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ADOPTION OF ORGANIC AGRICULTURE AND AGROECOLOGICAL PRACTICES AMONG SMALLHOLDER FARMERS IN NIGERIA: EVIDENCE ABIA STATE

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ABSTRACT

Organic agriculture and agroecology are increasingly recognized as sustainable approaches to improving agricultural productivity, environmental health, and long-term food system sustainability among smallholder farmers in Nigeria. These practices emphasize the use of natural inputs, ecological processes, and biodiversity conservation to enhance soil fertility and reduce dependence on synthetic inputs, while also addressing broader environmental challenges.

This study examines the adoption of organic farming practices among smallholder farmers in Abia State, Nigeria. A mixed-method approach was employed, combining primary data collected through structured questionnaires with secondary data sources. Descriptive statistics and the Heckman double hurdle model were used to analyses both the decision to adopt and the intensity of adoption.

The results reveal moderate awareness but relatively low adoption of organic practices, particularly for more technical methods. Training, education, farming experience, household size, and age significantly influence adoption decisions, while training, education, age, and experience affect adoption intensity. Key constraints include limited access to credit, high input costs, technical challenges, and poor market information.

The study concludes that strengthening institutional support and capacity building is essential to enhance the adoption of organic farming practices and promote sustainable agricultural systems.

Keywords: *Organic Agriculture; Agroecology; Adoption; Smallholder Farmers*

INTRODUCTION

Organic agriculture and agroecology have increasingly emerged as sustainable approaches to improving agricultural productivity, environmental health, and long-term food system sustainability, particularly among smallholder farmers in developing countries such as Nigeria. These approaches emphasize the use of natural inputs, ecological processes, and biodiversity conservation to enhance soil fertility, maintain ecosystem balance, and reduce dependence on synthetic inputs. Practices such as crop rotation, composting, agroforestry, and biological pest control contribute to improved soil structure, increased water retention, and overall farm sustainability.

The relevance of these practices has become more pronounced in the face of growing environmental challenges, including climate variability, soil degradation, and declining agricultural productivity. Smallholder farmers in Nigeria, who depend largely on rain-fed agriculture and have limited access to resources, are particularly vulnerable to these challenges. Organic agriculture and agroecology therefore provide practical and locally adaptable solutions for improving farm resilience, sustaining productivity, and enhancing food security.

Despite these potential benefits, the adoption of organic agriculture and agroecological practices among smallholder farmers in Nigeria remains relatively low. Many farmers continue to rely on conventional farming systems that contribute to environmental degradation and limit the transition to more sustainable agricultural practices. This low level of adoption is largely attributed to factors such as limited access to credit, inadequate extension services, lack of technical knowledge, and weak market structures for organic products. These constraints significantly reduce farmers' capacity to adopt and sustain organic farming practices.

Furthermore, although existing studies have examined the determinants of organic farming adoption, there is limited empirical evidence that explicitly links organic agriculture and agroecology to broader outcomes such as climate resilience and sustainable food systems within the Nigerian context. Literature on organic agriculture and agroecology highlights their growing importance in enhancing climate resilience and promoting sustainable food systems, particularly among smallholder farmers in developing countries such as Nigeria (Bezner Kerr *et al.,* 2019; FAO, 2018). Practices such as composting, crop rotation, and the use of organic manure are essential in improving soil fertility and reducing dependence on synthetic inputs (Altieri and Nicholls, 2017). Similarly, agroecology extends beyond organic farming by integrating ecological principles with socio-economic and cultural dimensions, emphasizing farmer participation, local knowledge, and diversified farming systems. (Tittonell, 2014).

The theoretical foundation of the study is anchored on the Theory of Planned *Behaviour*, Diffusion of Innovations Theory, and Sustainable Development Theory. The Theory of Planned Behaviour explains how farmers' attitudes, social influences, and perceived control over resources shape their adoption decisions (FAO, 2021). The Diffusion of Innovations Theory highlights how organic farming practices spread through social systems, influenced by factors such as relative advantage, compatibility, and observability. Sustainable Development Theory provides a broader framework by linking organic agriculture and agroecology to environmental sustainability, economic viability, and social well-being.

Empirical studies further demonstrated that organic farming and agroecological practices contributed significantly to soil fertility improvement, reduced input costs, and enhanced resilience to climate change. (Pretty *et al.,* 2018; Bezner Kerr *et al.,* 2019). However, despite increasing awareness, adoption levels remain relatively low among smallholder farmers in Nigeria. Key factors influencing adoption include education, training, access to credit, farming experience, and market access. Farmers with higher education and access to extension services are more likely to adopt organic practices, while financial constraints and lack of technical knowledge hinder adoption.

Furthermore, existing studies often fail to consider the interaction between socio-economic, institutional, and behavioural factors. This study addresses these gaps by employing a mixed-method approach and the Heckman double hurdle model to analyses both the decision to adopt and the level of adoption of organic farming practices. Thus, the study therefore examines the role of organic agriculture and agroecology in promoting sustainable agricultural practices among smallholder farmers in Nigeria, with specific reference to Abia State. It further analyzes the socio-economic and institutional factors influencing both the decision to adopt and the level of adoption of organic farming practices using a mixed-method approach.

Materials and Methods

Study Area

The study was conducted in Abia State, Nigeria, a region located in the southeastern part of the country. The state lies between longitudes 7°23′E and 8°21′E, and latitudes 5°47′N and 6°01′N. Abia State shares boundaries with Akwa Ibom, Anambra, Cross River, Ebonyi, and Rivers States. It has a predominantly agrarian population, with agriculture serving as a major source of livelihood.

The state is divided into three agricultural zones—Umuahia, Aba, and Ohafia—and is characterized by favourable climatic conditions for crop and livestock production. Major crops cultivated in the area include maize, cassava, yam, rice, vegetables, and legumes, while livestock such as poultry, goats, and fish are also commonly reared. The dominance of smallholder farmers and reliance on rain-fed agriculture make the region suitable for studying organic agriculture and agroecological practices in the context of climate resilience.

Population and Sampling Procedure

The target population for this study comprised smallholder farmers engaged in crop production in Abia State. A multi-stage sampling technique was employed to select respondents for the study.

In the first stage, Umuahia agricultural zone was purposively selected due to the high concentration of smallholder farmers practicing crop production. In the second stage, three Local Government Areas—Umuahia North, Umuahia South, and Ikwuano—were purposively selected based on the intensity of farming activities.

In the third stage, one autonomous community was selected from each Local Government Area, followed by the selection of two villages from each community in the fourth stage. Finally, fifteen farmers were randomly selected from each village, resulting in a total sample size of ninety (90) respondents.

Data Collection Methods

The study employed a mixed-method approach, utilizing both primary and secondary data sources.

Primary data were collected through the use of structured questionnaires administered to the selected farmers. The questionnaire was designed to obtain information on socio-economic characteristics, awareness of organic farming practices, adoption levels, and challenges associated with adoption.

Secondary data were obtained from relevant sources, including academic journals, reports, conference proceedings, and other published materials. These sources provided supporting information on organic agriculture, agroecology, climate resilience, and sustainable food systems.

Analytical Techniques

Data collected from the field were analysed using both descriptive and econometric methods.

Descriptive statistics, including frequency distributions, percentages, and mean scores, were used to summarize the socio-economic characteristics of respondents, levels of awareness, and adoption patterns of organic farming practices.

To examine the determinants of adoption, the study employed the Heckman double hurdle model. This model is appropriate for analyzing adoption *behaviour* as it distinguishes between two separate decisions: the decision to adopt and the level of adoption. The first hurdle models the probability of adoption, while the second hurdle analyzes the intensity of adoption among adopters.

The use of the Heckman model allows for the correction of selection bias and provides a more comprehensive understanding of the factors influencing both stages of adoption. This makes it particularly suitable for studies examining agricultural innovation adoption among smallholder farmers.

Results and Discussions

Socio-Economic Characteristics

The socio-economic characteristics of the respondents revealed important insights into the capacity of smallholder farmers to adopt organic agriculture and agroecological practices. The mean age of approximately 41 years indicates that the farmers are within their economically active years, suggesting a high potential for adopting innovative agricultural practices. This finding aligns with studies that emphasize the role of active age groups in agricultural innovation and adoption *behaviour* (Mbow *et al.,* 2019). The gender distribution shows a slight dominance of female farmers, highlighting the critical role women play in agricultural production systems in Nigeria. This supports existing literature that recognizes women as key actors in sustainable agriculture and food systems (Bezner Kerr *et al.,* 2019).

Table 1: Distribution of Socio-Economic Characteristics of Respondents (n = 90)

Variable	Category	Frequency	Percentage (%)	Mean
Age (years)	—	—	—	41.09
Gender	Male	42	46.7	—
	Female	48	53.3	—
Education Level	Tertiary	50	55.6	—
	Others	40	44.4	—
Access to Credit	Yes	36	40.0	—
	No	54	60.0	—
Extension Contact	Yes	30	33.3	—
	No	60	66.7	—

Educational attainment among respondents is relatively high, with a significant proportion having tertiary education. This suggests strong human capital, which is essential for understanding and adopting improved agricultural practices. Previous studies have shown that education enhances farmers' ability to process information and adopt innovations (Pretty *et al.,* 2018). However, despite this advantage, access to institutional support remains limited. A relatively low proportion of farmers have access to credit and extension services, indicating a disconnect between farmers' capacity and the availability of enabling resources. This finding corroborates the assertion that institutional constraints significantly hinder

the adoption of sustainable agricultural practices (FAO, 2021).

4.2: Awareness of Organic Farming Practices (n = 90)

Table 2: Awareness and Adoption of Organic Farming Practices

Organic Practice	Aware Aware (Freq) (%)		Not Aware (Freq)	Not Aware (%)
Composting	58	64.4	32	35.6
Crop Rotation	62	68.9	28	31.1
Animal Manure Usage	60	66.7	30	33.3
Biological Pest Control	40	44.4	50	55.6
Mulching	45	50	45	50

The results indicate a moderate level of awareness of organic farming practices among smallholder farmers in the study area. The highest awareness was recorded for crop rotation (68.9%), composting (64.4%), and the use of animal manure (66.7%). These practices are commonly associated with traditional farming systems, suggesting that farmers are already familiar with certain elements of organic agriculture. Similar observations have been reported in previous studies, which highlight the compatibility of organic practices with traditional knowledge systems (Altieri and Nicholls, 2017)

However, awareness of more technical practices such as biological pest control (44.4%) and mulching (50.0%) is relatively lower. This indicates gaps in technical knowledge, particularly for practices that require specialized training and extension support.

However, the level of adoption remains relatively low, indicating that awareness does not necessarily translate into full implementation, there is a need for improved extension services and training programs to enhance farmers' understanding of comprehensive organic farming systems.

Table 3: Level of Adoption of Organic Farming Practices (n = 90)

Organic Practice	Adopted (Freq)	Adopted (%)	Not Adopted (Freq)	Not Adopted (%)
Composting	50	55.6	40	44.4
Crop Rotation	54	60.0	36	40.0
Animal Manure Usage	52	57.8	38	42.2
Biological Pest Control	30	33.3	60	66.7
Mulching	35	38.9	55	61.1

The results show that the level of adoption of organic farming practices among respondents is relatively low compared to awareness levels. While practices such as crop rotation (60.0%), animal manure usage (57.8%), and composting (55.6%) recorded moderate adoption rates, more technical practices such as biological pest control (33.3%) and mulching (38.9%) exhibited low adoption levels.

This disparity between awareness and adoption indicates that knowledge alone is insufficient to drive full implementation. Farmers may be aware of organic practices but are constrained by factors such as labour requirements, lack of technical skills, limited access to inputs, and financial constraints.

The relatively higher adoption of traditional practices suggests that farmers prefer methods that align with their existing knowledge and resource availability. In contrast, practices requiring specialized knowledge and additional labour inputs are less frequently adopted. This finding is consistent with the diffusion of innovation theory, which emphasizes the role of complexity and compatibility in adoption decisions (Tittonell, 2014). It also aligns with empirical evidence showing that technical complexity and labour requirements can hinder the adoption of agroecological practices (Bezner Kerr *et al.,* 2019).

Determinants of Organic Farming Adoption (Heckman Model Results)

The determinants of organic farming adoption were also analyzed using the Heckman double hurdle model, which examines both the decision to adopt and the level of adoption.

Table 4: Heckman Selection Model (Adoption Decision Equation)

Variable	Coefficient (β)	Std. Error	Z-value	P-value	Significance
Age	0.021	0.010	2.11	0.035	**
Education	0.185	0.015	12.12	0.000	***
Household Size	0.098	0.047	2.08	0.037	**
Farming Experience	0.134	0.024	5.62	0.000	***
Training	0.256	0.030	8.40	0.000	***
Constant	-1.542	0.412	-3.74	0.000	***

Model Statistics:

- Wald $\chi^2 = 63.85$ ($p < 0.000$)
- Rho (ρ) = 0.54

"Training is significant"

From Table 4.4.: Training → Z = 8.40, P-

value = 0.000

Since p < 0.01 → Highly significant

Interpretation: Farmers with training are more likely to adopt organic farming

"Education is highly significant"

- Z = 12.12 (very large)
- P = 0.000 Strongest variable in the model

Education increases farmers' ability to understand and adopt innovations

Why Household Size matters

- Z = 2.08
- P = 0.037 (< 0.05) Significant at 5%

Interpretation: Larger households = more labour → easier adoption

Why Age² (Age Squared) is important

From Table 4, Age = positive, Age² = negative

This gives inverted U-shape relationship

Interpretation: Adoption increases with age, then declines at older ages

Why Education became NEGATIVE in second stage

- Coefficient = -0.092, Significant

Interpretation logic: Educated farmers adopt, but not fully (selective adoption)

Why we said "two-stage process"

Because: Different variables behave differently in each stage.
Selection Stage measures whether farmers adopt while Outcome Stage measures how much they adopt.

Decision to Adopt Organic Farming

The econometric results from the Heckman selection model provide important insights into the factors influencing the decision of smallholder farmers to adopt organic farming practices. The findings reveal that training, education, farming experience, household size, and age all exert a positive and statistically significant influence on adoption decisions. This suggests that both human capital and resource availability play a critical role in shaping farmers' willingness to transition to organic agriculture.

The positive and highly significant effect of training underscores the importance of knowledge dissemination and capacity building in promoting the adoption of organic farming practices. Farmers who have access to training are more likely to understand the technical requirements and long-term benefits of organic agriculture, thereby increasing their likelihood of adoption. This finding is consistent with previous studies which emphasize that extension services and farmer training are key drivers of agricultural innovation and sustainable practice adoption (FAO, 2018; Pretty *et al.,* 2018).

Similarly, education exhibits a strong positive effect on adoption decisions, indicating that more educated farmers are better equipped to process information, evaluate new technologies, and make informed decisions regarding agricultural practices. This supports existing literature which suggests that education enhances farmers' cognitive ability and openness to innovation (Mbow *et al.,* 2019). Educated farmers are more likely to appreciate the environmental and economic benefits associated with organic agriculture, thereby increasing their likelihood of adoption.

Farming experience also shows a positive and significant relationship with adoption, implying that farmers with longer years of experience are better positioned to assess the viability and risks associated with organic farming practices. Experienced farmers tend to have accumulated knowledge and practical skills that enable them to experiment with and adopt improved agricultural practices. This finding aligns with earlier studies which indicate that farming experience enhances adaptive capacity and innovation uptake among smallholder farmers (Altieri and Nicholls, 2017).

Household size is another significant determinant of adoption, with a positive effect suggesting that larger households are more likely to adopt organic farming practices. This can be attributed to the labour-intensive nature of organic agriculture, which often requires additional manual effort for activities such as composting, weeding, and pest management. Larger households provide a readily available labour force, thereby reducing the cost of hired labour. This observation is consistent with findings in the literature that emphasize the role of family labour in facilitating the adoption of sustainable agricultural practices (Bezner Kerr *et al.,* 2019).

Age also has a positive and significant influence on adoption decisions, indicating that older farmers are more likely to adopt organic farming practices. This may be due to accumulated farming knowledge and experience, which

enhances their ability to evaluate new practices. However, this finding should be interpreted cautiously, as age can have varying effects depending on context. While older farmers may possess more experience, younger farmers are often more open to innovation. Nonetheless, similar studies have reported that age can positively influence adoption when it reflects accumulated knowledge and decision-making capacity (Serdeczny *et al.,* 2017).

Overall, the results highlight that the decision to adopt organic farming practices is largely driven by factors related to human capital, access to knowledge, and labour availability. These findings reinforce the importance of strengthening training programs, improving educational opportunities, and enhancing extension services to promote the adoption of organic agriculture among smallholder farmers.

Table 5: Outcome Equation (Level of Adoption)

Variable	Coefficient (β)	Std. Error	Z-value	P-value	Significance
Age	0.017	0.009	1.94	0.052	*
Age²	-0.0004	0.00006	-6.12	0.000	***
Education	-0.092	0.043	-2.12	0.034	**
Farming Experience	-0.071	0.036	-1.95	0.051	*
Training	0.142	0.031	4.51	0.000	***
Constant	0.864	0.298	2.90	0.004	***

Significance Levels: *** = 1% level, ** = 5% level, *10% level

Level of Adoption of Organic Farming

The results of the outcome equation provided deeper insight into the factors influencing the intensity of adoption of organic farming practices among smallholder farmers. Unlike the decision to adopt, which is largely driven by access to information and general capacity, the level of adoption reflects how extensively farmers implement organic practices after initial adoption. The findings reveal a more complex and nuanced relationship among the explanatory variables, indicating that adoption is not merely a binary process but a gradual and selective one.

Training continues to exhibit a positive and statistically significant influence on the level of adoption, suggesting that farmers who receive adequate training are more likely to implement organic practices more intensively. This underscores the importance of continuous knowledge acquisition and technical support in sustaining adoption beyond the initial stage. This finding is consistent with existing literature which emphasizes that training enhances both the depth and effectiveness of agricultural innovation adoption (FAO, 2018; Pretty *et al.,* 2018).

In contrast, education shows a negative and significant relationship with adoption intensity, indicating that more educated farmers may adopt organic practices selectively rather than fully. This may be because educated farmers tend to diversify their strategies and critically evaluate the cost-benefit implications of fully committing to organic systems. Rather than adopting all practices, they may integrate only those that align with their economic goals and resource constraints. This observation supports previous studies which argue that adoption intensity is often influenced by rational decision-making and selective implementation rather than complete transformation (Pretty *et al.,* 2018).

Similarly, farming experience exhibits a negative relationship with adoption intensity, suggesting that more experienced farmers may be cautious in fully embracing organic practices. Experienced farmers often rely on established farming methods and may perceive organic agriculture as risky or labour-intensive. This aligns with findings in the literature which indicate that while experience enhances awareness and initial adoption, it can also lead to resistance to full-scale change due to risk aversion and attachment to traditional practices (Altieri and Nicholls, 2017).

The relationship between age and adoption intensity is found to be nonlinear, as indicated by the positive coefficient of age and the negative coefficient of age squared. This suggests an inverted U-shaped relationship, where adoption intensity increases with age up to a certain point and then declines. Younger farmers may lack the resources or experience needed for full adoption, while older farmers may face physical limitations or reduced willingness to take risks. This finding is consistent with earlier studies that highlight the dual role of age in influencing agricultural innovation, where both youthful dynamism and accumulated experience play important but time-bound roles (Serdeczny *et al.,* 2017).

Overall, the results demonstrate that while factors such as training continue to promote deeper adoption, other variables such as education and experience introduce a level of selectivity in implementation. This reinforces the argument that adoption intensity is influenced by a combination of technical capacity, economic considerations, and individual preferences. These findings highlight the need for targeted interventions that go beyond awareness creation to address the practical and economic challenges associated with scaling up organic farming practices.

Table 6: Constraints to Adoption of Organic Farming Practices

Constraint	Mean Score	Rank
Limited access to credit	2.94	1st
High cost of inputs	2.89	2nd
Difficulty of organic practices	2.89	2nd
Poor market information	2.89	2nd
Weed and pest pressure	2.86	5th

Constraints Interpretation: The results reveal that several key constraints hinder the adoption of organic agriculture and agroecological practices among smallholder farmers in the study area. The most significant constraint is limited access to credit, with the highest mean score (2.94). This indicates that financial limitations are the primary barrier preventing farmers from investing in organic inputs and transitioning to sustainable farming practices. Without access to affordable credit, farmers are unable to bear the initial costs associated with organic farming.

Closely following are high input costs, difficulty of organic practices, and poor access to market information, all with mean scores of 2.89. The high cost of inputs suggests that even though organic farming reduces dependency on synthetic inputs, the availability and affordability of organic alternatives remain a challenge. The perceived difficulty of organic practices reflects the technical and labour-intensive nature of these methods, which discourages adoption.

Poor market information further limits adoption, as farmers lack awareness of market opportunities and price incentives for organic products. This reduces the economic motivation to adopt organic farming practices. Additionally, weed and pest pressure (mean = 2.86) represents a technical challenge, as organic farming relies on natural pest control methods that may be less immediate or effective compared to chemical alternatives.

These findings highlight the importance of financial and institutional support in facilitating the transition to sustainable agriculture. Similar constraints have been widely reported in the literature, where lack of credit, weak market systems, and inadequate institutional support are identified as major barriers to adoption (FAO, 2021; Bezner Kerr *et al.,* 2019).

Conclusion and Recommendations

The study demonstrated that organic agriculture and agroecology hold significant potentials for promoting sustainable agricultural practices among smallholder farmers in Nigeria. However, adoption remains constrained by a combination of socio-economic and institutional factors. While farmers exhibit moderate awareness and possess the necessary human capital, limited access to credit, inadequate extension services, and technical challenges hinder effective implementation (FAO, 2021; Pretty *et al.,* 2018).

To enhance the adoption of organic farming practices, there is a need to strengthen farmer training and extension services to improve technical knowledge and capacity. Improving access to credit through financial institutions and cooperative systems will enable farmers to invest in organic inputs and sustain adoption. Additionally, developing structured markets and improving access to market information will enhance the economic viability of organic farming. Policymakers should also promote labour-saving technologies to reduce the burden associated with organic practices. Finally, integrating organic agriculture into national agricultural and environmental policies will provide a supportive framework for scaling up adoption and achieving long-term sustainability.

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