



## GREEN INNOVATION AND ENTREPRENEURSHIP FOR SUSTAINABLE DEVELOPMENT TRANSITIONS

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### Abstract

*The growing need for sustainable development in developing economies underscores the importance of green innovation and entrepreneurship as key drivers of systemic change. This study examined the role of green innovation adoption and entrepreneurial initiatives in advancing sustainable development transitions in Imo State, Nigeria. Employing a cross-sectional survey design, data were collected from 215 managers, owners, and senior staff of green-oriented firms using a structured questionnaire titled Green Technology and Entrepreneurship for Sustainable Transitions Questionnaire (GTETSQ), validated with a reliability coefficient of 0.89. Data analysis was conducted using the Spearman Rank Order Correlation Coefficient at a 0.05 significance level. Findings revealed that green innovation adoption significantly improves sustainability outcomes by enhancing environmental performance, resource efficiency, and long-term competitiveness. Entrepreneurship was also found to play a critical role in driving sustainable transitions by promoting innovation, embedding eco-friendly business models, and transforming environmental challenges into viable business opportunities. The study concludes that green innovation and entrepreneurship are essential enablers of sustainable development in Imo State and recommends government incentives, capacity-building programs for entrepreneurs, and supportive policies to accelerate sustainability-driven innovation and foster long-term resilience.*

**Keywords:** Green Innovation, Entrepreneurship, Sustainable Development Transitions, Eco-Innovation, Competitiveness

## Introduction

In the context of a rapidly transforming global economy, green innovation and entrepreneurial initiatives have emerged as critical drivers for achieving sustainable development and long-term competitive advantage. Green innovation focuses on designing novel solutions that minimize environmental impacts, optimize resource use, and enhance resilience to climate change, while entrepreneurship facilitates the implementation and scaling of these innovations in society (Nidumolu, Prahalad, & Rangaswami, 2019). The transition to sustainable development thus requires innovators and entrepreneurs to balance economic success with environmental care, social responsibility, and overall systemic resilience.

Green innovation and entrepreneurship involve identifying and capitalizing on opportunities that simultaneously address ecological challenges and generate economic and social benefits. Researchers highlight that green innovators act as catalysts for change, introducing solutions such as renewable energy technologies, eco-efficient production processes, waste-to-resource systems, and sustainable service models (Halder, 2019; Demirel et al., 2020). Entrepreneurship in the green sector not only mitigates negative environmental impacts but also accelerates technological advancements and fosters the creation of business models consistent with circular economy principles (Kardos et al., 2019; Khan et al., 2021). These dynamics underscore the pivotal role of entrepreneurs in shaping sustainable business ecosystems and promoting long-term market competitiveness.

In Nigeria, especially in Imo State, small and medium-sized enterprises (SMEs) engaged in green innovation are playing a significant role in tackling environmental challenges such as ineffective waste management, limited access to renewable energy, and unsustainable agricultural practices. Nevertheless, the shift toward sustainability faces obstacles, including weak institutional frameworks, limited access to capital, inadequate infrastructure, and cultural resistance to adopting environmentally friendly practices (Okeke & Nwosu, 2021). Sustainable development transitions are understood as multi-faceted, long-term processes that guide societies away from resource-intensive systems toward environmentally sound, socially inclusive, and economically resilient modes of production and consumption (Geels, 2018; Smith et al., 2019).

Although sustainability has become a major global concern, there is still a notable lack of empirical studies examining how green innovation and entrepreneurship contribute to sustainable development transitions in Nigeria. Exploring this relationship is essential for understanding how entrepreneurs and green firms in Imo State can drive systemic change, enhance adaptability, and foster long-term sustainability. Consequently, this study seeks to investigate the role of green innovation and entrepreneurship in advancing sustainable development transitions, using selected green firms in Imo State as a case study.

## Statement of the Problem

Sustainability is a pressing global priority, yet many firms in developing countries like Nigeria struggle to integrate green innovation and entrepreneurial approaches into their operations. In Imo State, although some green innovation firms have emerged in renewable energy, recycling, and eco-friendly services, their impact remains limited due to financial constraints, weak policy support, and low adoption of environmentally sustainable practices. Many entrepreneurs lack the resources and institutional backing necessary to scale innovations that could drive meaningful development transitions.

This gap highlights the need to understand the extent to which green innovation and entrepreneurship contribute to sustainable development transitions. Addressing this issue will provide empirical insights to guide policies, entrepreneurial strategies, and investment decisions that enhance sustainability in Imo State and beyond.

### Objectives of the Study

The major aim of this study is to empirically investigate the role of green innovation and entrepreneurship in driving sustainable development transitions in Imo State. The specific objectives are to:

1. Assess the impact of green innovation adoption on sustainability outcomes among firms in Imo State.
2. Examine how entrepreneurship drives sustainable development transitions in Imo State.

### Research Questions

1. To what extent does green innovation adoption influence sustainability outcomes among firms in Imo State?
2. How does entrepreneurship contribute to sustainable development transitions in Imo State?

### Research Hypotheses

**H<sub>01</sub>:** Green innovation adoption does not significantly influence sustainability outcomes among firms in Imo State.

**H<sub>02</sub>:** Entrepreneurship does not significantly drive sustainable development transitions in Imo State.

## Review of Related Literature

### Conceptual Review

#### Green Innovation

Green innovation refers to the creation and implementation of new technologies, processes, or products that aim to reduce environmental damage, enhance resource efficiency, and support sustainable patterns of production and consumption. Often referred to as eco-innovation or clean technology, green innovation includes renewable energy systems, energy-efficient processes, waste-to-value technologies, sustainable materials, and pollution-control methods. Beyond technical solutions, it also involves organizational strategies, managerial practices, and institutional mechanisms that enable firms to integrate these innovations effectively into their operations and markets (Zhang & Li, 2021).

For small and medium-sized enterprises (SMEs), adopting green innovation depends on several critical factors, including access to finance, availability of skilled personnel, technical expertise, institutional support, and regulatory incentives. Policies that provide financial support, infrastructure development, and targeted research programs can accelerate the adoption of green innovations, allowing firms to achieve both environmental benefits and economic advantages (Adeoye & Ogundele, 2022). Green innovation not only helps firms comply with environmental standards but also enhances their competitiveness by opening new markets, reducing operational costs, and building reputational value.

In essence, green innovation serves as a foundation for sustainable development by linking technological progress with ecological responsibility, providing the tools and strategies necessary for firms to operate efficiently while contributing positively to societal well-being.

#### Entrepreneurship as a Driver of Sustainable Development

Entrepreneurship is the process of identifying opportunities, mobilizing resources, and creating ventures that generate economic

value. Entrepreneurs play a critical role in driving innovation, responding to market demands, and fostering economic growth. By introducing new products, services, and business models, they contribute to societal transformation and help address emerging challenges in dynamic business environments (Li, Wang, & Zhao, 2020; Zhang & Chen, 2024).

Building on this, sustainable entrepreneurship represents a specialized form of entrepreneurship that integrates environmental and social responsibility with economic objectives. Entrepreneurs in this field act as change agents, transforming environmental challenges into opportunities for innovation, new products, and services that advance sustainability. Examples include renewable energy startups, recycling and waste-to-product ventures, and eco-friendly service enterprises.

The success of sustainable entrepreneurship is highly dependent on contextual factors. In Nigeria, the growth of green ventures is shaped by the availability of institutional support, market readiness, policy frameworks, and capacity-building initiatives that encourage innovation and scalability. Entrepreneurs who can effectively navigate these conditions are better positioned to drive systemic change, embed sustainability into local economies, and foster long-term development transitions (Nwokike, 2024).

Ultimately, entrepreneurship serves not only as a mechanism for generating economic value but also as a vehicle for promoting green innovation and sustainable development. By aligning business objectives with environmental and social considerations, sustainable entrepreneurs act as catalysts for inclusive, resilient, and environmentally responsible growth.

### **Sustainable Development Transitions**

Sustainable development transitions refer to long-term systemic changes that integrate environmental, social, and economic sustainability. These transitions involve moving from traditional production and consumption patterns toward practices that support resilience, equity, and environmental stewardship (Obi & Nwokike, 2023; Smith et al., 2019).

Sustainable transitions extend beyond technology adoption to include organizational culture, leadership, stakeholder engagement, and policy alignment. Effective transitions require innovation, planning, and integration of sustainability into strategic decision-making. Successful implementation enables firms to reduce environmental impacts, improve social outcomes, and maintain competitiveness in evolving markets. In developing economies, enabling conditions such as access to green finance, research, skill development, and collaboration among stakeholders are essential to support sustainable transitions (Akinyemi & Okafor, 2021; Ikejemba & Schuur, 2020). Green innovation and entrepreneurship play a central role in driving these systemic changes by fostering adaptability, resilience, and inclusive development.

## **Theoretical Review**

The study is anchored on Triple Bottom Line Theory, Stakeholder Theory, and Innovation Diffusion Theory.

### **Triple Bottom Line Theory**

The Triple Bottom Line (TBL) Theory, introduced by Elkington (1997), expands the assessment of business performance beyond financial profits to include environmental and social dimensions. The framework emphasizes balancing three pillars: People (social responsibility), Planet (environmental protection), and Profit (economic viability). According to TBL, sustainable business practices require integrating all three aspects to achieve long-term

resilience, competitiveness, and shared value creation.

This theory is particularly relevant to the present study because it aligns directly with green entrepreneurship and innovation. Green firms in Imo State pursue business models that not only generate economic returns but also minimize environmental impact and provide social benefits, such as job creation and community development. By applying the TBL framework, the study underscores that entrepreneurship in the green sector is most impactful when it simultaneously delivers financial, environmental, and social value, thus facilitating sustainable development transitions.

### **Stakeholder Theory**

Stakeholder Theory, developed by Freeman (1984), posits that organizations operate within a network of stakeholders whose interests and needs must be considered to ensure long-term success. Unlike traditional shareholder-centric approaches, this theory emphasizes accountability, ethical responsibility, and value creation for a broad range of actors, including employees, customers, suppliers, government, investors, and local communities.

The relevance of this theory to the study lies in its focus on collaboration and engagement. Sustainable entrepreneurship requires the active involvement of multiple stakeholders. For green firms in Imo State, successful adoption and scaling of green innovations depend on supportive government policies, access to green financing from investors, acceptance of eco-friendly products by consumers, and community engagement in sustainable practices. Stakeholder Theory highlights that effective sustainable development transitions are achieved when all key actors work together to align economic, environmental, and social objectives.

### **Innovation Diffusion Theory**

Innovation Diffusion Theory (IDT), proposed by Rogers (1962), explains how new technologies, ideas, or practices are communicated and adopted within a social system over time. Adoption is influenced by characteristics such as relative advantage, compatibility with existing practices, complexity, trialability, and observability. Individuals and organizations are categorized as innovators, early adopters, early majority, late majority, and laggards, based on how quickly they embrace new innovations.

This theory is relevant to the study because it provides a framework for understanding how green innovations such as solar energy, waste recycling, and eco-efficient production processes spread among SMEs in Imo State. Entrepreneurs play a key role in the diffusion process by demonstrating the practical, economic, and social benefits of green innovations, persuading stakeholders, and facilitating wider adoption. According to IDT, sustainable development transitions are accelerated when innovations are perceived as advantageous, compatible, and supported by institutional and societal structures.

## **Empirical Review**

Mbah and Nwosu (2021) investigated the impact of green innovation adoption on operational performance and environmental sustainability among SMEs in Sub-Saharan Africa. The study employed a survey research design, collecting data from 195 SMEs engaged in renewable energy, eco-efficient production, and sustainable supply chain practices. Descriptive and regression analyses revealed that firms adopting green innovations experienced improved environmental performance, higher competitiveness, and cost efficiencies. The study concluded that access to finance and organizational support significantly enhance the successful implementation of green technologies, leading to both economic and



sustainability outcomes.

Adewumi and Oladipo (2022) examined the role of entrepreneurial activities in driving sustainable development transitions in Nigeria, with a particular focus on renewable energy ventures. Using a mixed-methods approach, the study involved interviews with 25 policymakers and surveys of 140 renewable energy firms across the South-West region. Findings showed that green entrepreneurs serve as catalysts for systemic change by creating jobs, introducing eco-friendly innovations, and promoting community awareness of sustainability practices. The study emphasized that supportive policy frameworks and stakeholder engagement are critical for scaling green innovations and fostering long-term sustainability transitions.

Nwokike (2024) examined Nigeria's transition to a green economy with a focus on the role of renewable energy and eco-innovation. The study used a mixed-methods approach, involving interviews with policymakers and surveys of 150 green technology firms across the South-East. Findings revealed that inadequate infrastructure, limited financing, and policy inconsistency hinder large-scale adoption of green technologies. However, firms that successfully implemented solar and recycling technologies reported improved profitability and stronger community acceptance. The study emphasized the need for institutional support to accelerate sustainable transitions.

Olanipekun and Adekunle (2023) explored the impact of entrepreneurial innovation on the adoption of green technologies among small and medium enterprises (SMEs) in Lagos and Ogun States. Using a quantitative research design, data were collected from 178 SME owners and analyzed with structural equation modeling. Results indicated that entrepreneurial orientation, particularly proactiveness and risk-taking, significantly influenced the adoption of renewable energy systems and eco-friendly production methods. The study recommended capacity-building and innovation-focused training for entrepreneurs to foster sustainable business practices.

Chukwu, Eze, and Umeh (2023) explored green innovation adoption and its effects on sustainable business practices among Nigerian SMEs. The study utilized a quantitative design, gathering data from 162 SME owners involved in waste recycling, renewable energy use, and sustainable service delivery. Structural equation modeling analysis indicated that firms adopting eco-innovations achieved measurable improvements in environmental stewardship, social inclusivity, and economic performance. The research highlighted the importance of market readiness, institutional incentives, and capacity-building programs in facilitating the adoption of green technologies and achieving Triple Bottom Line outcomes.

## Methods

The study employed a cross-sectional survey research design to examine the role of green innovation and entrepreneurship in driving sustainable development transitions in Imo State. The target population comprised managers, owners, and senior staff of green-oriented firms in the state, including enterprises engaged in renewable energy, waste recycling, eco-friendly production, and sustainable agricultural practices. A purposive sampling technique was adopted to select participants who were directly involved in decision-making, sustainability initiatives, and entrepreneurial activities, as they were considered most relevant to the study objectives. A total of 230 respondents were selected from green firms operating within Imo State. Data were collected using a structured questionnaire titled Green Technology and

Entrepreneurship for Sustainable Transitions Questionnaire (GTETSQ). The instrument employed a modified four-point Likert scale with the following response options: Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. The questionnaire was validated by two experts in entrepreneurship and sustainability studies to ensure content validity, while its reliability was tested using Cronbach's Alpha, yielding a coefficient of 0.89, indicating high internal consistency. Out of the 230 questionnaires administered, 215 (93.5%) were successfully retrieved and used for analysis. Data were analyzed using the Spearman Rank Order Correlation Coefficient ( $r$ ) to test the hypotheses in a bivariate format, with the aid of SPSS Version 23, at a 0.05 level of significance.

## Results

**Ho1:** Green innovation adoption does not significantly influence sustainability outcomes among firms in Imo State.

**Table 1:** Correlation between Green Innovation Adoption and Sustainability Outcomes

| Variables                 | N   | Correlation Coefficient ( $r$ ) | Sig. (2-tailed) |
|---------------------------|-----|---------------------------------|-----------------|
| Green Innovation Adoption | 215 | 1.000                           | —               |
| Sustainability Outcomes   | 215 | 0.748**                         | 0.000           |

Correlation is significant at 0.05 level (2-tailed).

**Source:** Researchers' Data, 2026.

Table 1 shows a correlation coefficient ( $r$ ) of 0.748 with a significance value of 0.000, which is less than the 0.05 alpha level. Since the significance value is below 0.05, the null hypothesis (Ho1), which states that green innovation adoption does not significantly influence sustainability outcomes among firms in Imo State, is rejected. Therefore, the alternative hypothesis is accepted. This indicates that green innovation adoption significantly enhances sustainability outcomes, including improved environmental performance, resource efficiency, and long-term competitiveness of firms in Imo State.

**Ho2:** Entrepreneurship does not significantly drive sustainable development transitions in Imo State.

**Table 2:** Correlation between Entrepreneurship and Sustainable Development Transitions

| Variables               | N   | Correlation Coefficient ( $r$ ) | Sig. (2-tailed) |
|-------------------------|-----|---------------------------------|-----------------|
| Entrepreneurship        | 215 | 1.000                           | —               |
| Sustainable Transitions | 215 | 0.772**                         | 0.000           |

Correlation is significant at 0.05 level (2-tailed).

**Source:** Researchers' Data, 2026.

Table 2 shows a correlation coefficient ( $r$ ) of 0.772 with a significance value of 0.000, which is less than the 0.05 alpha level. Since the significance value is below 0.05, the null hypothesis (Ho2), which states that entrepreneurship does not significantly drive sustainable development transitions in Imo State, is rejected. Therefore, the alternative hypothesis is accepted. This indicates that entrepreneurship plays a critical role in driving sustainable development transitions by promoting innovation, supporting eco-friendly business practices, and advancing the shift toward a green economy in Imo State.

## Discussion of Findings

The findings of this study revealed that green innovation adoption significantly influences sustainability outcomes among green firms in Imo State. Firms that integrate renewable energy systems, waste-to-value practices, and energy-efficient production methods experience measurable improvements in environmental stewardship, cost efficiency, and market competitiveness. This outcome aligns with the study by Mbah and Nwosu (2021), who found that SMEs in Sub-Saharan Africa adopting green innovations demonstrated enhanced operational performance, reduced environmental impacts, and higher competitive advantage. The study also emphasized that access to finance and organizational support significantly facilitate the successful implementation of green technologies, resulting in both economic and sustainability benefits. Similarly, Chukwu, Eze, and Umeh (2023) highlighted that the adoption of eco-innovations among Nigerian SMEs improved environmental protection, social inclusivity, and overall economic performance, reinforcing the critical role of green technologies in achieving Triple Bottom Line outcomes.

The results further indicated that entrepreneurship significantly drives sustainable development transitions in Imo State. Entrepreneurs who identify environmental challenges as opportunities act as change agents, embedding sustainable practices into business operations and local economies. These findings are consistent with Adewumi and Oladipo (2022), who demonstrated that green entrepreneurs in Nigeria's renewable energy sector catalyze systemic change by creating employment, introducing eco-friendly innovations, and raising community awareness of sustainability practices. Moreover, Olanipekun and Adekunle (2023) found that entrepreneurial orientation particularly proactiveness and risk-taking significantly influences the adoption of renewable energy technologies and eco-efficient production among SMEs, highlighting the importance of entrepreneurial drive in scaling sustainable innovations. Nwokike (2024) also underscored that, despite challenges such as limited infrastructure and inconsistent policies, firms that effectively leverage entrepreneurial innovation achieve improved profitability and community acceptance, emphasizing the importance of entrepreneurial leadership in facilitating sustainable transitions.

## Conclusion

This study examined the role of green innovation and entrepreneurship in driving sustainable development transitions in Imo State. The findings revealed that the adoption of green technologies significantly improves sustainability outcomes by enhancing environmental performance, reducing operational costs, and boosting competitiveness. Additionally, entrepreneurship was found to be a key driver of sustainable transitions, as entrepreneurs transform environmental challenges into business opportunities, foster innovation, and embed sustainability practices into local economies. The study concludes that green innovation and entrepreneurship are essential enablers of sustainable development. Firms that integrate eco-innovation, renewable energy, and circular business models can contribute to environmental protection, economic growth, and social well-being, while green entrepreneurs act as catalysts for lasting sustainable change in the region.

## Recommendations

Drawing from the results and conclusions, the researchers offer the following recommendations:

1. Government and private stakeholders should provide subsidies, tax incentives, and accessible financing to green

firms in Imo State to offset the high costs of adopting renewable energy and eco-innovations, encouraging wider adoption and improved sustainability outcomes.

2. Training, mentorship, and capacity-building programs should be established to equip entrepreneurs with the skills, knowledge, and resources needed to develop and scale sustainable ventures, with a focus on eco-friendly production, green business models, and access to green finance.

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