Eco-Innovation and Enterprise Environmental Performance. Evidence From Manufacturing Small and Medium Enterprises in Kenya

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ABSTRACT

Purpose: The main aim of the paper to determine Eco-Innovation and Enterprise Environmental Performance. Evidence From manufacturing small and medium enterprises in Kenya

Material/methodologies: The study sample consisted of 395 small and medium manufacturing enterprises (SMEs) selected from a target population of 31,392 registered SMEs in Nairobi County, Kenya. A structured questionnaire was distributed to the owners and managers of these enterprises, utilizing a stratified random sampling technique.

Findings: The analysis results indicate that eco-product innovation had a statistically significant positive effect on environmental performance. However, there was an unexpected negative effect of eco-process innovation on environmental performance.

Conclusions: Eco-product innovation practices lead to reduced energy consumption, further enhancing environmental performance. However, while eco-process innovations aim to enhance sustainability, they may inadvertently introduce challenges that temporarily impact environmental performance**.**

Implication: Implementing eco-innovation practices in manufacturing SMEs offers significant environmental and economic advantages. This involves adopting energy-efficient technologies, maintaining equipment for optimal performance, and exploring renewable energy sources to reduce reliance on fossil fuels. To address any negative impacts of eco-process innovations, thorough employee ecopreneurship training and supportive education programs are essential.

Keywords: Small And Medium Manufacturing Enterprises, Eco-process innovation , Eco-product innovation , Environmental Performance

Highlights:

- Eco-product innovation positively influences environmental performance in small and medium manufacturing firms, consistent with prior research.
- Unexpectedly, eco-process innovation shows a complex relationship with environmental performance, warranting further investigation.

- These findings highlight ongoing management concerns regarding eco-innovation and sustainable business performance among SMEs.

1. Introduction

Ecopreneurial performance is crucial due to the pressing environmental challenges facing the world today. Traditional entrepreneurial ventures focused solely on profits are inadequate to address the sustainability issues like climate change, pollution, and biodiversity loss caused by human economic activities. Ecopreneurship, which integrates ecological innovation, opportunity, and commitment, offers a pathway to a more sustainable economy (Dhahri et al., 2021). Scholars argue that ecopreneurs, or environment-conscious entrepreneurs, strive for eco-efficiency by producing goods and services that minimize resource use and negative environmental impacts (Gupta & Dharwal, 2022; Soomro et al., 2020). This approach not only enhances environmental sustainability but also improves business performance. The need for such green entrepreneurship is underscored by the diminishing capacity of critical ecosystems and the negative impacts of business activities on the environment. Therefore, ecopreneurial ventures play a key role in driving the necessary systemic and comprehensive transformations towards a greener and more sustainable future.

Enterprise investment in improving environmental performance is a key driver of sustainable economic development, with significant contributions from government initiatives. Investigating the factors that influence enterprise environmental performance is an important area within environmental economics, especially as interest in the environmental behaviors of microenterprises grows (Zhang et al., 2020; Wen and Lee, 2020). In this context, ecopreneurship has emerged as a new dimension of entrepreneurship, merging business activities with environmentalism to promote an ecological society (Bawakyillenuo & Agbelie, 2021). Since the United Nations ratified the Sustainable Development Goals (SDGs) in 2015, these goals have become the primary global framework for achieving sustainable prosperity. Entrepreneurial activities are increasingly seen as potential solutions to environmental and social issues (Dhahri et al., 2021). Ecopreneurship, which combines traditional entrepreneurial characteristics with social and environmental innovation, is closely aligned with sustainable development goals, extending business benefits to meet environmental and societal needs (Alwakid et al., 2021; Gupta & Dharwal, 2022; Soomro et al., 2020).

Research shows that ecopreneurs are adept problem solvers who leverage innovation and critical thinking to address challenges, driven by a strong motivation to implement their ideas (Bawakyillenuo & Agbelie, 2021; Dhahri et al., 2021). Given the consensus on the crucial role of entrepreneurship in job creation and national development (Audretsch et al., 2023), understanding the characteristics, behaviors, and motivations of ecopreneurs is vital. This emerging field of study promises to enhance wealth and economic efficiency, particularly in developing countries (Annamdevula et al., 2023; Hoogendoorn et al., 2020). Most OECD (Organisation for Economic Co-operation and Development) countries recognize eco-innovation as a critical solution to contemporary environmental challenges such as climate change and energy security. Many nations view eco-innovation as a source of competitive advantage in the burgeoning market for environmental products and services (Yurdakul & Kazan, 2020). For companies, eco-innovation is valuable not only for reducing negative environmental impacts but also for creating a positive competitive edge. Therefore, this study aims to examine the eco-innovation behaviors of ecopreneurs and how these behaviors influence their enterprise environmental performance. Understanding these dynamics is

essential for promoting sustainable entrepreneurship and achieving broader sustainability goals.

In Kenya, SMEs represent 98% of all businesses, contributing to 30% of jobs annually according to the National Economic Survey Report by the Central Bank of Kenya (CBK) (KNBS, 2024). In 2016, SMEs contributed approximately 34% to the country's GDP (Gok et al., 2019). Recognizing their importance, Kenya has prioritized manufacturing as one of its Big Four Agenda goals (2017-2022), aiming to boost economic development by increasing the manufacturing sector's contribution from 8% to 15% by 2022 (GoK, 2018). This goal aligns with Kenya's Vision 2030, which aspires to transform Kenya into a newly industrialized, middle-income country with a clean and safe environment by 2030. However, SMEs, particularly in the manufacturing sector, are major consumers of resources and significant contributors to pollution and waste, accounting for approximately 60–70% of industrial pollution (Cheruiyot and Tarus, 2017). Given their central role in the economy and their environmental impact, SMEs are crucial targets for sustainable development strategies, including eco-innovation. The environmental challenges in Kenya could drive future ecopreneurship by presenting opportunities for eco-innovation and commitment to sustainability. Despite this potential, the impact of eco-innovation on enterprise environmental performance in this region remains empirically unexplored, representing a significant research gap. Given the growth of ecopreneurship, this study sought to answer the critical question of how to harness the innovative potential of ecopreneurs to exploit opportunities arising from environmental degradation. Specifically, it investigates how to foster the development of new entrepreneurial firms capable of creating the innovations necessary to solve environmental problems. Addressing this question is vital for promoting sustainable economic development and achieving Kenya's long-term environmental and economic goals.? This study aimed to fill this gap by examining how eco-innovation affects the environmental performance of enterprises in Kenya, thereby contributing to the promotion of sustainable development in the region.

2. Literature Review

Theoretical review

Hart’s (1995) natural-resource-based view of the firm (NRBV) theory has received substantial support in research on environmental sustainability practices, particularly regarding eco-innovation activities that enhance economic, operational, and market performance (Vachon et al., 2008). Ashby (2018) also endorsed NRBV for its reusability, which confers a competitive advantage to firms. Sustainable development is crucial as it increases market power and differentiates opportunities. This theory offers a comprehensive perspective on eco-innovation (Wang et al., 2020). Hart (1995) argued that strategy and competitive advantage are rooted in capabilities that enable environmentally sustainable economic activities. Businesses that enhance their skills to address environmental issues amid natural environmental challenges can gain a competitive edge, leading to lower production costs. In addition to pollution prevention and product stewardship capabilities, businesses should focus on adopting cleaner

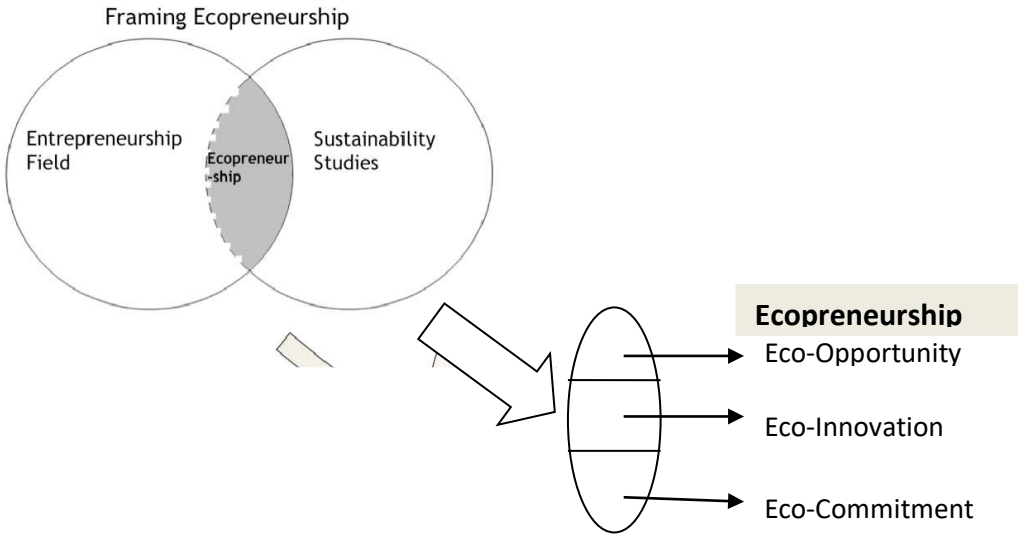
production methods. Developing or utilizing cleaner production technologies necessitates a strong eco-innovation capability (Munodawafa & Johl, 2019).

Concept of eco-innovation

The concept of eco-innovation has gained traction as a solution to environmental degradation since the 1990s (Yurdakul & Kazan, 2020). Fussler and James expanded on this concept in 1996, defining eco-innovation as reducing negative environmental impacts while offering new products and processes that benefit both customers and businesses (Hojnik & Ruzzier, 2016). Eco-innovation involves the creation, adoption, or utilization of products, processes, services, or management methods that are new to the organization and lead to reduced environmental risks and impacts throughout their life cycle compared to existing alternatives (Kemp and Foxon, 2007, as cited in Dong et al., 2014). The MEI (Measuring Eco-Innovation) project (2007) similarly defines eco-innovation as the production, assimilation, or exploitation of novel methods that decrease environmental risks and resource use impacts over their life cycle (p. 16). Eco-innovation stands out from general innovation by prioritizing environmental benefits, aiming to mitigate or resolve ecological issues through new ideas, behaviors, products, and processes developed and implemented by various societal actors, as outlined by Rennings (2000). Measuring eco-innovation's impact can involve the "factor X reduction" concept from the Wuppertal Institute, which focuses on decreasing resource use through combined technological, financial, and lifestyle changes (Kainrath, 2009). Distinguishing between integrated and end-of-pipe technologies is essential, with the former minimizing environmental impact throughout the system and the latter addressing pollution after it occurs. Halila and Hörte (2006) provide a classification system for eco-innovation based on creativity, knowledge required, scope, and environmental effect, ranging from minor product updates to major system innovations and scientific breakthroughs. This holistic approach ensures eco-innovations contribute significantly to sustainable development by aligning technological advancements with necessary social changes.

In Kainrath's (2009) Framing Ecopreneurship model, eco-innovation is identified as one of the three key dimensions of ecopreneurship, alongside eco-opportunity and eco-commitment, collectively termed Ecopreneurial Manifestations. These dimensions encapsulate the holistic approach of ecopreneurship in addressing environmental challenges through innovative, opportunity-driven, and committed actions.

Figure: 1. Framing Ecopreneurship



Source: Adapted from Kainrath David (2009).

Dimensions of eco- innovation

Eco-innovation encompasses various dimensions, as explored by different researchers. Horbach et al. (2012) focused on eco-product and eco-process innovation subcategories, while Cheng and Shiu (2012), Cheng et al. (2014), and Rennings et al. (2006) expanded this perspective to include eco-organizational innovation. In line with the Oslo Manual (2005) by the OECD and European Commission, these scholars evaluated eco-innovation as comprising eco-product and eco-process dimensions. Eco-product innovation involves significantly improving new or existing products or services to reduce environmental impacts, as highlighted by Rashid et al. (2014). On the other hand, eco-process innovation entails the development and implementation of innovative methods, techniques, or procedures within production processes to mitigate environmental impact while enhancing operational efficiency (Mat Dahan & Yusof, 2020). Eco-product innovation aims to reduce environmental impacts (Cheng et al., 2014), improve environmental performance, meet the market's environmental expectations, and increase resource efficiency whilst achieving optimal environmental benefits in the whole product life cycle (Dong, et al., 2014). Eco-process innovation, which requires a change in business processes and systems (Cheng et al., 2014),, increases productivity, reduces greenhouse gas emissions, and reduces resource costs . Additionally, it replaces harmful inputs, optimizes the production process, and reduces the negative effects of production output.

Concept of Enterprise Environmental performance

enterprise environmental performance is defined as the degree of impact of enterprise behavior on the environment, that is, the effectiveness of enterprise environmental management (Liu, et al., 2021). Environmental performance measures how well businesses interact with their surroundings, including how they use and manage natural resources and

how they manage pollution. The International Organization for Standardization's Technical Committee, also known as (ISO 14000), has created international standards for environmental management and environmental performance measurement (Al-Hanakta, et al., 2023). These policies also had a global component. Multiple Environmental Agreements (MEAS) are a collection of 200 international agreements that deal with environmental issues; on the other hand, the World Bank policy established a number of guiding principles that must be followed when funding development projects by the World Bank, which collectively reflects the absence of financing for environmentally harmful projects (Dangelico, 2017).

Environmental performance, as before, is the effectiveness of environmental management in reducing pollution and protecting the environment by concentrating on sectorial environmental policies that focus on the production side using tools to measure and evaluate environmental performance through environmentally sustainable performance assessment, product life cycle assessment, and environmental auditing to determine the level of compliance. The facility for environmental laws, as well as the performance measurement model to choose the most efficient mode of production (Kristensen, et al., 2021).

Empirical Review And Hypothesis Development

Zheng & Iatridis (2022) underscored the increasing relevance of Eco-innovation as an effective strategy for mitigating corporate environmental impacts. Their findings provide compelling evidence of the positive influence eco-innovation exerts on overall firm performance. Yet, they also shed light on specific types of eco-innovation that fail to bolster this relationship, emphasizing the pivotal role of moderators in elucidating disparities noted in the literature. Madaleno et al. (2020) discovered that eco-innovations may, paradoxically, impede turnover and employment growth, an outcome unaffected by firm size. Nevertheless, the environmental advantages inherent in products, demanded by end-users, exhibit sensitivity to the enterprise's size classification. Human capital and the adoption of eco-innovation strategies both exhibit a positive correlation with firm performance, with their sensitivity to firm size becoming apparent. Larbi-Siaw et al. (2022) revealed that R&D investments in eco-innovations, coupled with innovative green management practices and staff training in eco-innovation, can enhance a firm's social performance. Johl and Toha (2021), employing random-effects GLS regression modeling, demonstrated the direct impact of proactive eco-innovation on the financial performance of Malaysian public listed energy companies between 2015 and 2019. Zulkiffli et al. (2022), through multiple regression analysis, found that most manufacturing SMEs in Klang Valley prioritize eco-management and eco-logistics innovations as critical business capabilities during the pandemic. However, amidst the pandemic-induced challenges, eco-product innovation exhibited an insignificant relationship with sustainable business performance, attributed to the observed low productivity rates. Brasil et al. (2016) suggested a positive association between business performance and eco-product innovation. Ch'ng et al. (2021) corroborated this, highlighting the significant impact of eco-management innovation on economic performance. In their study involving 245 Chinese companies, Dong et al. (2014) concluded that eco-organizational innovation

significantly enhances environmental performance and competitiveness by providing the necessary infrastructure for adopting an environmentally conscious perspective and implementing innovative practices. Despite extensive research on the relationship between eco-innovation and sustainability, particularly in developed economies, Larbi-Siaw et al. (2022) noted inconsistent findings in the literature, underscoring management's ongoing concerns regarding eco-innovation and sustainable business performance, particularly among small and medium enterprise. Therefore, the study hypothesized that:

Hypothesis 1 (H_1). *Eco-product innovation has significant influence on Environmental Performance of Small and medium manufacturing firms*

Hypothesis 2 (H_2). *Eco-process innovation has significant influence on Environmental Performance of Small and medium manufacturing firms*

Thus, the study developed the following theoretical framework

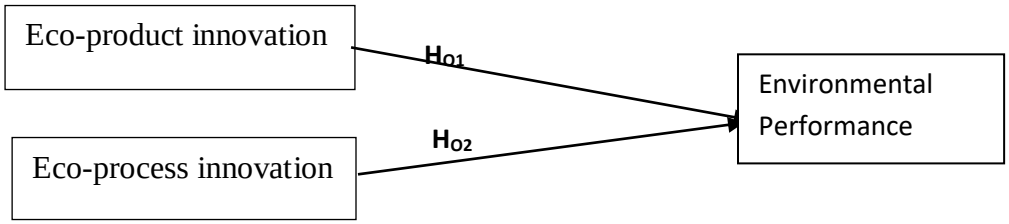


Figure 1 Conceptual Framework

3. Methods

To fulfill the research problem and purpose, this study adopted positivism research philosophy. and uses quantitative approach to test a theory about reality, develop variables to be measured, and hypothesis to be tested. Explanatory research design was preferred for this study allowing causal relationship between an independent variable(s) and one or more dependent variables and discovered causal inferences (Creswell and Creswell, 2018).

Target Population and Sampling

The population for the study constituted small and medium manufacturing enterprises in Kenya. According to the Nairobi County Government, ministry of Trade, (2021) there are a total of 31,392 registered small and medium manufacturing enterprises. Thus, the unit of observation will be owners/managers small and medium manufacturing enterprises. For this study, Slovin's formula (2018) also developed by Yamane (1967), was used to calculate the sample size of 395. For the selection of the sample, the study will adopt the stratified random sampling technique.

Data Collection

This study used a structured closed-ended questionnaire on a five-Point Likert Scale: strongly disagree (SD) 1, disagree (D) 2, undecided (U) 3, agree (A) 4 and strongly agree (SA) 5, and

used closed-ended questions to collect quantitative data from medical doctors. Face validity was applied in the early phases of designing the questionnaire. Face validity was attained when supervisors critiqued the questionnaire, experts examined the items, gave their opinions and necessary adjustments made to the items to fit their purpose. To test for criterion validity, this study borrowed items from previous studies and theories. These items were selected to align with the specific constructs being measured in the current study. CVI for the items measured in the questionnaire was 0.923. The study generated Cronbach's Alpha tables and principal component analysis to enhance the reliability of the instruments. The study considered a Cronbach's Alpha coefficient of 0.7 and above as recommended by Hair et al. (2010) that composite reliability values larger than .70 are sufficient for data collection to proceed.

Measurement of Variables study Variables

A total of three variables were investigated in this study. Eco-innovation consisting of eco product innovation and eco- process innovation conceptualized as independent variables while environment performance was conceptualized as the dependent variable.

Environmental performance was conceptualized as an exogenous latent variable measured using seven indicators he environmental performance consists of 7 items and is adapted from three sources from Paillé et al. (2014) For instance, three items like "reduced environmental impact of its products/services", "reduced purchase of non-renewable material, chemicals, and components" and "reduced waste and emission from operations and components"

Eco-product innovation was measured using seven indicators from Chen (2008), Cheng et al., (2014) and Adomako, S., & Tran, M. D. (2024). owners/managers of SMEs were asked to indicate how their firms have performed in terms of eco-product innovation practices over the past 3 years.

Eco-process innovation was measured using four indicators from Lisi, (2015). The sample items included "environmental management within our enterprise has reduced wastes, conserve water usage, and conserved energy usage

Factor analysis was used to reduce and reorganize questionnaire items by classifying them into various categories based on how strongly they are correlated with one another (Chua, 2014). Through factor analysis, the validity of the items were determined by examining specific indices that should conform to suggested values by (Hair, 2018). It is essential to eliminate inappropriate survey questions and compile connected questions into a single construct. Since all test tools were taken from the original source, this study only makes use of the load factor aspect of EFA in an effort to keep the dimensions set by the original researcher. Factor loading values less than 0.5 were disregarded in exploratory factor analysis (EFA). Findings in Table 1 showed that loadings for environmental performance (EP), eco-product innovation and eco-process innovation had loadings above 0.6; thus, the study fulfilled the criterion for individual item reliability.

Moreover, composite reliability (CR) was tested to confirm the construct reliability as well. Hair et al (2019) suggested a guideline to determine the composite reliability (CR) coefficient,

suggesting a minimum value of 0.7. The composite reliability coefficients for each construct in the study are presented in Table 4. The results indicate that the internal consistency and reliability of the constructs are adequate, as all of their composite reliability coefficients (ranging from 0.555 to 0.809) fall within the recommended range. This conclusion is supported by Zimmerman and colleagues' research from 1993

To assess convergent validity, the average variance extracted (AVE) has been employed. According to Chin's (1998) recommendation, an AVE value of 0.5 or more is considered acceptable for demonstrating the convergent validity of a variable. The findings indicate that all values of AVE (ranging from 0.707 to 0.907) exceed the recommended threshold of 0.5, as suggested by Hair, Black, and Babin (2010). Thus, the convergent validity of the specific variable is demonstrated. Table 3 also shows that the findings of the total variance explained for environmental performance = 56.664, eco-product innovation= 83.187, eco-process innovation = 80.918). Hence, these values exceed 60% and acceptable (Bahkia et al., 2019; Yahaya et al., 2018; hair).

Table 1 Reliability and Validity of Measurement of Variables

		loadings	CVA	reliability (Cronbach alpha)	CR	AVE
Environmental Performance Constructs	The enterprise has complied with environmental regulations	0.662	**56.664**	**0.736**	**0.857**	**0.601**
	The enterprise reduces its use of energy and water	0.651				
	The enterprise minimizes waste (liquid & solid) production	0.869				
	The enterprises reduces gaseous emissions	0.885				
	The enterprise uses renewable energy (wind, bio-fuels and solar etc)	0.674				
	The enterprise recycles and re-uses waste	0.819				
Eco-product innovation	Our firm emphasizes developing new eco-products with simplified packaging using new technologies.	**0.912**	**83.187**	**0.797**	**0.713**	**0.555**
	Our firm emphasizes developing new eco-products with simplified construction using new technologies.	0.939				
	Our firm emphasizes developing new eco-products with easily recyclable components using new technologies.	0.748				
	Our firm emphasizes developing new eco-products with easily decomposable materials using new technologies.	0.828				
	Our firm emphasizes developing new eco-products using natural materials through new technologies.	0.789				
	Our firm emphasizes developing new eco-products to minimize waste damage through new technologies.	0.912				
	Our firm emphasizes developing new eco-products to use minimal energy through new technologies	0.847				
Eco-process innovation	Our firm often innovatively updates manufacturing processes to protect against contaminations.	**0.895**	**80.918**	**0.820**	**0.944**	**0.809**
	Our firm often innovatively updates manufacturing processes to meet standards of environmental law.	0.686				
	Our firm often uses innovative technologies in manufacturing processes to save energy.	0.826				
	Our firm often innovatively updates manufacturing equipment in manufacturing processes to save energy	0.645				

4. Findings

Descriptive statistics

The descriptive statistics for Environmental Performance, Eco Product Innovation, and Eco Process Innovation, based on a sample of 328 participants, reveal generally positive perceptions. SMEs had moderate environmental performance (M = 3.742, SD = 0.585). Eco Product Innovation was moderately perceived among SMEs (M = 3.580, SD = 0.744), indicating positive perceptions but greater variability in opinions regarding eco-friendly product innovation. Eco Process Innovation also had moderate ratings (M = 3.617, SD = 0.719), reflecting similarly positive but varied perceptions regarding innovative processes related to environmental sustainability. Overall, the results indicate strong positive perceptions of environmental and eco-innovation practices, though with some diversity in experiences and opinions among the participants. This underscores the need for continued emphasis on improving these practices to maintain and enhance favorable perceptions and effectiveness within organization

Table 2 Descriptive Statistics

n=328	Min	Max	Mean	Std. Deviation	Skewness	Kurtosis
Environmental Performance	2.360	5.000	3.742	0.585	-0.527	-0.351
Eco product innovation	1.710	4.860	3.580	0.744	-0.297	-0.672
Eco process innovation	1.710	4.860	3.617	0.719	-0.601	-0.304

Assessment of the Measurement Model

To determine measurement model validation, Confirmatory factor analysis (CFA) was utilized. An elaborated test of the multilevel data structure called Multilevel factor analysis was used, following Dyer et al.'s research in 2005. Confirmatory factor analysis (CFA) Table 3 displayed good fit indices between the data and the hypothesized model of four factors. All fit indices were applied in the model, with the fit indices exceeding the threshold values of 0.9, such as TLI = 0.940, CFI = 0.956, and IFI = 0.957 (Tabachnick and Fidell, 2013). The values of the model fit, X2/df = 111.956/57 = 1.654, were minimum tolerable values of under 2 (Carmines and McIver, 1981). The values of error estimations were also within the required range, with RMSEA = 0.070

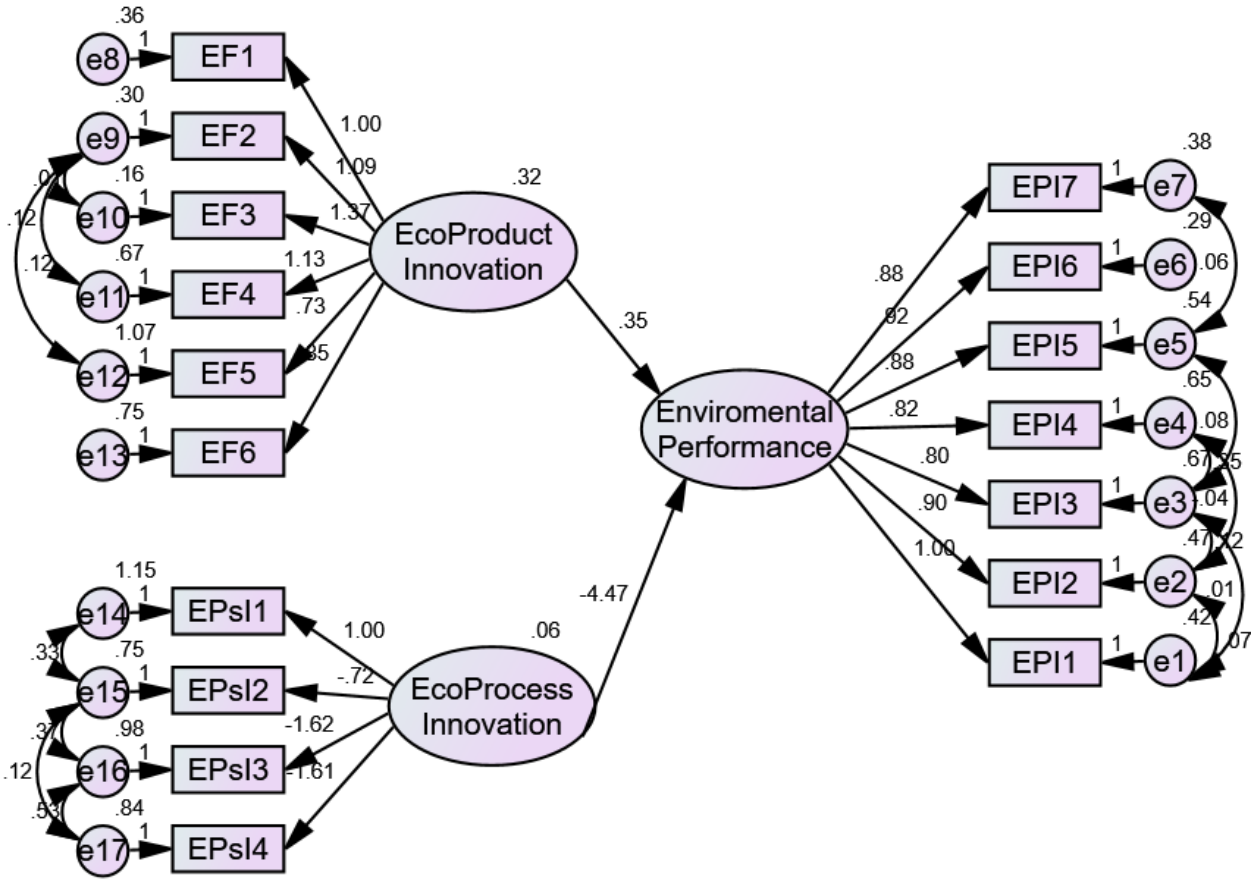
Table 3 Summary of Final CFA Measurement Model

Fit Indices	(CFA) Measurement Model fit results
$\chi 2$(df)	111.956 (57), p=.000
CMIN/df	1.654
IFI	.957
TLI	.940
CFI	.956
GFI	.920
NFI	.915
RFI	.884
PNFI	.669
RMSEA	.070

SEM Results

The research used structural equation modelling (SEM) to analyse the data. According to the goodness-of-fit statistics in figure 1, the overall model achieved a good fit with three first-order constructs based on the observed data as shown by root mean square error of approximation (RMSEA) of 0.048. It is important to note that the root mean square error of approximation (RMSEA) value is a useful indicator of the model fit. If the RMSEA value is less than 0.05, it indicates a good fit (Hidrus, Kueh, and Kuan, 2020). The model showed a GFI value of 0.943 showing that the model achieved a good fit. To demonstrate a good fit, the comparative fit index (CFI) value should be greater than 0.90. The CFI value of .981 obtained in this study confirms that the model achieved a good fit. The model is considered a good fit, based on the chi-square measure, which is an absolute fit measure, and the estimated ratio (CMIN/DF) of 1.447, as reported by Hair et al. (2006). Overall, the goodness-of-fit indices and other estimated parameters suggest that the model fits the data fairly well.

The analysis results indicate that Hypothesis 1, which posited a positive relationship between eco-product innovation and Environmental Performance, was accepted. The estimate coefficient of 0.354 ($p < 0.001$) provides strong evidence to support the hypothesis, suggesting that eco-product innovation significantly influences Environmental Performance in small and medium manufacturing firms. Conversely, Hypothesis 2, which proposed a positive relationship between eco-process innovation and Environmental Performance, failed to be rejected. The estimate coefficient of -4.472 ($p < 0.001$) presents an unexpected negative relationship between eco-process innovation and environmental performance.



χ2(df) 78.128 (54), p=.018, CMIN/df = 1.447, GFI=.943, NFI= .941, RFI= .915, IFI=.981, TLI= .972, CFI= .981, PNFI = .651, RMSEA= .048

Figure 1 SEM Model Results

Table 4 Regression Weights

			Estimate	S.E.	C.R.	P	Label
Environmental Performance	<---	Eco Product Innovation	.354	.107	3.295	***	
Environmental Performance	<---	Eco Process Innovation	-4.472	1.149	-3.893	***	

5. Discussion

The findings of Hypothesis 1 conform to a positive relationship between eco-product innovation and environmental performance, suggesting that higher levels of eco-product innovation contribute to improved environmental outcomes for small and medium manufacturing firms. This aligns with Zheng & Iatridis's (2022) emphasis on the increasing significance of eco-innovation in mitigating corporate environmental impacts, consistent with earlier research demonstrating its beneficial effect on overall firm performance. However, their study highlights certain types of eco-innovation that do not reinforce this connection, indicating the influence of various moderating factors. Madaleno et al. (2020) uncover a paradoxical effect of eco-innovations on turnover and employment growth, irrespective of firm size, while also recognizing the sensitivity to firm size concerning the environmental benefits derived from products. Additionally, Larbi-Siaw et al. (2022) illustrate how R&D investments in eco-innovations, combined with innovative green management practices and staff training, conform to previous findings, indicating improvements in a firm's social performance. Similarly, Johl and Toha's (2021) findings support the direct impact of proactive eco-innovation on the financial performance of Malaysian energy companies, consistent with earlier research. Furthermore, Zulkiffli et al. (2022) shed light on the prioritization of eco-innovation among manufacturing SMEs during the pandemic, aligning with previous research trends.

In contrast, Hypothesis 2 reveals an unexpected positive association between eco-process innovation and environmental performance, which warrants further investigation into this complex relationship. This contradicts previous studies like Brasil et al. (2016) and Ch'ng et al. (2021), which suggested a positive correlation between business performance and eco-product innovation. The literature, as observed by Larbi-Siaw et al. (2022), presents inconsistent findings, indicating ongoing management concerns regarding eco-innovation and sustainable business performance, particularly among small and medium enterprises.

6. Conclusions

In conclusion, eco-product innovation practices, such as developing new eco-products with simplified packaging and construction using advanced technologies, incorporating easily recyclable and decomposable materials, as well as utilizing natural materials through innovative technologies, have a demonstrably positive effect on SME environmental performance. These practices contribute to waste reduction, energy and water conservation, and the reduction of gaseous emissions. Furthermore, enterprises can enhance their environmental performance by recycling and reusing waste materials. Moreover, SMEs can improve their environmental performance by developing new eco-products to minimize waste damage through innovative technologies. Additionally, placing significant importance on using minimal energy in product development processes leads to reduced energy consumption, further enhancing environmental performance.

However, eco-process innovation, such as updating manufacturing processes to protect against contamination, meeting environmental law standards, using innovative technologies to save energy, and upgrading manufacturing equipment for better energy efficiency, can unexpectedly

reduce environmental performance. This counterintuitive outcome may be due to several factors, such as the initial resource and energy investments required for implementing new technologies, the complexity of integrating innovative processes into existing systems, and potential disruptions during the transition period. Therefore, while eco-process innovations aim to enhance sustainability, they may inadvertently introduce challenges that temporarily impact environmental performance.

7. Implications

Implementing sustainable practices in manufacturing SMEs can yield numerous environmental and economic benefits. One effective managerial practice is adopting lean manufacturing principles to reduce waste and improve efficiency. By streamlining processes and minimizing resource use, SMEs can lower production costs while simultaneously reducing their environmental footprint. Additionally, investing in renewable energy sources such as solar or wind power can help SMEs reduce their reliance on fossil fuels, decrease energy costs, and lower greenhouse gas emissions. Another beneficial practice is incorporating eco-friendly materials and technologies in the manufacturing process, such as using recycled materials or energy-efficient equipment. This not only demonstrates a commitment to sustainability but also attracts environmentally conscious consumers and enhances the company's reputation. Furthermore, implementing sustainable supply chain management practices, such as sourcing materials locally or choosing suppliers with strong environmental credentials, can further enhance the environmental and social sustainability of manufacturing SMEs while reducing risks associated with supply chain disruptions. Overall, integrating sustainable practices into managerial decision-making can position manufacturing SMEs for long-term success while contributing to a more sustainable future.

To mitigate the negative effects of eco-process innovations, managers should ensure thorough training for employees to properly utilize new technologies and integrate them smoothly into existing workflows. Establishing a monitoring and evaluation system to track the performance of these innovations can help identify issues early and adjust strategies accordingly. A phased implementation approach, gradually integrating new technologies and processes, allows for adjustment and optimization, reducing potential disruptions. Prioritizing energy conservation in manufacturing processes is also essential. This involves using energy-efficient technologies, maintaining equipment for optimal performance, and exploring renewable energy sources to reduce dependency on fossil fuels, achieving long-term environmental and economic benefits.

The findings underscore significant implications for ecopreneurship initiatives. Policies should be tailored to foster an ecosystem conducive to the growth and development of eco-entrepreneurs. Governments can incentivize ecopreneurial ventures by offering tax breaks, subsidies, or grants specifically geared towards eco-innovation and sustainable practices. Moreover, eco-entrepreneurs should be supported through mentorship programs, access to funding, and networking opportunities with like-minded individuals and organizations. By nurturing the ecopreneurial spirit and innovation, policymakers can cultivate a vibrant ecosystem where eco-entrepreneurs thrive, driving positive environmental change and contributing to sustainable economic development. Establishing clear regulations and standards for environmental performance can guide SMEs in their sustainability efforts by setting achievable

targets for waste reduction, energy efficiency, and emissions control. Additionally, funding and supporting education and training programs can empower SME owners and employees with the knowledge needed to effectively implement and benefit from eco-product and eco-process innovations, accelerating the adoption of sustainable practices across the sect.

8. Further Research Recommendations

The study focused solely on SMEs in the manufacturing sector, suggesting avenues for future research in other industries. Moreover, the limited number of items used to measure eco-process innovation may have influenced the negative findings, warranting further investigation in subsequent studies. Additionally, while the study examined two aspects of eco-innovation, future research could explore additional dimensions such as eco-organization and eco-marketing to provide a more comprehensive understanding.

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