for 42.0%. Most respondents were aged 25–44 years (64.6%), comprising those aged 25–34 years (30.3%) and 35–44 years (34.3%). Senior high school or equivalent was the most common educational level (48.7%), followed by bachelor's degrees (19.6%) and junior high school education (14.0%).

Three characteristics were particularly prominent. First, culinary MSMEs represented the largest business sector (49.0%), followed by local crafts (30.3%) and tourism services (20.7%). Second, most enterprises had operated for 2–6 years (63.4%) and employed 1–4 workers (70.7%), indicating that micro-enterprises dominated the sample. Third, monthly revenue was concentrated below IDR 25 million (72.7%), consisting of enterprises earning less than IDR 10 million (34.0%) and IDR 10–25 million (38.7%). Digital marketing was actively used by 61.3% of respondents, whereas 27.3% reported limited use and 11.4% had not adopted it. These descriptive results characterize the sample and provide the empirical context for the subsequent measurement and structural model assessments

Table 1. Respondent Characteristics.

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	126	42.0
	Female	174	58.0
Age	<25 years	24	8.0
	25–34 years	91	30.3
	35–44 years	103	34.3
	45–54 years	60	20.0
	>54 years	22	7.4
Educational level	Elementary school	18	6.0
	Junior high school	42	14.0
	Senior high school/equivalent	146	48.7
	Diploma	30	10.0
	Bachelor's degree	59	19.6
	Postgraduate degree	5	1.7
Business sector	Culinary	147	49.0
	Local craft	91	30.3
	Tourism services	62	20.7
Business duration	2–3 years	83	27.7
	4–6 years	107	35.7
	7–10 years	66	22.0
	>10 years	44	14.6
Number of employees	1–4 employees	212	70.7
	5–9 employees	69	23.0
	10–19 employees	19	6.3
Monthly revenue	<IDR 10 million	102	34.0
	IDR 10–25 million	116	38.7
	>IDR 25–50 million	55	18.3

Digital marketing adoption	>IDR 50 million	27	9.0
	Active use	184	61.3
	Limited use	82	27.3
	Not yet adopted	34	11.4

Source: Research data (2026).

Measurement Model Assessment: Indicator Reliability

Table 2 and Figure 1, present the outer loadings for the 29 reflective indicators measuring Eco-Innovation, Green Economy Practices, and Sustainable MSME Performance. All loadings exceeded the recommended threshold of 0.70, ranging from 0.729 to 0.900; therefore, the retained indicators demonstrated satisfactory reliability.

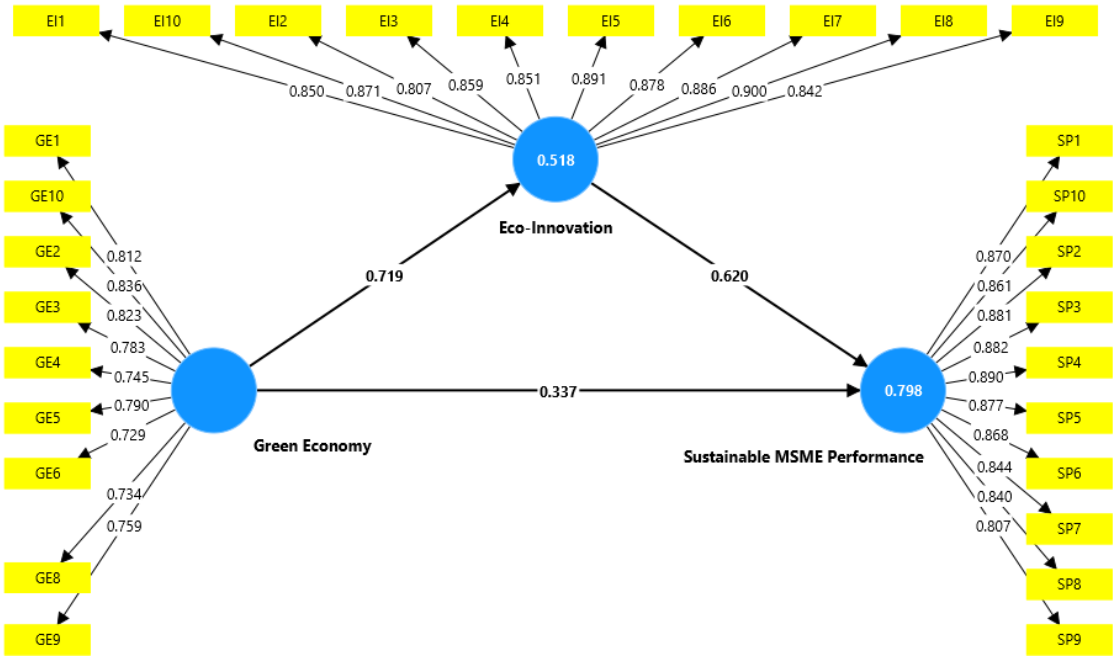

Figure 1. Outer Loading.

Three principal results were identified. First, the ten Eco-Innovation indicators produced loadings between 0.807 and 0.900, with EI8 recording the highest value. Second, the nine Green Economy Practices indicators yielded loadings between 0.729 and 0.836; GE10 had the highest loading, while GE6 had the lowest. Third, the ten Sustainable MSME Performance indicators generated loadings between 0.807 and 0.890, with SP4 recording the highest value. No loading below 0.70 was observed in the final measurement model. Accordingly, all 29 indicators were retained for the subsequent assessments of internal consistency, convergent validity, and discriminant validity (Hair et al., 2021).

Table 2. Indicator Loadings and Reliability.

	Eco-Innovation	Green Economy Practices	Sustainable MSME Performance
EI1	0.850		
EI10	0.871		
EI2	0.807		
EI3	0.859		
EI4	0.851		
EI5	0.891		
EI6	0.878		
EI7	0.886		
EI8	0.900		
EI9	0.842		
GE1		0.812	
GE10		0.836	
GE2		0.823	
GE3		0.783	
GE4		0.745	
GE5		0.790	
GE6		0.729	
GE8		0.734	
GE9		0.759	
SP1			0.870
SP10			0.861
SP2			0.881
SP3			0.882
SP4			0.890
SP5			0.877
SP6			0.868
SP7			0.844
SP8			0.840
SP9			0.807

Source: Research data (2026).

Construct Reliability and Convergent Validity

Table 3 reports the internal consistency and convergent validity of the three constructs. Cronbach's alpha, rho_A, and rho_C were used to assess construct reliability, while average variance extracted (AVE) was used to evaluate convergent validity. All reliability coefficients exceeded the recommended threshold of 0.70, and all AVE values were above 0.50.

Eco-Innovation recorded reliability coefficients ranging from 0.962 to 0.967 and an AVE of 0.746. Green Economy Practices produced reliability values between 0.920 and 0.933 and an AVE of 0.608. Sustainable MSME Performance generated reliability coefficients ranging from 0.962 to 0.967 and an AVE of 0.744. These results confirmed that all three constructs achieved satisfactory internal consistency and explained more than 50% of the variance in their

respective indicators. However, the alpha and rho_C values exceeding 0.95 for Eco-Innovation and Sustainable MSME Performance indicated possible indicator redundancy. Despite this caution, the constructs satisfied the reliability and convergent validity criteria and were retained for discriminant validity assessment (Hair et al., 2021).

Table 3. Construct Reliability and Convergent Validity.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Eco-Innovation	0.962	0.963	0.967	0.746
Green Economy Practices	0.920	0.926	0.933	0.608
Sustainable MSME Performance	0.962	0.962	0.967	0.744

Source: Research data (2026).

Discriminant Validity

Table 4 presents the discriminant validity assessment based on the heterotrait–monotrait ratio (HTMT). The values ranged from 0.742 to 0.895 and remained below the 0.90 threshold. Green Economy Practices and Eco-Innovation recorded an HTMT value of 0.742, while Green Economy Practices and Sustainable MSME Performance produced a value of 0.819. These results indicated satisfactory empirical separation between the respective constructs (Hair et al., 2021).

The HTMT value between Eco-Innovation and Sustainable MSME Performance was 0.895. Although it satisfied the 0.90 criterion, its proximity to the threshold indicated substantial empirical overlap and required cautious interpretation. It would not satisfy the more conservative threshold of 0.85. Overall, discriminant validity was supported under the HTMT < 0.90 criterion; however, the distinction between Eco-Innovation and Sustainable MSME Performance should be further examined using bootstrapped HTMT confidence intervals and a review of possible conceptual similarity among their indicators (Hair et al., 2021).

Table 4. Discriminant Validity Based on the HTMT Criterion.

	Heterotrait-monotrait ratio (HTMT)
Green Economy Practices <-> Eco-Innovation	0.742
Sustainable MSME Performance <-> Eco-Innovation	0.895
Sustainable MSME Performance <-> Green Economy	0.819

Source: Research data (2026).

Effect Size Assessment (f^2)

Table 5 presents the effect size (f^2) of each exogenous construct on its corresponding endogenous construct. Values of 0.02, 0.15, and 0.35 indicate small, medium, and large effects, respectively.

Green Economy Practices had a large effect on Eco-Innovation ($f^2 = 1.073$), representing the strongest effect in the model. Eco-Innovation also demonstrated a large effect on Sustainable MSME Performance ($f^2 = 0.917$). Meanwhile, Green Economy Practices produced a medium effect on Sustainable MSME Performance ($f^2 = 0.270$).

These findings demonstrate that Green Economy Practices strongly contribute to the development of Eco-Innovation, while Eco-Innovation substantially improves Sustainable MSME Performance. The results further emphasize the importance of Eco-Innovation in translating environmental practices into sustainable economic, social, and environmental outcomes (Hair et al., 2021).

Table 5. Effect Size Assessment (f^2).

	Eco-Innovation	Green Economy Practices	Sustainable MSME Performance
Eco-Innovation			0.917
Green Economy	1.073		0.270
Sustainable MSME Performance			

Source: Research data (2026).

Determination (R^2)

Table 6 presents the coefficients of determination for the endogenous constructs. Green Economy Practices explained 51.8% of the variance in Eco-Innovation ($R^2 = 0.518$; adjusted $R^2 = 0.516$), indicating moderate explanatory power. The remaining 48.2% was attributable to factors outside the proposed model.

Green Economy Practices and Eco-Innovation jointly explained 79.8% of the variance in Sustainable MSME Performance ($R^2 = 0.798$; adjusted $R^2 = 0.796$), demonstrating substantial explanatory power. Only 20.2% of its variance remained unexplained. For both constructs, the difference between R^2 and adjusted R^2 was 0.002, indicating that adjustment for the number of predictors produced minimal change. Overall, the structural model demonstrated moderate explanatory power for Eco-Innovation and substantial explanatory power for Sustainable MSME Performance.

Table 6. Coefficient of Determination (R^2).

	R-square	R-square adjusted
Eco-Innovation	0.518	0.516
Sustainable MSME Performance	0.798	0.796

Source: Research data (2026).

Structural Model Assessment and Hypothesis Testing

Table 7 presents the direct-effect estimates obtained through bootstrapping in SmartPLS 4. Statistical significance was established when $t > 1.96$ and $p < 0.05$. All three direct relationships were positive and significant at $p < 0.001$, thereby supporting H1, H2, and H3.

Three principal findings emerged. First, Green Economy Practices had the strongest direct relationship with Eco-Innovation ($\beta = 0.719$, $t = 21.655$, $p < 0.001$), supporting H1. Second, Green Economy Practices were positively related to Sustainable MSME Performance ($\beta = 0.337$, $t = 7.097$, $p < 0.001$), supporting H2. Third, Eco-Innovation had a positive relationship with Sustainable MSME Performance ($\beta = 0.620$, $t = 14.072$, $p < 0.001$), supporting H3. The coefficient for Eco-Innovation was greater than the direct coefficient for Green Economy Practices, indicating that Eco-Innovation was the stronger predictor of Sustainable MSME Performance in the proposed model. The significant Green Economy Practices → Eco-Innovation path also established the first condition required for testing the indirect effect proposed in H4.

Table 7. Path Coefficients and Direct-Effect Testing.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Decision
Eco-Innovation -> Sustainable MSME Performance	0.620	0.619	0.044	14.072	0.000	Significant
Green Economy Practices -> Eco-Innovation	0.719	0.720	0.033	21.655	0.000	Significant
Green Economy Practices -> Sustainable MSME Performance	0.337	0.338	0.047	7.097	0.000	Significant

Source: Research data (2026).

Table 8 presents the specific indirect effect of Green Economy Practices on Sustainable MSME Performance through Eco-Innovation. Bootstrapping produced a positive and significant indirect effect ($\beta = 0.446$, $t = 12.262$, $p < 0.001$), supporting H4. The coefficient corresponded to the product of the two constituent paths ($0.719 \times 0.620 = 0.446$).

The direct effect of Green Economy Practices on Sustainable MSME Performance also remained positive and significant after Eco-Innovation was included ($\beta = 0.337$, $t = 7.097$, $p < 0.001$). Because the direct and indirect effects were significant and had the same positive direction, Eco-Innovation demonstrated complementary partial mediation. The combined direct and indirect effects produced a total effect of 0.783. The indirect pathway accounted for 56.96% of the total effect (VAF = 0.446/0.783 × 100), indicating that more than half of the relationship between Green Economy Practices and Sustainable MSME Performance was transmitted through Eco-Innovation, while a significant direct relationship remained.

Table 8. Specific Indirect Effect and Mediation Testing.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Decision
Green Economy Practices -> Sustainable MSME Performance	0.446	0.445	0.036	12.262	0.000	Significant

Source: Research data (2026).

Green Economy Practices and Eco-Innovation

The positive relationship between Green Economy Practices and Eco-Innovation supported H1 and represented the strongest direct pathway in the model. This finding indicates that resource efficiency, waste reduction, sustainable production, and environmental responsibility provide an operational foundation for developing environmentally oriented products, processes, organizational systems, marketing practices, and business models. Green practices therefore function not only as mechanisms for reducing environmental harm but also as stimuli for organizational innovation.

This result is consistent with Bag et al. (2022), who connected Eco-Innovation with green supply chain management and circular economy capability, and with Rodríguez-Espíndola et al. (2022), who demonstrated that circular economy implementation encouraged sustainability-oriented innovation. It also complements evidence from Indonesian culinary MSMEs showing that circular economy policies supported green business innovation (Megawati et al., 2024). Collectively, these findings suggest that MSMEs innovate more effectively when environmental responsibility is embedded in their operational routines rather than treated as an isolated compliance activity.

For Lake Toba MSMEs, this relationship means that environmental problems can become sources of innovation. Culinary businesses may translate waste reduction into sustainable packaging and low-waste production, craft enterprises may develop products from renewable or recycled materials, and tourism-service businesses may redesign visitor

experiences around environmentally responsible practices. Green Economy Practices thus enable MSMEs to recognize environmental challenges and convert them into new sources of customer and destination value.

Green Economy Practices and Sustainable MSME Performance

The positive direct relationship between Green Economy Practices and Sustainable MSME Performance supported H2. This indicates that environmental practices can improve business outcomes through resource savings, cost control, reduced waste, stronger stakeholder legitimacy, and improved operational continuity. The finding supports the Natural Resource-Based View by showing that environmental resources and routines can create value when integrated into core business operations. For tourism-based MSMEs, this integration is particularly important because business competitiveness depends on the environmental quality and cultural attractiveness of the destination.

The finding is consistent with Rodríguez-Espíndola et al. (2022), who linked circular economy practices with financial, environmental, and social performance. It also supports the meta-analytic evidence of Yin et al. (2023) and the sustainable supply chain findings of Nyamah et al. (2026). However, it contrasts with Alraja et al. (2022), who found that certain green supply chain activities did not improve SME Sustainable MSME Performance' during the COVID-19 crisis. This inconsistency may reflect differences in context and implementation. Crisis-related disruptions can prevent resource-constrained SMEs from obtaining immediate benefits from environmental practices, whereas the tourism MSMEs examined here may have embedded resource efficiency and waste management more directly into daily operations.

Nevertheless, the direct contribution of Green Economy Practices was weaker than that of Eco-Innovation. This difference is theoretically meaningful: environmental practices may initially generate efficiency and legitimacy, but they produce greater competitive value when transformed into differentiated products, improved processes, and market-relevant innovations. Thus, environmental responsibility is necessary but may not be sufficient for achieving stronger Sustainable MSME Performance'.

Eco-Innovation and Sustainable MSME Performance

The positive relationship between Eco-Innovation and Sustainable MSME Performance supported H3. Eco-Innovation was the stronger direct predictor of Sustainable MSME Performance', indicating that MSMEs generated greater value when environmental commitments were converted into product, process, organizational, and marketing improvements. This finding supports Dynamic Capabilities Theory because Eco-Innovation

enables enterprises to reorganize resources and respond to changing technologies, customer expectations, competition, and environmental pressures.

The result is consistent with Oduro (2024) meta-analysis, which confirmed that Eco-Innovation improved the economic, social, and environmental performance of MSMEs, with organizational innovation producing the strongest contribution. It also supports Tegethoff et al. (2025), who associated Eco-Innovation with resource efficiency, emissions reduction, and waste management, and Wasiq et al. (2023), who found that green innovation adoption strengthened SME sustainability performance. These similarities demonstrate that Eco-Innovation is not merely an environmental response; it is a strategic capability that combines ecological value with operational efficiency and market differentiation.

In the Lake Toba context, Eco-Innovation can simultaneously strengthen enterprises and the destination. Sustainable packaging and food-waste reduction can improve culinary business efficiency; renewable or recycled materials can differentiate culturally based crafts; and environmentally responsible services can improve visitor experiences. These innovations may also strengthen reputation and customer trust among tourists who value responsible consumption. However, most sampled enterprises employed fewer than five workers, suggesting that limited human and financial resources may constrain the scale and speed of innovation. Eco-Innovation initiatives should therefore be practical, affordable, and adapted to micro-enterprise capacity.

The Mediating Role of Eco-Innovation

The significant indirect relationship supported H4 and identified Eco-Innovation as a complementary partial mediator. More than half of the total relationship between Green Economy Practices and Sustainable MSME Performance was transmitted through Eco-Innovation. This indicates that green practices created sustainable value through two simultaneous pathways. The direct pathway generated efficiency, cost control, and environmental legitimacy, whereas the indirect pathway converted environmental resources into marketable products, cleaner processes, improved organizational systems, and responsible marketing practices.

This mediation pattern is consistent with Achi et al. (2022), who found that green process innovation mediated the relationship between corporate social responsibility and MSME performance. It also supports (Siddiqi et al., 2025), who identified green product innovation as the mechanism connecting green human resource management with business performance. Junejo et al. (2025) similarly demonstrated that green innovation and green knowledge sharing partially mediated the relationship between green supply chain management and sustainable

MSME performance. The present study extends this evidence by showing that Eco-Innovation transmits the effect of an integrated Green Economy Practices construct rather than a single environmental initiative.

The partial nature of the mediation is theoretically important. Eco-Innovation did not replace the direct value of Green Economy Practices; instead, it strengthened that value. This finding extends the Natural Resource-Based View by demonstrating that environmental resources can generate direct efficiency benefits while requiring a conversion capability to realize their broader competitive potential. It also extends Dynamic Capabilities Theory by positioning Eco-Innovation as the mechanism that transforms environmental routines into sustainable market and stakeholder value. The integration of these perspectives therefore explains both why green practices matter and how their contribution is amplified.

Theoretical and Practical Implications

The study contributes theoretically by distinguishing between an environmental efficiency pathway and an innovation-conversion pathway. Previous research has frequently examined circular economy practices, green supply chains, or Eco-Innovation separately. The present model demonstrates that these elements operate complementarily: Green Economy Practices establish the resource foundation, while Eco-Innovation converts that foundation into Sustainable MSME Performance'. This mechanism helps explain why previous studies have reported inconsistent direct effects of environmental practices.

Managerially, tourism-based MSMEs should connect every environmental initiative to a specific innovation outcome. Resource conservation should inform production redesign, waste reduction should support circular products or packaging, and environmental responsibility should be communicated through credible branding and customer engagement. Policymakers and destination managers should similarly integrate environmental and innovation support rather than administer them as separate programs. Green financing, technical training, shared waste-management facilities, access to environmentally responsible technologies, sustainability certification, digital marketing, and collaboration with universities and local communities can help resource-constrained MSMEs implement Eco-Innovation.

Limitations and Future Research

These findings should be interpreted within several limitations. The cross-sectional design does not establish temporal causality, purposive sampling restricts population-level generalization, and self-reported measurements may introduce common method and social desirability bias. The study also focused on one tourism destination and did not test sectoral differences among culinary, craft, and tourism-service MSMEs. Moreover, the high empirical

association between Eco-Innovation and Sustainable MSME Performance requires careful conceptual distinction.

Future studies should use longitudinal or multi-wave designs, probability sampling, objective performance indicators, and data from multiple respondents within each enterprise. Comparative research across tourism destinations could determine whether institutional support, environmental regulation, market turbulence, digital capability, green financing, or organizational culture changes the proposed relationships. Multi-group analysis could also establish whether the model differs across business sectors, enterprise sizes, revenue groups, and levels of digital marketing adoption. Such extensions would clarify when Green Economy Practices and Eco-Innovation generate the strongest Sustainable MSME Performance' outcomes.

5. CONCLUTION

This study examined how Green Economy Practices contributed to Sustainable MSME Performance through Eco-Innovation among tourism-based MSMEs in Lake Toba, Indonesia. PLS-SEM analysis showed that Green Economy Practices were positively associated with Eco-Innovation and Sustainable MSME Performance, while Eco-Innovation had the stronger direct relationship with Sustainable MSME Performance'. Eco-Innovation also transmitted a substantial proportion of the relationship between Green Economy Practices and Sustainable MSME Performance through complementary partial mediation. These findings demonstrate that environmental practices generate direct benefits through resource efficiency, waste reduction, and operational responsibility, but create greater sustainable value when transformed into environmentally oriented products, processes, organizational systems, marketing practices, and business models.

The study contributes to sustainable entrepreneurship theory by integrating the Natural Resource-Based View and Dynamic Capabilities perspective. Green Economy Practices constitute an environmental resource foundation, whereas Eco-Innovation functions as a conversion capability that transforms environmental resources into economic, social, and environmental outcomes. The findings therefore distinguish between a direct efficiency pathway and an indirect innovation pathway, clarifying why environmental practices may produce limited performance benefits when they are not supported by innovation.

Practically, tourism-based MSMEs should integrate resource efficiency, sustainable materials, waste reduction, and responsible production with continuous Eco-Innovation. Destination managers and policymakers should support this integration through green

financing, technical training, shared waste-management facilities, access to environmentally responsible technologies, sustainability certification, digital marketing, and collaboration among MSMEs, universities, government agencies, and local communities. Such support is essential for strengthening enterprise competitiveness without compromising the natural and cultural resources on which Lake Toba tourism depends.

Several limitations need to be acknowledged. The cross-sectional design restricted temporal and causal interpretation, purposive sampling limited population-level generalization, and self-reported data may have introduced common method and social desirability bias. The study was also confined to one tourism destination, included no control variables, and did not examine differences across culinary, craft, and tourism-service MSMEs. Future research should employ longitudinal or multi-wave designs, probability sampling, objective performance indicators, and multi-informant data. Comparative and multi-group studies should investigate whether sector, enterprise size, digital capability, green financing, government support, organizational culture, environmental knowledge, and market turbulence alter the proposed relationships. These extensions would clarify when and under what conditions Green Economy Practices and Eco-Innovation generate the strongest Sustainable MSME Performance' outcomes..

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