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# Environmental Innovation Practices and Performance of Microenterprises in Wukari Metropolis, Taraba State, Nigeria

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***Abstract***

*Microenterprises contribute to local employment and economic activity, but resource constraints can limit their capacity to adopt environmentally sustainable practices. This study examined the effect of environmental innovation practices on the performance of microenterprises in Wukari Metropolis, Taraba State, Nigeria, focusing on environmental product innovation and environmental process innovation. The study was anchored on the Resource-Based View and adopted a cross-sectional survey design. A convenience sample of 100 microenterprise owner-managers was approached, and 96 usable questionnaires were analysed. Data were collected with a structured questionnaire using five-point Likert response options. Multiple regression analysis using SPSS version 27 showed that the model was statistically significant, $F(2, 93) = 49.336$, $p < .001$, and explained 51.5% of the variance in performance ($R^2 = .515$; adjusted $R^2 = .504$). Environmental product innovation was positively associated with performance ($B = .512$, $SE = .077$, $\beta = .562$, $t = 6.659$, $p < .001$), as was environmental process innovation ($B = .262$, $SE = .091$, $\beta = .242$, $t = 2.866$, $p = .005$). The findings indicate positive associations in the analysed sample; the cross-sectional convenience-sampling design does not establish causality or support broad population generalisation. The study recommends practical, affordable product and process improvements and targeted institutional support for microenterprises.*

***Keywords:*** *Environmental Innovation, Environmental Product Innovation, Environmental Process Innovation, Microenterprise Performance.*

## Introduction

Microenterprises are important contributors to employment, household livelihoods and local economic activity. Their small scale often allows them to respond flexibly to customer needs, although limited finance, technical knowledge and infrastructure can constrain investment in new practices. At the same time, businesses face increasing expectations to reduce waste, use resources efficiently and limit the environmental effects of their products and operations. Environmental innovation provides one possible response by introducing or improving products and processes in ways that reduce environmental burdens while supporting business objectives (Rodrigues & Franco, 2023).

The relationship between environmental innovation and firm performance can be understood through the Natural Resource-Based View (NRBV). Hart (1995) argued that capabilities for pollution prevention, product stewardship and sustainable development can become sources of competitive advantage. Hart and Dowell (2011) subsequently revisited and developed this perspective. For microenterprises, relevant practices may include using recyclable or less

harmful materials, improving packaging, reducing production waste and conserving energy. Such practices may lower operating costs or help a business respond to customer preferences, although the benefits can vary by industry, resource availability and institutional context (Hojnik et al., 2022).

The performance implications of environmental innovation should therefore be examined rather than assumed. Product-oriented and process-oriented changes may have different costs and benefits, and evidence from larger firms or other geographical settings may not fully represent microenterprises in Wukari Metropolis. This study addresses that context-specific question by examining the association of environmental product innovation and environmental process innovation with microenterprise performance in Wukari Metropolis, Taraba State, Nigeria.

**Statement of the Problem**

Microenterprises must maintain business performance while operating under financial, technological and infrastructural constraints. Environmental product innovation, such as selecting less harmful or reusable materials and improving product packaging, and environmental process innovation, such as reducing waste and conserving energy, may help firms respond to environmental concerns. However, the initial cost of materials or equipment, limited technical capacity and uncertainty about customer demand may discourage adoption. Consequently, owner-managers may be uncertain whether these practices are associated with better financial, operational and market outcomes in their businesses.

Nigerian studies report mixed findings on the relationship between green innovation and business outcomes. Achaku et al. (2022), using survey evidence from six states and the Federal Capital Territory, reported that green entrepreneurial innovation was associated with competitive advantage. Ibrahim et al. (2024), in a study of 220 SMEs in Kano State, reported that green product and process innovation did not have significant effects on SME performance, whereas green management innovation had a positive significant effect. Ajani et al. (2026) reported that process and management innovation were positively associated with sustainable performance among MSMEs in Lagos State, while product innovation was not significant. These findings suggest that outcomes may differ according to the innovation dimension and study context.

Although these Nigerian studies provide useful evidence, they focus on SMEs or MSMEs and on locations such as the North-Central zone, Kano State and Lagos State. Their findings cannot automatically be generalised to microenterprises in Wukari Metropolis. The specific empirical gap addressed here is the limited context-specific evidence on the separate associations of environmental product innovation and environmental process innovation with microenterprise performance in Wukari. The practical problem is that owner-managers and business-support agencies have limited local evidence on which to base decisions about adopting and supporting these practices.

Against this background, the study examines environmental product innovation and environmental process innovation in relation to the performance of microenterprises in Wukari Metropolis, Taraba State, Nigeria. It does not presume that innovation causes improved performance; rather, it tests whether the measured innovation dimensions are statistically associated with performance in the surveyed businesses.

**Research Objectives**

The broad objective of this study is to examine the association between environmental innovation practices and the performance of microenterprises in Wukari Metropolis. Specifically, the study seeks to:

i. Examine the effect of environmental product innovation on performance of microenterprises in Wukari Metropolis.
ii. Examine the effect of environmental process innovation on performance of microenterprises in Wukari Metropolis.

**Research Questions**

i. What effect does environmental product innovation has on performance of microenterprises in Wukari Metropolis?
ii. What effect does environmental process innovation has on the performance of microenterprises in Wukari Metropolis?

**Research Hypotheses**

$H0_1$: Environmental product innovation is not significantly associated with the performance of microenterprises in Wukari Metropolis.

$H0_2$: Environmental process innovation is not significantly associated with the performance of microenterprises in Wukari Metropolis.

**Significance of the Study**

The findings may assist microenterprise owners and managers in considering whether practical environmental product and process improvements are associated with business performance. Business-support organisations may use the findings to inform training and advisory services on resource efficiency, waste reduction and product or packaging choices. Policymakers and relevant government agencies may also find the results useful when considering support measures for small businesses. These implications should be interpreted in light of the study's cross-sectional design and convenience sample.

Academically, the study provides context-specific evidence on environmental product innovation, environmental process innovation and microenterprise performance in Wukari Metropolis. It applies the Resource-Based View to a microenterprise setting and contributes local evidence to a literature that often examines SMEs and larger firms. The study does not claim to extend or validate the theory beyond the evidence generated by this sample.

**Literature Review**

**Environmental Innovation Practices**

Environmental innovation refers to the introduction or implementation of products, processes or organisational practices that reduce environmental burdens compared with relevant alternatives. The terms environmental innovation,

eco-innovation and green innovation overlap in the literature, and are sometimes used interchangeably when the innovation is intended to produce an environmental benefit. However, they are not necessarily identical in scope: eco-innovation and green innovation may also include organisational and marketing changes, while this study operationalises environmental innovation through two specific dimensions—environmental product innovation and environmental process innovation. General product or process innovation is broader and is not automatically environmental unless it incorporates an environmental improvement (Klewitz & Hansen, 2014; OECD/Eurostat, 2018).

**Environmental Product Innovation**

Environmental product innovation concerns the introduction of a new or significantly improved product or service, or a change to an existing product's materials, components, design or packaging that reduces its environmental impact. Examples include the use of recyclable or reusable materials, reduced material intensity, longer product life and design that facilitates reuse or recycling. The Oslo Manual treats product innovation as a new or improved good or service that differs significantly from the firm's previous products (OECD/Eurostat, 2018). In this study, the environmental criterion distinguishes the construct from general product innovation.

**Environmental Process Innovation**

Environmental process innovation refers to the introduction or significant improvement of production, delivery or business processes in ways that reduce material use, energy consumption, waste or pollution. Examples include improving production methods, reusing materials, reducing avoidable waste and conserving energy. Process innovation concerns how a product or service is produced or delivered; it is classified as environmental in this study only where the change is intended to reduce environmental impact (OECD/Eurostat, 2018). Such changes may also be associated with lower operating costs and more efficient resource use, although the magnitude of any benefit depends on the business context.

**Performance of Microenterprises**

Microenterprise performance is treated in this study as a multidimensional business outcome. The conceptual discussion recognises financial performance, operational performance and market performance as relevant dimensions. Financial performance concerns outcomes such as profitability, revenue and sales growth; operational performance concerns the efficiency of day-to-day activities and resource use; and market performance concerns customer attraction, market position and responsiveness to customer needs. The empirical instrument and analysis use an overall microenterprise performance measure. The item-level scale and aggregation procedure should be reported transparently in the final manuscript; the present manuscript does not provide the individual questionnaire items or the precise aggregation formula.

Accordingly, the study's performance construct is discussed in terms of financial, operational and market outcomes. Environmental or social sustainability outcomes are not treated as separate dependent-variable dimensions in the reported

regression model. The distinction is important because the dependent variable analysed is microenterprise performance (PME), not a separately measured sustainability-performance index.

## Theoretical Review

### Resource-Based View (RBV)

This study is anchored on the Natural Resource-Based View (NRBV), rather than the broader Resource-Based View alone. The Resource-Based View has roots in Penrose's (1959) account of firm growth and explains how firm-specific resources and capabilities may support competitive advantage (Wernerfelt, 1984; Barney, 1991). Hart (1995) developed the NRBV by incorporating the natural environment into the analysis of strategy and competitive advantage. The framework identifies pollution prevention, product stewardship and sustainable development as strategic capabilities through which firms may respond to environmental challenges. Hart and Dowell (2011) revisited the framework and discussed its subsequent development.

## Empirical Review

### Environmental Innovation and Performance of Small Enterprises

Several empirical studies have examined the link between environmental or green innovation and the performance or sustainability of small enterprises. Khasanova, et al., (2024) investigated the impact of environmental innovation on the sustainable development of small enterprises using a qualitative research approach. The results of the study showed that eco-innovation practices like reducing waste, using cleaner technologies and making resource-efficient processes have a positive impact on the environment and also lead to increased operational efficiency in small companies. The research, however, even though it established the strategic importance of eco-innovation, was not very strong empirically due to the lack of clear sampling procedures and data-collection methods which in turn pointed to the necessity of more open and mixed-method designs in future studies.

In a like manner, Lutfi et al. (2023) did quantitative research on small and medium-sized enterprises in the manufacturing sector to establish the factors that influence the acceptance of green innovation as well as the impact of such an innovation on eco-performance. Using survey data from 179 firms and applying PLS-SEM analysis, the authors found that perceived benefits, managerial support and institutional pressures strongly predicted the adoption of environmental management accounting practices, which in turn significantly improved environmental performance. This research had a solid theoretical foundation and clearer empirical procedures than previous qualitative studies, yet its cross-sectional design restricted causal inference and its focus on one country limited the applicability of the findings to other contexts.

More recently, Wesarat, et al., (2024) examined the effect of green innovation on SME performance with sustainability readiness as a mediator and firm size as a moderator. Utilizing 421 SMEs data, the researchers' conclusions indicated that green product and process innovation had a positive

effect on firm performance, and sustainability readiness was a major factor in reinforcing this relationship. Additionally, the analysis revealed that firm size affected the degree of benefit that SMEs received from green innovation. Despite the fact that the researchers provided very strong statistical evidence, the use of self-reported performance measures and a single country sample imposes restrictions similar to those found in many studies of SMEs

Taken together, the reviewed studies suggest that environmental innovation may be associated with improved firm and environmental outcomes, but the strength and nature of the association vary by innovation type, firm characteristics and context. Much of the evidence concerns SMEs rather than microenterprises, and several studies use cross-sectional, self-reported data. The present study therefore examines the two specified environmental innovation dimensions in the Wukari microenterprise context; this provides the basis for the two hypotheses.

**Product Innovation and Performance of Micro Enterprises**

Alvarez Jaramillo et al. (2019) discussed the potential performance benefits of eco-innovation among businesses, including opportunities to differentiate products and reach customers who value environmental attributes. Ni Wayan and Ni Putu (2022) examined whether green innovation improves SME performance and reported a positive relationship between green innovation and business performance. However, the author names and full bibliographic identity of the latter study require verification against the original publication before submission. The evidence is also based on SMEs and should not be assumed to represent microenterprises in Wukari.

Zhang (2023a) examined eco-efficiency and environmental and sustainable energy innovation in relation to business performance among European SMEs. The study reported that resource-efficient and environmentally oriented energy practices were associated with better business outcomes. Because the study concerns European SMEs and energy-related practices, its findings provide contextual background rather than direct evidence about product innovation among Wukari microenterprises.

Zhang (2023b) is cited in the source manuscript as a meta-analysis of eco-innovation and SME sustainable performance. The manuscript reports that the analysis covered almost 100 studies and more than 130,000 SMEs. These precise coverage figures and the publication's bibliographic details have not been independently confirmed from the materials supplied and should be checked against the original article before publication. Subject to that verification, the cited review is relevant because it considers several forms of eco-innovation rather than environmental product innovation alone.

**Process Innovation and Performance Micro Enterprises**

For small firms, process improvements such as reducing energy use, minimising waste and improving material efficiency may be associated with lower operating costs. Revell and Blackburn

(2007) examined the business case for sustainability among small UK firms and discussed the potential commercial implications of environmental practices. Such evidence is relevant to the resource-efficiency rationale for environmental process innovation, although it is not direct evidence from Nigerian microenterprises.

Do Thi (2024) examined several forms of innovation, including process and product innovation, in relation to the performance of 488 Vietnamese SMEs. The study used regression analysis and reported that process innovation was an important correlate of business performance. The findings suggest that improvements in production methods and operational efficiency may be relevant to SME competitiveness. However, the cross-sectional survey and SME setting limit direct generalisation to microenterprises in Wukari.

Iherobiem and Sanusi (2023) examined process innovation and organisational performance in Nigerian manufacturing firms using questionnaire responses from 340 employees. The study reported a positive relationship between process innovation and organisational performance. The manuscript's original claims of a 10–20% increase in efficiency and a 10% improvement in competitive position are not retained because the precise statistics require confirmation from the original source. Moreover, evidence from large manufacturing firms may not reflect the operating conditions of microenterprises.

**Methodology**

The study adopted a cross-sectional survey design with an associational explanatory purpose. Data were collected from microenterprise owner-managers at one point in time using a structured questionnaire; the study variables were not manipulated. The design permits examination of statistical associations between environmental product innovation, environmental process innovation and microenterprise performance, but it does not establish temporal order or causality. The target population comprised microenterprises operating in Wukari Metropolis, Taraba State, Nigeria, including businesses engaged in trading, agro-processing, services, artisanship and other small-scale economic activities. Both registered and informal businesses were included in the fieldwork.

However, the number of employees was not recorded for the participating businesses, and asset information was obtained for only some businesses. Consequently, the researcher cannot claim that every participating business was individually verified against both elements of the national microenterprise classification. The businesses were treated as microenterprises on the basis of the field identification used during data collection, but this limitation should be recognised when interpreting the study. A comprehensive, current register or sampling frame showing the total number of eligible microenterprises specifically within Wukari Metropolis was not available to the researcher. The exact population size therefore was not be established, and no population-based sample-size formula or probability-sampling claim is made. Instead, 100 accessible businesses were identified and

approached using non-probability convenience sampling. Accessibility and willingness to participate guided their selection.

Data were collected using a structured questionnaire with five-point Likert-type response options. The instrument covered environmental product innovation, environmental process innovation and microenterprise performance. The reported Cronbach's alpha coefficients were .78, .71 and .74, respectively, indicating internal consistency above the commonly used .70 guideline. Data were analysed in SPSS version 27 using descriptive statistics and multiple linear regression. The analysis and reporting of regression results were guided by established quantitative-analysis texts (Hair et al., 2010; Pallant, 2017). Hypotheses were evaluated at the .05 significance level.

**Table 1: Regression Model Summary**

| Model | R | $R^2$ | Adjusted $R^2$ | Std. Error | Durbin–Watson |
|---|---|---|---|---|---|
| 1 | .717 | .515 | .504 | 2.04032 | 1.776 |

a. Note. Predictors: environmental product innovation and environmental process innovation. Dependent variable: microenterprise performance.

***Source;*** *SPSS 27, (2026)*

Table 1 indicates that the model containing environmental product innovation and environmental process innovation has R = .717, $R^2$ = .515 and adjusted $R^2$ = .504. Thus, the two predictors jointly account for 51.5% of the observed variance in microenterprise performance in the analysed sample. The remaining 48.5% is unexplained by this model; the available analysis does not identify the specific factors responsible for that remaining variance.

**Table 2: Analysis of Variance (ANOVA)**

| Source | Sum of Squares | Df | Mean Square | F | p |
|---|---|---|---|---|---|
| Regression | 410.757 | 2 | 205.379 | 49.336 | < .001 |
| Residual | 387.149 | 93 | 4.163 | | |
| Total | 797.906 | 95 | | | |

Note. Dependent variable: microenterprise performance. Predictors: environmental product innovation and environmental process innovation.

***Source****: SPSS 27, (2026)*

The ANOVA results show that the regression model is statistically significant, $F(2, 93) = 49.336$, $p < .001$. This indicates that the set of predictors is statistically associated with microenterprise performance in the

analysed sample. Statistical significance does not, by itself, establish causality or demonstrate that the model will generalise to all microenterprises in Wukari.

**Table 3: Multiple Regression Coefficients and Hypothesis Decisions**

| Hypothesis | B | SE | β | t | p | 95% CI for B | Decision |
|---|---|---|---|---|---|---|---|
| $H0_1$:Environmental product innovation | .512 | .077 | .562 | 6.659 | < .001 | [.359, .665] | Reject $H0_1$ |
| $H0_2$:Environmental process innovation | .262 | .091 | .242 | 2.866 | .005 | [.081, .443] | Reject $H0_2$ |

Note. B = unstandardised coefficient; SE = standard error; β = standardised coefficient; CI = confidence interval. The confidence intervals are approximate, calculated from the reported B and SE values.

The coefficient estimates show that environmental product innovation is positively associated with microenterprise performance (B = .512, SE = .077, β = .562, t = 6.659, p < .001). Environmental process innovation is also positively associated with performance (B = .262, SE = .091, β = .242, t = 2.866, p = .005). The approximate 95% confidence intervals for the unstandardised coefficients, calculated as B ± 1.986 × SE using the residual degrees of freedom (93), are [.359, .665] for product innovation and [.081, .443] for process innovation. These intervals are approximate and should be replaced with the exact SPSS confidence intervals if the original output is available.

**Regression Assumption Tests**

The source manuscript reports a Kolmogorov–Smirnov statistic of .071 with p = .200, tolerance values of .842 and a VIF value of 1.188 for the predictors, and a Durbin–Watson statistic of 1.776. These values were interpreted as indicating no serious departure from the reported normality, multicollinearity and residual-independence checks. However, the manuscript does not provide the supporting diagnostic output or report checks for linearity and homoscedasticity. The authors should retain the stated diagnostics only if they can be confirmed from the original SPSS output. The value 1.188 is a VIF, not a tolerance value; the tolerance value reported for both predictors is .842.

**Test of Hypotheses**

The following null hypotheses were evaluated using the multiple regression coefficients. Because the study is cross-sectional and observational, the results are interpreted as associations rather than causal effects. The independent variables were environmental product innovation and environmental process innovation, while the dependent variable was microenterprise performance.

$H0_1$: Environmental product innovation is not significantly associated with the performance of microenterprises in Wukari Metropolis. The

coefficient is positive and statistically significant ($B = .512$, $SE = .077$, $\beta = .562$, $t = 6.659$, $p < .001$). Therefore, the null hypothesis is rejected. This result indicates a positive association in the analysed sample; it does not establish a causal effect.

$H0_2$: Environmental process innovation is not significantly associated with the performance of microenterprises in Wukari Metropolis. The coefficient is positive and statistically significant ($B = .262$, $SE = .091$, $\beta = .242$, $t = 2.866$, $p = .005$). Therefore, the null hypothesis is rejected. This result indicates a positive association in the analysed sample and should not be interpreted as proof of causation.

**Conclusion**

This study examined the association between environmental innovation practices and the performance of microenterprises in Wukari Metropolis, focusing on environmental product innovation and environmental process innovation. The regression results indicate that both dimensions were positively and significantly associated with performance among the 96 usable responses. The model explained 51.5% of the observed variance in performance ($R^2 = .515$), and the overall regression was statistically significant, $F(2, 93) = 49.336$, $p < .001$.

The findings suggest that environmental product and process practices may be relevant to the business performance of the surveyed microenterprises. However, the cross-sectional design, convenience sampling and absence of a verified population frame mean that the results should be interpreted cautiously. The study does not establish that the practices caused the reported performance outcomes, and the findings should not be generalised to all microenterprises in Wukari without further representative research.

**Recommendations**

First, microenterprise owner-managers should consider feasible product-related improvements, such as reducing unnecessary packaging, selecting reusable or recyclable materials where affordable, and improving the durability or reuse potential of products. These measures should be selected in line with customer requirements, product safety and the firm's financial capacity. Second, owner-managers should consider practical process improvements, including avoiding material waste, reusing suitable materials, maintaining equipment and adopting energy-saving routines. The study's findings support attention to these practices, but owners should assess their costs and benefits in their own operating conditions.

**Contribution to Knowledge**

The study's contribution is the provision of context-specific empirical evidence on the association of environmental product innovation and environmental process innovation with microenterprise performance in Wukari Metropolis, Taraba State. It applies the Natural Resource-Based View as an interpretive framework in a microenterprise setting. The study does not claim to extend the theory; rather, it adds

evidence from a local business context that is less represented in the reviewed Nigerian studies.

Practically, the results provide owner-managers and business-support stakeholders with local evidence that the two measured environmental innovation dimensions were positively associated with performance in the analysed sample. The contribution is bounded by the convenience sample, cross-sectional design and measurement information available. Future research using a verified sampling frame, probability sampling, fuller scale documentation and longitudinal or mixed-method designs could test the robustness and transferability of these findings.

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