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Green Innovation in MSMEs: Adaptive Strategies for Competitiveness and Sustainable Economic Growth

Sabil Sabil[1*], Lukman Hakim[2], Amin Setio Lestiningsih[3], Dwiyatmoko Puji Widodo[4], Sugiyah[5], Devy Sofyanty[6]
[1]Bina Sarana Informatika University, Jakarta, Indonesia, sabil.sbl@bsi.ac.id
[2]Bina Sarana Informatika University, Jakarta, Indonesia, lukman.lmh@bsi.ac.id
[3]Bina Sarana Informatika University, Jakarta, Indonesia, amin.asl@bsi.ac.id
[4]Bina Sarana Informatika University, Jakarta, Indonesia, dwiyatmoko.dpw@bsi.ac.id
[5]Bina Sarana Informatika University, Jakarta, Indonesia, sugiyah.sgy@bsi.ac.id
[6]Bina Sarana Informatika University, Jakarta, Indonesia, devy.dyy@bsi.ac.id

[*]Corresponding Author: sabil.sbl@bsi.ac.id[1]

Abstract: This study examines green innovation and adaptive strategies as strategic determinants of MSME competitiveness and sustainability in the context of sustainable economic development. It analyzes how green innovation contributes to sustainable economic growth and identifies key drivers and barriers to its implementation, while also assessing the role of adaptive strategies in responding to globalization, shifting consumer preferences, and rising environmental demands. Using a quantitative survey of 150 MSMEs in Indonesia and data analysis with PLS-SEM, the study tests the relationships among green innovation, adaptive strategies, competitiveness, and sustainable economic growth. The results show that green innovation significantly promotes sustainable economic growth, and adaptive strategies are crucial in enhancing MSME competitiveness as well as mediating the relationship between green innovation and economic growth. Nonetheless, limited resources, constrained technological access, and weak regulatory support remain major obstacles. Theoretically, the study advances the literature on the integration of green innovation and adaptive strategies in MSMEs in developing countries. Practically, it offers implications for policy and managerial strategies to strengthen MSME competitiveness and sustainability through multi-stakeholder collaboration and policy incentives.

Keywords: Green Innovation, Adaptive Strategies, Competitiveness, Sustainable Economic Growth.

INTRODUCTION

The role of micro, small, and medium-sized enterprises (MSMEs) is inseparable from the structure of both the global and national economy, as this sector serves as a primary driver of economic activity. In Indonesia, MSMEs make a highly dominant contribution, as reflected in their ability to absorb more than 97% of the national workforce and to contribute over 60%

of gross domestic product (GDP) (Ministry of Cooperatives and SMEs, 2024). Nevertheless, external pressures arising from increasingly complex global economic dynamics, shifts in consumer preferences and behavior, and growing attention to environmental sustainability require MSMEs to undertake fundamental adjustments in their business models and strategies. Accordingly, the adoption of green innovation has become increasingly relevant as a strategic approach, as it not only enhances operational efficiency and reduces cost structures but also strengthens the competitive position of MSMEs and expands opportunities for penetration into international markets, which increasingly emphasize compliance with environmentally friendly principles (Dangelico, 2016; Elsayed, 2024).

Despite the substantial growth potential of MSMEs, the implementation of green innovation in business practices continues to face several fundamental constraints. These barriers include limited access to financing, inadequate technological capabilities and utilization, and relatively low levels of managerial awareness and competence among MSME owners and managers. Previous studies have confirmed that green innovation contributes positively to economic performance and business sustainability; however, the focus of this literature has largely been on large-scale firms in developed countries (Arranz et al., 2021; Xie et al., 2019). Consequently, empirical studies examining developing country contexts—particularly within the MSME sector—remain relatively limited. This gap highlights the need for further investigation into the role of green innovation as an adaptive strategy for strengthening competitiveness and promoting sustainable economic growth.

From a conceptual perspective, this study is grounded in the Resource-Based View (RBV), Dynamic Capability Theory, and the Triple Bottom Line framework. Collectively, these theoretical perspectives suggest that green innovation can be positioned as a strategic resource that is valuable, rare, and difficult to imitate, thereby enabling the creation of sustained competitive advantage (Li et al., 2018; Sun et al., 2019). In line with Porter's competitiveness perspective, the implementation of green innovation enables firms to strengthen product differentiation while simultaneously reducing costs through improved resource-use efficiency. Moreover, sustainable development theory and the concept of the circular economy emphasize that economic growth should proceed in parallel with environmental preservation and social well-being, without generating prolonged negative externalities (Agyabeng-Mensah et al., 2020; Elsayed, 2024).

Consistent with this conceptual foundation, the present study focuses on addressing several core issues. First, it examines the extent to which green innovation contributes to strengthening MSME competitiveness amid increasingly dynamic and uncertain economic conditions. Second, it identifies various forms of adaptive strategies that MSMEs can adopt to integrate green innovation principles into their business activities and processes. Third, this study investigates the key drivers and barriers affecting the implementation of green innovation in MSMEs, particularly in relation to efforts to support sustainable economic growth. Empirically, the hypotheses are tested by analyzing the effects of green innovation on competitiveness and sustainable growth, with adaptive strategies positioned as a mediating variable that bridges the relationship between green innovation and these performance outcomes.

The novelty of this study lies in its integrative effort to examine the relationships among green innovation, adaptive strategies, competitiveness, and sustainable growth using a quantitative approach based on MSME data. This approach provides empirically grounded insights that are highly relevant for scholars, business practitioners, and policymakers (Sun et al., 2019; Xie et al., 2019).

This article makes significant contributions from both theoretical and practical perspectives. Theoretically, it extends the literature on green innovation within the context of MSMEs in developing countries—an area that remains relatively underexplored (Agyabeng-

Mensah et al., 2020; Arranz et al., 2021). Practically, the findings offer strategic recommendations that can be utilized by MSME actors in designing adaptive strategies that not only strengthen business competitiveness but also align with broader efforts to promote sustainable economic growth in Indonesia. The study's contribution is further reinforced by its integrative quantitative approach, which empirically examines the interrelationships among green innovation, adaptive strategies, competitiveness, and sustainable growth using MSME-based data, thereby providing comprehensive and policy-relevant empirical evidence for academics, business practitioners, and policymakers (Sun et al., 2019; Xie et al., 2019).

Literature Review

The concept of green innovation is rooted in the sustainable development approach and strategic management theory, particularly the Resource-Based View (RBV), which positions valuable, rare, and difficult-to-imitate resources as the primary foundation of competitive advantage. Green innovation is understood as the implementation of various forms of renewal in products, processes, and business models that are systematically oriented toward improving environmental performance, such as the use of renewable energy, more effective waste management, and the optimization of resource utilization. In the context of MSMEs, this approach is positioned as a crucial strategy for responding to intensifying external pressures, including environmental regulations, market demands, and increasing consumer awareness of sustainability issues (Li et al., 2023). In addition to the RBV framework, the Triple Bottom Line (TBL) theory serves as an important conceptual foundation by emphasizing the need to balance economic, social, and environmental dimensions as key indicators of sustainable business performance (Sun et al., 2022). Accordingly, green innovation is not merely a tool to enhance operational efficiency but has evolved into an integrative strategy that contributes to building and sustaining the long-term competitiveness of MSMEs.

A wide range of prior empirical studies confirms that the adoption of green innovation makes a substantial contribution to improved business performance and strengthened competitiveness among MSMEs. For example, Chen et al. (2023) demonstrate that the adoption of green innovation in production processes not only enhances energy-use efficiency and reduces operational costs but also improves corporate image and reputation among global consumers. Furthermore, studies focusing on the manufacturing sector reveal that firms' green orientation plays a critical role in expanding international market penetration through compliance with increasingly stringent environmental standards (Wang & Yu, 2022). Other research highlights the urgency of implementing adaptive strategies in response to market dynamics, showing that MSMEs that successfully combine green innovation with the ability to adapt rapidly to regulatory changes and shifts in consumer preferences exhibit higher levels of resilience in the face of economic crises (Zhou et al., 2021).

Nevertheless, several research gaps warrant closer attention. The majority of prior studies have concentrated on large firms with relatively abundant resources, while research specifically examining MSMEs in developing countries remains limited. For instance, studies on the relationship between green innovation and sustainable economic growth have more frequently emphasized macroeconomic perspectives rather than micro-level practices within MSMEs (Hussain et al., 2022). In addition, there is still a paucity of research addressing the barriers to green innovation adoption among MSMEs, including limited access to finance, insufficient technological support, and low managerial capacity (Nguyen & Adomako, 2023). Bridging these gaps is essential to ensure that both policy strategies and business practices are more contextually aligned with the needs and characteristics of MSMEs.

To address these research gaps, this article places its primary empirical focus on MSMEs in Indonesia. Although MSMEs play a strategic role in the national economic structure, they continue to face multiple constraints in adopting green innovation. Using a quantitative

approach, this study not only analyzes the effects of green innovation on MSME competitiveness and sustainable growth but also examines in greater depth the role of adaptive strategies as a mediating variable that serves as a key mechanism linking these constructs. In doing so, this article makes a relevant contribution to the literature by correcting the tendency of prior research to generalize findings based largely on large-firm contexts, which may not fully reflect the realities and specific characteristics of MSMEs in developing countries (Kraus et al., 2022).

Moreover, recent developments in the literature indicate a shift in analytical orientation from static approaches toward more dynamic frameworks that emphasize the importance of firms' adaptive capabilities. In this regard, Dynamic Capability Theory is widely used to explain how firms, including MSMEs, can build business resilience through the implementation of flexible green innovation tailored to their business environment (Guo et al., 2020). This perspective is particularly relevant given that MSMEs typically operate in environments characterized by high uncertainty and rapid change. At the same time, Contingency Theory is often employed to underscore the importance of alignment between firms' adaptive strategies and regulatory dynamics as well as market expectations, which represent critical external factors shaping and driving the adoption of green innovation (Yuan & Cao, 2022).

The synthesis of these theoretical perspectives and prior empirical findings suggests that the successful implementation of green innovation in MSMEs is strongly determined by the degree of integration among internal resource orientation, firms' adaptive capabilities, and support from the external environment. Based on this understanding, this study is designed using a conceptual framework that integratively links green innovation, adaptive strategies, competitiveness, and sustainable economic growth within a single, comprehensive analytical model. This integrative approach enables a more holistic examination of the relationships among these variables, while also providing meaningful conceptual contributions and empirical evidence for the advancement of academic literature and the formulation of MSME-oriented policies (Zhang et al., 2023).

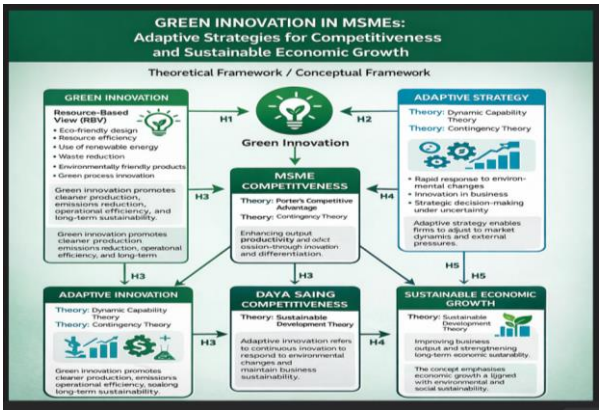

Figure 1: Theoretical Framework

METHOD

This study adopts a quantitative approach with an explanatory research design that is specifically aimed at examining the causal relationships among green innovation, adaptive strategies, competitiveness, and sustainable economic growth in Indonesian MSMEs. The selection of a quantitative approach is based on its ability to generate empirical evidence through statistical analysis to test causal relationships among variables, while also enabling the generalization of findings to a broader population (Creswell & Creswell, 2018). The research model is developed to test the previously formulated hypotheses using Partial Least Squares–

Structural Equation Modeling (PLS-SEM), which is considered appropriate for analyzing complex research models and for studies involving relatively moderate sample sizes.

The data sources in this study consist of both primary and secondary data, which are used in a complementary manner. Primary data are collected through a survey using a structured questionnaire distributed to MSME owners or managers across various business sectors, including manufacturing, trade, services, and culinary businesses, who meet the research criteria. Secondary data are obtained from official documents and reports, including publications from government agencies, national statistical reports, and international sources. Key reference institutions include the Ministry of Cooperatives and SMEs, Statistics Indonesia (Badan Pusat Statistik), and reports from global institutions such as the World Bank and the OECD, which are utilized to strengthen the empirical analysis and theoretical framework of the study (OECD, 2021). The integration of these two types of data is expected to provide a comprehensive overview of the actual conditions of MSMEs while supporting the validity of the research findings.

Primary data collection is conducted through the distribution of structured questionnaires administered both online and offline to the designated respondents. The questionnaire instrument is developed based on indicators for each research variable adapted from prior scholarly sources and measured using a five-point Likert scale, ranging from 1 (“strongly disagree”) to 5 (“strongly agree”). Prior to large-scale distribution, a pilot test is conducted to assess validity and reliability, ensuring clarity of questionnaire items and consistency of measurement across indicators (Taherdoost, 2016). In addition, observation and documentation techniques are employed as supplementary methods to enrich the survey data with contextual information related to the actual implementation of green innovation practices in the field.

The selection of research respondents is based on several inclusion criteria, namely MSMEs that have been in operation for at least one year, demonstrate awareness of or initiatives toward environmentally friendly practices, and whose owners or managers are willing to participate as respondents. Conversely, the exclusion criteria include MSMEs that have not demonstrated a commitment to environmental sustainability or businesses that do not meet legal requirements. Respondents are selected using purposive sampling, which is considered appropriate as it allows researchers to selectively choose participants in accordance with the objectives and characteristics of the study (Etikan et al., 2016). The sample size is determined based on the Slovin formula and in consideration of the recommendations by Hair et al. (2019) for PLS-SEM, namely a minimum of five to ten times the number of indicators. Accordingly, the final sample size in this study is set at 150 MSMEs.

The unit of analysis in this study is Indonesian MSMEs operating across various industry sectors. The analysis focuses on MSME owners or managers, as they play a central role in strategic decision-making processes, including the adoption of green innovation and the formulation of adaptive strategies. The selection of MSMEs as the research object is based on their critical role in the national economy, as well as the structural challenges they face in integrating sustainability principles into daily business practices (Kraus et al., 2020).

Data analysis is conducted using Partial Least Squares–Structural Equation Modeling (PLS-SEM) implemented through SmartPLS version 4.0 software. This method is selected due to its ability to estimate complex latent variable models, its tolerance for non-normal data distributions, and its suitability for research with moderate sample sizes. The analysis process is carried out in two main stages: (1) evaluation of the measurement model (outer model) to assess indicator validity and reliability, and (2) assessment of the structural model (inner model) to analyze causal relationships among variables and the significance of path coefficients (Hair et al., 2019). Indicators such as Cronbach’s alpha, composite reliability, average variance extracted (AVE), and the heterotrait–monotrait ratio (HTMT) are used to assess construct

quality, while R-square, F-square, and path coefficients are employed to evaluate the strength and explanatory power of the structural model (Sarstedt et al., 2020).

Through this methodological approach, the study is expected to generate rigorous and comprehensive empirical evidence on the relationships among green innovation, adaptive strategies, competitiveness, and sustainable economic growth in the context of Indonesian MSMEs, while also strengthening the validity of the findings through the application of systematic and robust quantitative methods.

RESULTS AND DISCUSSION

The descriptive analysis of the 150 respondents, consisting of MSME owners and managers, indicates that the respondent distribution is dominated by the trade sector (40%), followed by the services sector (35%), manufacturing (15%), and the culinary sector (10%). The majority of the MSMEs included in the study have been operating for more than three years (65%) and demonstrate an initial level of awareness regarding the implementation of environmentally friendly practices. These practices are reflected, among others, in efforts to reduce the use of single-use plastics reported by 58% of respondents and the adoption of energy efficiency measures by 46% of respondents. The mean score for respondents' perceptions of green innovation is 3.94 on a five-point Likert scale, indicating a relatively good level of implementation. Meanwhile, adaptive strategies obtained a mean value of 4.02, MSME competitiveness 3.87, and sustainable economic growth 3.91. These findings suggest that most MSMEs perceive green innovation and adaptive strategies as factors with the potential to support business sustainability.

Table. 1.Outer Loading

	DS.	GI.	PEB.	SA.
DS.1	0.768			
DS.2	0.859			
DS.4	0.758			
GI.2		0.895		
GI.5		0.873		
PEB.5			1.000	
SA.1				0.720
SA.2				0.825
SA.3				0.772
SA.4				0.793
SA.5				0.875

Table. 2. R. Square

	R-square	R-square adjusted
DS.	0.482	0.475
PEB.	0.454	0.442

Table.3.F Square

	DS.	GI.	PEB.	SA.
DS.			0.041	
GI.	0.005		0.212	
PEB.				
SA.	0.600		0.031	

Table. 4. Countruct Reabilyty and Validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
DS.	0.712	0.726	0.839	0.635
GI.	0.721	0.724	0.877	0.781

SA.	0.857	0.864	0.898	0.638

Table. 5. Discriminant Validity (HTMT)

	DS.	GI.	PEB.	SA.
DS.				
GI.	0.576			
PEB.	0.600	0.696		
SA.	0.875	0.676	0.588	

The evaluation of the measurement model (outer model) shows that all constructs in the study meet the required standards of validity and reliability. All indicator outer loadings exceed the threshold of 0.70, with two indicators falling within the range of 0.72 to 0.76, which are still considered acceptable. Cronbach's alpha values range from 0.712 to 0.857, while composite reliability values range from 0.839 to 0.898. In addition, the average variance extracted (AVE) values range from 0.635 to 0.781, indicating adequate convergent validity and internal consistency (Fornell & Larcker, 1981). Discriminant validity testing using the heterotrait–monotrait (HTMT) ratio also yields values below the 0.90 threshold, confirming clear distinctions among constructs in the research model (Henseler et al., 2015).

Table. 6. Parth Coefisient – P. Value

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
DS. -> PEB.	0.209	0.210	0.107	1.962	0.050
GI. -> DS.	0.061	0.071	0.074	0.819	0.413
GI. -> PEB.	0.404	0.416	0.112	3.615	0.000
SA. -> DS.	0.660	0.658	0.061	10.776	0.000
SA. -> PEB.	0.194	0.181	0.108	1.794	0.073

The results of the structural model (inner model) testing indicate that green innovation has a positive and significant effect on sustainable economic growth ($\beta = 0.404$; $t = 3.615$; $p < 0.001$), confirming that the implementation of green innovation substantially enhances MSME sustainability performance. However, the direct effect of green innovation on competitiveness is not statistically significant ($\beta = 0.061$; $t = 0.819$; $p = 0.413$), suggesting that MSME competitiveness is more strongly influenced by other factors. In contrast, adaptive strategies have a highly significant effect on MSME competitiveness ($\beta = 0.660$; $t = 10.776$; $p < 0.001$), underscoring their critical role in strengthening MSMEs' competitive position in the market. Adaptive strategies also exhibit a positive effect on sustainable economic growth, although the level of significance is marginal ($\beta = 0.194$; $t = 1.794$; $p = 0.073$).

The coefficient of determination (R-square) values indicate that 48.2% of the variance in MSME competitiveness is explained by green innovation and adaptive strategies, while 45.4% of the variance in sustainable economic growth is explained by green innovation, adaptive strategies, and competitiveness. The F-square effect size results show that adaptive strategies have a strong effect on competitiveness ($f^2 = 0.600$), whereas green innovation exerts a moderate effect on sustainable economic growth ($f^2 = 0.212$). In addition, competitiveness is found to contribute significantly to sustainable economic growth ($\beta = 0.209$; $t = 1.962$; $p = 0.050$), although the magnitude of the effect is moderate.

Table. 7. Indirect Effect

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
GI. -> PEB.	0.013	0.016	0.019	0.663	0.507

SA. -> PEB.	0.138	0.138	0.073	1.893	0.058

Mediation analysis reveals that adaptive strategies partially mediate the relationship between green innovation and sustainable economic growth; however, this indirect effect does not reach conventional levels of statistical significance (β = 0.138; t = 1.893; p = 0.058). Similarly, the mediating role of competitiveness in the relationship between green innovation and sustainable economic growth shows a weak and non-significant effect (β = 0.013; t = 0.663; p = 0.507). These findings indicate that although green innovation has a strong direct effect, the mediating roles of adaptive strategies and competitiveness are not fully supported statistically in the context of this study.

Overall, these results are consistent with prior studies that emphasize the contribution of green innovation to improved environmental performance and sustainable growth (Xie et al., 2019; Dangelico et al., 2017), as well as the importance of adaptive strategies in building MSME competitive advantage amid market dynamics and uncertainty (Zhang et al., 2020). However, the weak mediation effects also suggest that the integration of green innovation and adaptive strategies continues to face structural and institutional constraints within the MSME sector (Klewitz & Hansen, 2014; Yousaf et al., 2021).

In addition, secondary data indicate a global trend whereby MSMEs that consistently adopt green innovation tend to enhance their competitiveness in international markets, particularly in countries or regions with stringent environmental regulations (Cainelli et al., 2015; Bossle et al., 2016). These findings further reinforce the relevance of the present results, highlighting that green innovation among Indonesian MSMEs has substantial potential to support competitiveness and sustainable economic growth, although its implementation remains influenced by limitations in internal resources and external support (Singh et al., 2020; Demirel & Danisman, 2019).

Taken together, this study provides a comprehensive empirical overview of the relationships among green innovation, adaptive strategies, competitiveness, and sustainable economic growth in Indonesian MSMEs through PLS-SEM–based statistical analysis.

Discussion

The findings of this study indicate that green innovation has a significant effect on sustainable economic growth, but does not exhibit a strong direct relationship with MSME competitiveness. In contrast, adaptive strategies are shown to make a substantial contribution to strengthening MSME competitiveness and to have a moderate association with sustainable growth. Accordingly, the research objectives aimed at examining the roles of green innovation and adaptive strategies in enhancing competitiveness while simultaneously promoting sustainable economic growth among Indonesian MSMEs can be considered to have been partially achieved. These results suggest that green innovation exerts a stronger impact on long-term business sustainability, whereas adaptive strategies play a more dominant role in building short-term competitive advantage for MSMEs.

From the perspectives of the Resource-Based View (RBV) and Dynamic Capabilities, these findings can be interpreted as indicating that green innovation represents a strategic resource that is valuable, rare, and difficult to imitate, thereby directly contributing to the achievement of sustainability-oriented business objectives (Barney, 1991). However, without adequate adaptive strategies, the potential of green innovation cannot be fully converted into competitive advantage. Rapid changes in the business environment require organizations to develop adaptive capabilities and to exploit opportunities dynamically, as emphasized in Dynamic Capability Theory (Teece, 2018). Therefore, the results of this study underscore that green innovation and adaptive strategies function in a complementary manner in shaping sustainable MSME performance.

When compared with prior empirical studies, the results of this study are consistent with Chen et al. (2015), who concluded that environmental orientation contributes to improved sustainability performance but does not necessarily translate into direct gains in firm competitiveness. Conversely, these findings differ from those of de Marchi (2012), who reported that green innovation can directly enhance firm competitiveness. These differences may be explained by the specific characteristics of MSMEs in developing countries, which typically face constraints related to limited resources, restricted access to technology, and weaker institutional support. In line with Li et al. (2020), adaptive strategies emerge as a key factor in ensuring business continuity, particularly in sectors that are highly vulnerable to market fluctuations and regulatory changes.

The scholarly contribution of this article lies in its empirical integration of green innovation, adaptive strategies, competitiveness, and sustainable growth within the context of Indonesian MSMEs. In contrast to much of the prior literature, which has focused predominantly on large corporations (Fernando & Wah, 2017), this study provides evidence that these factors are also highly relevant in the MSME sector, albeit with different dynamics. This article extends the literature on sustainability entrepreneurship by highlighting the importance of adaptive strategies as a moderating and connecting mechanism between green innovation and business performance. In practical terms, this study suggests that MSME actors should not only invest in environmentally friendly innovations but also strengthen their adaptive capacity in order to respond effectively to external changes.

Despite its significant contributions, this study has several limitations. First, the use of cross-sectional survey data limits the ability of the analysis to capture the long-term dynamics of green innovation and adaptive strategy implementation. Second, the research model does not incorporate external factors such as government policy support or environmental regulations, which prior studies have identified as important drivers of successful green innovation (Del Río et al., 2016). Third, although PLS-SEM is robust for testing relationships among latent variables, it is limited in its ability to model more complex causal relationships over time.

The implications of this study are broad and multidimensional. For policymakers, the findings highlight the importance of formulating policies that promote the adoption of green innovation through fiscal incentives and programs aimed at strengthening MSMEs' adaptive capacities. For practitioners, particularly MSME owners and managers, the results suggest that flexible and innovative business strategies can enhance competitiveness while simultaneously strengthening firms' contributions to the sustainable development agenda. For future researchers, this study opens avenues for the development of longitudinal research designs or mixed-methods approaches to more deeply explore the mediating and moderating mechanisms among green innovation, adaptive strategies, and external variables such as regulatory support and digital technology utilization (González-Sánchez et al., 2021). Future studies may also extend the research context to other developing countries in order to compare MSME dynamics across different cultural and institutional settings (Roxas & Coetzer, 2012).

Overall, this discussion reinforces the view that the integration of green innovation and adaptive strategies represents a critical pathway for enhancing MSME competitiveness and promoting sustainable economic growth in developing-country contexts.

CONCLUSION

The results of this study indicate that the implementation of green innovation makes a significant contribution to the sustainable economic growth of MSMEs, although its direct relationship with enhanced competitiveness does not demonstrate strong consistency. In contrast, adaptive strategies are shown to play a more dominant role in strengthening MSME competitiveness and in supporting business sustainability. Accordingly, green innovation can

be understood to function primarily as a source of long-term strategic value, whereas adaptive strategies act as a key mechanism that enables MSMEs to maintain both sustainability and competitive advantage amid market dynamics and uncertainty.

The theoretical contribution of this study lies in reinforcing the Resource-Based View and Dynamic Capabilities frameworks, which emphasize that MSME success in achieving sustainable performance is not solely determined by the possession of strategic resources, but is also strongly influenced by firms' abilities to responsively adjust their strategies to changes in the external environment. From a practical perspective, these findings provide important implications for MSMEs to not only adopt environmentally friendly innovation practices, but also to integrate them with adaptive flexibility in managerial decision-making processes, thereby enhancing business performance in a sustainable manner and in alignment with the sustainable development agenda.

As a further implication, future research is encouraged to extend the analytical model by incorporating external variables, such as regulatory support, digital technology development, or cross-country contexts, in order to deepen understanding of the dynamics of green innovation in MSMEs. For policymakers and business practitioners, these findings underscore the importance of collaboration in providing incentives, capacity building, and the development of a supportive innovation ecosystem, so that MSMEs are not only able to survive, but also to play an active role in promoting inclusive and sustainable economic growth.

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