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Research Article

Adoption Patterns of Organic Farming Practices among Vegetable Farmers in Enugu State, Nigeria

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Abstract

This study examined the adoption patterns of organic farming practices among vegetable farmers in Enugu State, Nigeria. A multi-stage sampling procedure was used to collect data from 200 vegetable farmers across five local government areas in Enugu State, and the data were analyzed using percentages, Likert-scale ratings, and binary and multivariate logistic models. The results indicate high awareness (78%) and a moderate mean adoption intensity index of 54.2%. The Binary Logit results identified education (1.056), farm size (1.166), cooperative membership (1.463), and extension contacts (1.692) as significant positive drivers of the decision to adopt. Education, farming experience, farm size, cooperative membership, and extension services are the most significant drivers of adopting specific organic farming options, as each variable influenced adoption of all six outcome variables in different ways. The study recommends strengthening extension services to close knowledge deficits, enhancing cooperative institutions to foster collective action, and developing robust organic markets that secure premium prices as critical pathways forward. Tailored education programs that build technical capacity, combined with institutional reforms that reduce barriers to entry, would accelerate the transition to sustainable organic vegetable production.

Introduction

Organic agriculture is widely regarded as a viable pathway to sustainable farming, with strong potential to advance green economy initiatives, particularly in developing countries where smallholder farming remains the backbone of economic activity (Ume et al., 2023). However, full adoption of this eco-friendly farming system among vegetable farmers in Nigeria, particularly in Enugu State, remains very limited. Vegetable production provides greater value when based on organic practices that exclude synthetic or agrochemical inputs such as chemical fertilizers and pesticides. According to Singh & Kumar (2024), organic products are grown under organic agricultural systems without chemical fertilizers or pesticides, using an environmentally and socially responsible approach, and provide healthy food. Organic farming reduces health hazards, agricultural Greenhouse Gas (GHG) emissions, and soil nutrient depletion, and promotes eco-friendly agriculture. Organic farming is a panacea for the adverse effects of climate change, land degradation, and the loss of soil nutrients, which are increasingly undermining soil quality, sustainable agriculture, and food security. According to Gamage et al. (2023), organic farming provides solutions to most contemporary problems in agriculture and food production. Organic farming is a production system that sustains ecosystems, soil, and human health while reducing the risk of environmental pollution (Gamage et al., 2023; Adewale et al., 2023; Amusat & Omirin, 2024; Ogungbaro et al., 2024).

As the adverse effects of conventional farming, such as soil degradation, chemical residue accumulation, and biodiversity loss, become more evident, there is growing emphasis on transitioning to eco-friendly agricultural alternatives, including the use of organic fertilizers and the adoption of organic farming (FAO, 2023; Yuan et al., 2026).

Organic farming not only provides sufficient food for practitioners but also contributes to food security and rural development by improving livelihoods, preserving natural resources, and reducing dependence on non-renewable external inputs (International Federation of Organic Agriculture Movements [IFOAM], 2020, 2023). Anugwa and Nwobodo (2020) reported that organic farming practices such as composting and natural pest control significantly improve crop production among farmers in Enugu State. Organic farming emphasizes composting, crop rotation, green manures, and biological pest control (Devi et al., 2024). Several factors influence smallholder farmers' adoption of organic farming practices. Ume et al. (2023) identified key determinants of organic farming adoption, including farmers' knowledge of organic practices, access to extension services, availability of credit facilities, and farming experience. Their study in the Southeast geopolitical region of Nigeria found that farmers with greater awareness and access to information were significantly more inclined to adopt organic methods. Similarly, Okonta et al. (2023) reported that 71.5% of arable-crop farmers in Oyo State were willing to adopt organic farming practices. The study highlighted that farmers' knowledge and perception significantly influence adoption decisions.

The negative impacts of conventional agriculture have spurred interest in sustainable alternatives, such as organic farming (Ogungbaro et al., 2024). The insights from this research will be valuable to policymakers, extension officers, non-governmental organizations (NGOs), and farmers, especially vegetable producers. In addition, identifying key socioeconomic and institutional determinants will inform targeted interventions, including awareness campaigns and tailored training programs, as well as increased provision of institutional facilities, such as credit, extension services, and cooperative membership, to enhance adoption of organic agriculture in the study area.

Despite recognition of the benefits, the adoption of organic farming practices in most parts of Nigeria, including Enugu State, remains limited, particularly among smallholder vegetable farmers (Ugwu & Nnaji, 2021; Adewale et al., 2023; Ogungbaro et al., 2024). Vegetable farming, a major livelihood activity for many rural households in Nigeria, especially in Enugu State, relies heavily on inorganic inputs and is highly vulnerable to environmental changes. The excessive use of chemical fertilizers, synthetic pesticides, and unsustainable soil management practices has degraded soil fertility, contaminated water bodies, reduced biodiversity, and increased the risk of chemical residues in food, posing health risks to humans (FAO, 2023; Yuan et al., 2026).

Although previous studies have examined aspects of organic and climate-smart farming in Nigeria, empirical evidence on vegetable farmers' adoption of organic practices in Enugu State remains limited. For example, Anugwa and Nwobodo (2020) focused on crop farmers' use of organic practices, while Obazi et al. (2022) restricted their analysis to fluted pumpkin farmers. Similarly, Ukwuaba et al. (2025) investigated eco-friendly vegetable production using multinomial logit regression, and Ume et al. (2023) explored determinants of adoption at a broader Southeast regional level. Other studies, such as Pelemo et al. (2024) and Oparaojiaku et al. (2025), addressed climate-smart practices among arable and cassava farmers outside Enugu State. However, none of these studies comprehensively assessed the drivers of vegetable farmers' decision-making and their choice of specific organic farming practices in Enugu State.

This study addresses that gap by using binary Logit and multivariate probit models to capture both the likelihood and the interdependence of adoption choices. The multivariate probit approach is particularly innovative because it accounts for the reality that farmers often adopt multiple practices simultaneously, with correlated decisions across practices. Therefore, this study sought to assess vegetable farmers' awareness of organic farming practices; evaluate the intensity of adoption; identify the key drivers of their decisions to adopt organic farming; and examine the factors shaping their choice of specific organic methods. Ultimately, this study provides robust evidence to guide targeted policy interventions and positions Enugu State as a case study for understanding the dynamics of organic vegetable farming adoption in Nigeria.

Methodology

This study was conducted in Enugu State, which lies between latitudes 5°56' and 7°36' N and longitudes 6°53' and 7°55' E of the Greenwich Meridian (Eze, 2020; ENADEP, 2009). The state covers 13,161 km² (Nwokeabia et al., 2025) and has a population density of 615 people per km². The land is well-suited to vegetable cultivation, and farmers capitalize on short maturity periods and strong market demand for crops such as tomatoes, peppers, and a variety of leafy greens, including fluted pumpkin (Telfairia occidentalis), okra (Abelmoschus esculentus), amaranthus, and spinach.

A multistage sampling procedure was employed. In the first stage, five Local Government Areas (LGAs) (Nsukka, Nkanu-East, Udi, Ezeagu, and Awgu) were purposively selected for their prominence in vegetable production and the presence of both organic and conventional vegetable farmers. In the second stage, five communities were purposively selected from each LGA, for a total of 25 communities. To ensure every farmer in each community had an equal chance of selection, the researchers used simple random sampling to select eight vegetable farmers from each of the 25 communities, for a total of 200 respondents. The researchers collected primary data from vegetable farmers using a structured questionnaire. Before data collection, all participants provided informed consent, and the researchers carefully protected their confidentiality. The study also received ethical approval from the Strategic Contacts, Ethics and Publications Directorate of the University of Nigeria, Nsukka, with research code UNN/EC/NSTA/FAGAGC STR/54 11 SEPT/2026.

The binary logit model was used to assess the socioeconomic and institutional factors that influence the adoption of organic farming practices among vegetable farmers. The model was specified as:

$$Ln = \beta 0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 \quad (1)$$

Where: P*i* is the probability that a vegetable farmer is an adopter of organic farming practices
1-P*i* is the probability of a vegetable farmer being a non-adopter of organic farming practices

β_0 = intercept

$\beta_1, \beta_2 \ldots \beta_9$ are slopes of the equation in the models or coefficients

$X_{1...}$Xn are the independent variables.

Thus:
Y= (Adoption of organic farming practices =1, Otherwise, 0)
X_1 = Sex
X_2 = Age (Years)
X_3 = Education level (Years)
X_4 = Household Size (Number)
X_5 = Farming Experience (Years)
X_6 = Farm size (Ha)
X_7 = Cooperative Membership (Yes =1, No = 0)
X_8 = Access to credit (Yes = 1, No = 0)
X_9 = Extension Contact (Yes = 1, No = 0)
The coefficients (β) were exponentiated to obtain odds ratios, which represent the change in the odds of adoption per one-unit increase in each predictor.

Odd ratio = P (Yi=1). (2)

To examine the factors influencing vegetable farmers' choices of organic farming practices, we used a Multivariate Probit (MVP) model.

The MVP is specified as: $= +, j = 1,2, \dots, n$ (3)

where:

is the latent variable representing the propensity of farmer i to adopt a practice j.

$= 1$ if > 0(practice adopted), and $= 0$ otherwise. is a vector of explanatory variables (e.g., Age, access to extension services, education, farm size). is the parameter vector associated with practice j. are error terms assumed to follow a multivariate normal distribution with mean zero and covariance matrix Σ. The covariance matrix Σ captures the correlation among adoption decisions.

We tested all variables in both the binary logit and multivariate probit models at the 5% significance level ($p<0.05$), which served as the threshold for statistical significance. In addition, no generative artificial intelligence (AI) tools were used in the conception, design, data collection, analysis, interpretation of results, or writing of this manuscript. The only AI-assisted technology used was language-editing software, applied exclusively to enhance grammar, spelling, punctuation, readability, and overall linguistic quality. Every section of the paper, along with the complete scientific content and final manuscript, was solely conceived, developed, reviewed, and approved by the authors, who accept full responsibility for the originality and quality of the work.

Results and Discussion

Awareness Level of Vegetable Farmers of Organic Farming

As shown in Table 1, 78% of vegetable farmers in Enugu State exhibited a relatively high level of awareness of organic farming practices. This indicates that nearly half of the farmers are familiar with organic methods, though a considerable proportion still lacks adequate knowledge. Awareness is a critical precursor to adopting sustainable

innovations, and the rate suggests that farmers in the region are increasingly exposed to information on organic farming. This heightened awareness can be attributed to active extension services and NGOs' efforts to promote sustainable agriculture. The result is consistent with Ume et al. (2023), who note that farmers with a clear understanding of organic farming are more likely to adopt it. Similarly, Maggio et al. (2022) emphasize that awareness is a major precursor to behavioral change in agricultural innovation.

Table 1: Farmers' awareness levels of organic practices

Awareness Category	Awareness Range (%)	Percentage (%) (n=200)
Low	0 – 25	4.0
Moderate	26 – 50	20.0
High	51 – 75	48.0
Very High	76 – 100	28.0

Source: Field Survey, 2025.

Adoption Intensity Index of Organic Farming Practices

The adoption intensity of organic farming practices among vegetable farmers in Enugu State is moderate, with a mean Adoption Intensity Index (AII) of 54.2%, indicating that farmers adopt more than half of the six recommended practices. The distribution shows that 52% of farmers use at least three practices, with the largest share (24%) using exactly three. Only 4% of farmers applied no chemical inputs to their vegetable farms, while 12% used no organic practices.

The distribution of adoption intensity between 0.333 and 0.667 (62%) indicates a transition period for farming systems, with awareness and institutional incentives driving partial changes rather than a complete shift to organic farming. Only 4% reported full adoption (organic fertilizers, bio-pesticides, and bio-herbicides). This result aligns with Umeh & Bahta (2024), who report that full organic systems are uncommon among vegetable farmers because there is no market premium and certification costs are high. However, they also report moderate rates of practice adoption (Umeh & Bahta, 2024).

Table 2: Adoption intensity index of organic farming practices

Number of Organic Farming Practices Adopted	Adoption Intensity Index (AII)	Percentage (%)
0	0.000	12.0
1	0.167	16.0
2	0.333	20.0
3	0.500	24.0
4	0.667	18.0
5	0.833	6.0
6	1.000	4.0

Mean AII = 54.2% (Moderate)
Source: Field survey, 2025.

Drivers of Decision by Vegetable Farmers to Adopt Organic Farming

Education, farm size, cooperative membership, and extension contact have the strongest positive effects on vegetable farmers' adoption of at least one organic farming practice in Enugu State. The coefficients for education, farm size, cooperative membership, and extension contact were 1.056, 1.166, 1.463, and 1.692, respectively. An additional year of schooling increases the odds of adoption by 2.87 times. The evidence supports the claim that education builds knowledge of the ecological benefits and technical needs of organic systems (Ogunjimi & Adekalu, 2021). Ukwuaba et al. (2025) also show that education and access to extension contacts are critical for adopting suitable new technologies. Obazi et al. (2022) corroborate this finding.

Likewise, larger farm size increases the odds of organic adoption by 3.17, reflecting economies of scale that support greater input use and risk-bearing capacity. Cooperative membership and extension contact are key institutional drivers of organic farming adoption, with odds ratios of 3.98 and 4.60, respectively. Cooperative membership facilitates peer learning, bulk input purchasing, and access to broader market outlets for organic produce at a higher premium. Ume et al. (2023) observed that an organized marketing structure and a premium for organic produce increased the share of land dedicated to organic farming. Extension contacts, with the highest odds ratio (5.46), indicate a very significant positive effect on the adoption of organic farming. Extension services provide platforms for targeted training in practices such as composting and biological pest control, which accelerate technology adoption in resource-constrained environments (Adebayo & Ogunniyi, 2022).

Table 3: Drivers of adoption of organic farming

Variables	Coef	Odd Ratio	Std. Err.	Z
Sex	0.210	0.57	0.343	0.61
Age	-0.035	0.09	0.033	-1.05
Education	1.056*	2.87	0.251	4.21
Household size	0.094	0.26	0.171	0.55
Farming experience	0.053	0.14	0.041	1.29
Farm size	1.166*	3.17	0.342	3.41
Cooperative membership	1.463*	4.0	0.367	3.98
Access to credit	1.463*	1.71	0.349	1.80
Extension contacts	0.629*	5.46	0.411	4.12
Constant	-1.234			
LR χ^2 (9) = 105.18				
Prob > χ^2 = 0.0000				
Pseudo R^2 = 0.381				
Log likelihood = -85.432				
* P ≤0.05				

Source: Field Survey, 2026

Determinants of Choice of Organic Farming Practices

Education, farm size, cooperative membership, and extension contacts were significant and positively associated with adopting individual organic practices. Education has a significant positive effect on adopting all six practices (compost, 0.988; animal manure, 0.765; mulching, 1.099; green manure, 0.877; crop rotation, 1.432) and on adopting biopesticides (0.654). This implies that each additional year of schooling increases the likelihood of adopting each organic practice, as indicated by the respective education coefficients. This result suggests that education is a key factor in organic farming adoption among vegetable farmers. Education is strongly related to the adoption of knowledge-intensive and eco-friendly practices (Odoemelam & Olojede, 2020; Omeje et al., 2025; Ukwuaba et al., 2025).

Farm size also strongly and positively influences all six organic practices ($p< 0.001$), with the greatest effect on crop rotation (1.765), indicating that a 1-unit increase in farm size is associated with a 1.765-unit increase in crop rotation. Cooperative membership and extension contacts are strong institutional drivers of adoption for almost all practices. However, cooperative membership has the strongest effect on crop rotation (1.988) and compost use (1.654). Cooperatives enable joint input sourcing, peer learning, and market outlets for organic produce at premium prices. Ume et al. (2023) observed that an organized marketing structure and a premium for organic produce increased the area dedicated to organic farming in Southeast Nigeria.

Extension contacts positively and significantly motivated the adoption of all six organic farming practices, with greater influence on the use of compost manure (1.432) and biopesticides (1.877). This result implies that a unit increase in extension visits increased the adoption of compost manure and biopesticides by 1.432 and 1.877, respectively. These MVP results also align with the findings of Oparaojiaku et al. (2025) in Abia State, Nigeria.

Table 4: Determinants of choice of organic farming practice

Variables	Compost Use	Animal Manure	Green Manure	Mulching	Ash/Soap Biopesticide	Crop Rotation
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Sex	0.299	0.211	0.188	0.254	0.211	0.177
	(0.277)	(0.288)	(0.321)	(0.277)	(0.311)	(0.299)
Age	-0.021	-0.032	-0.043*	0.020	-0.054*	-0.011
	(0.020)	(0.021)	(0.023)	(0.019)	(0.026)	(0.020)
Edu.	0.988*	0.765*	0.877*	1.099*	0.654*	1.432*
	(0.221)	(0.234)	(0.299)	(0.254)	(0.288)	(0.321)
Family size	0.077	0.099	0.065	0.110	0.054	0.088
	(0.088)	(0.077)	(0.099)	(0.088)	(0.099)	(0.110)
Farm. Exp.	0.054*	0.043	0.032	0.065*	0.021	0.077*
	0.032	(0.031)	(0.035)	(0.032)	(0.037)	(0.035)
Farm size	1.321*	1.099*	0.988*	1.543*	0.877*	1.765*
	(0.432)	(0.399)	(0.388)	(0.499)	(0.432)	(0.543)
Coop. mem.	1.654*	1.432*	1.211*	1.765*	1.099*	1.988*
	(0.511)	(0.532)	(0.599)	(0.543)	(0.599)	(0.599)
Credit	0.877*	0.988**	0.6543	0.988*	1.235*	0.877
	(0.499)	(0.488)	(0.511)	(0.532)	(0.499)	(0.543)
Extension	1.4321	1.211*	1.099*	1.321*	1.877*	1.543*
	(0.543)	(0.577)	(0.654)	(0.577)	(0.654)	(0.654)

Wald χ^2 (54) = 298.76
Prob > χ^2 = 0.0000
Log likelihood = -487.321
*$P \leq 0.05$,
Values in the brackets are the Standard Errors.

Source: Field Survey, 2025

Conclusion and Recommendations

This study shows that although awareness of organic farming practices is widespread among vegetable farmers in Enugu State, full adoption remains limited, with only a small share practicing fully organic systems. Education, farm size, cooperative membership, access to credit, and extension services shape adoption intensity, reflecting the interplay of socioeconomic and institutional factors. Notably, 52% of farmers have integrated at least three organic practices, indicating moderate but promising uptake. However, the persistent whole-farm adoption gap underscores the need for targeted interventions. Strengthening extension services to close knowledge gaps, enhancing cooperative institutions to foster collective action, expanding access to credit, and developing robust organic markets that secure premium prices are critical pathways forward. Tailored education programs that build technical capacity, combined with institutional reforms that reduce barriers to entry, would accelerate the transition to sustainable organic vegetable production. Aligning these measures with identified drivers offers a roadmap for government agencies, NGOs, and farmer organizations to transform vegetable farming in Enugu State into a model of resilience and ecological sustainability.

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