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Farmers' Awareness and Adoption of Agro-Waste Innovations for Sustainable Food Production in Ekiti State, Nigeria

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Abstract

This study examined farmers' awareness and utilisation of agro-waste innovations for sustainable food production in Ekiti State, Nigeria. A multistage sampling procedure was used to select 144 smallholder farmers, and data were analysed using percentages, Pearson Product-Moment Correlation (PPMC), and Chi-square analysis. The results revealed high awareness of crop residues (85.4%) and poultry droppings (83.3%), while awareness of cassava peels was relatively low (46.5%). Major utilisation practices included selling agro-waste (61.8%), composting (57.6%), and using it as livestock feed (50.0%). However, some respondents still disposed of agro-waste through burning (25.7%) and open decomposition (40.3%). Reduced fertiliser cost was identified as the most important perceived benefit of agro-waste utilisation. The results further showed that farm size ($r = 0.170$) had a significant positive relationship with agro-waste utilisation. Livestock farming enterprise ($\chi^2 = 19.768$) and awareness level ($\chi^2 = 8.967$, $p = 0.003$) were also significantly associated with agro-waste utilisation. The study concludes that utilisation of agro-waste innovations among farmers is moderate and significantly influenced by awareness, farm size, and livestock farming enterprise. The study recommends strengthening extension services, raising awareness, and expanding access to agro-waste processing technologies to enhance sustainable food production and environmental management.

Key words: Farmers' awareness; adoption of agro-waste innovations; sustainable food production

Introduction

Agricultural sustainability has become a critical concern in Sub-Saharan Africa, where increasing population pressure, declining soil fertility, and environmental degradation threaten food security (Abdi et al., 2024; Pandey et al., 2025). In Nigeria, smallholder farmers dominate agricultural production and contribute significantly to national food security, yet their productivity is often constrained by inefficient resource utilisation and limited access to agricultural innovations (Chiaka et al., 2022; Ikuemonisan, 2024). Awareness and adoption are important determinants of the successful diffusion of agricultural innovations. Farmers' awareness refers to the degree of knowledge they possess regarding the existence, functions, benefits, and potential applications of an innovation, while adoption refers to the decision to continually use an innovation after

evaluating its usefulness and compatibility with existing farming systems (Adesida et al., 2021; Izuogu et al., 2023). Higher levels of awareness generally increase the likelihood of adoption, although actual utilisation may also depend on socioeconomic, institutional, and technological factors (Ehiwario et al., 2024; Echefu et al., 2026). One innovation with considerable potential for improving agricultural sustainability is agro-waste utilisation. Agro-waste innovations comprise technologies and practices that convert agricultural residues, crop by-products, and livestock wastes into useful products such as organic fertilisers, compost, livestock feed, bioenergy, and other value-added products. These innovations support sustainable food production by improving soil fertility, reducing environmental pollution, lowering production costs, promoting efficient resource utilisation, and strengthening circular agricultural systems (Capanoglu et al., 2022; Koul et al., 2022; Yaashikaa et al., 2021; Ufitikirezi et al., 2024). Consequently, agro-waste utilisation can enhance farm productivity, strengthen rural livelihoods, and improve the long-term resilience of smallholder farming systems. Despite these benefits, the adoption of agro-waste innovations among smallholder farmers remains relatively low and inconsistent. Studies have shown that awareness and access to information significantly influence farmers' willingness to adopt and utilise agro-waste innovations (Adesida et al., 2021; Ariyo, 2025; Akinbile et al., 2024). However, awareness levels are often uneven, particularly regarding advanced applications such as biogas production and value-added processing (FAO, 2021; Liu et al., 2021). Consequently, agro-waste is still frequently burned, discarded, or left to decompose in many rural communities, resulting in environmental pollution and loss of valuable resources (Chilakamarry et al., 2020; Koul et al., 2022). In addition, socio-economic factors such as education, farm size, income, and farming system influence farmers' adoption decisions. Farmers with better access to information, larger farm holdings, and diversified farming enterprises are generally more likely to adopt innovative agricultural practices (Kamanda et al., 2022; Echefu et al., 2026). Nevertheless, empirical evidence on the interaction between awareness, utilisation, and perceived benefits of agro-waste innovations remains limited, particularly in southwestern Nigeria. In Ekiti State, agriculture is a major livelihood activity, and substantial quantities of agro-waste are generated annually. However, information on farmers' awareness and utilisation of agro-waste innovations remains scarce (Ariyo, 2025; Ogunlana et al., 2025). Limited awareness, inadequate extension support, and poor access to processing technologies may constrain the effective utilisation of agro-waste resources. This creates a gap between the potential benefits of agro-waste innovations and their actual application among farmers. Against this backdrop, this study assessed farmers' awareness and adoption of agro-waste innovations for sustainable food production in Ekiti State, Nigeria. Specifically, the study sought to ascertain the socio-economic characteristics of respondents, determine their awareness levels of different agro-waste categories, identify existing utilisation practices, and assess the perceived benefits of agro-waste utilisation.

Hypothesis

1. Farmer’s socio-economic factors do not significantly influence the adoption of agro-waste innovation.
2. There is no significant relationship between awareness and agro-waste utilization.

Methodology

The study was conducted in Ekiti State, southwestern Nigeria, located between latitudes 7°15′N and 8°05′N and longitudes 4°45′E and 5°45′E. Agriculture is the major occupation of the people, with crop and livestock production being widely practised. The State was selected for the study because agricultural activities generate substantial agro-waste. The target population comprised farmers involved in agro-waste generation and utilisation in Ekiti State, Nigeria.

A multistage sampling procedure was employed to select respondents for the study. In the first stage, four Local Government Areas (LGAs) were randomly selected from the sixteen LGAs in the State to ensure representation across the agricultural zones. In the second stage, three rural farming communities were purposively selected from each LGA based on the intensity of agricultural activities and concentration of farming households. In the third stage, twelve farmers were randomly selected from each community, resulting in a total sample size of 144 respondents.

The sample size was derived from Cochran's (1977) formula and adjusted for the finite population. Although the adjusted sample size was approximately 150 respondents, a total of 144 farmers were selected to ensure equal representation across the twelve sampled communities and facilitate field administration. Primary data were collected through a structured interview schedule administered to the respondents.

Awareness of agro-waste utilisation was measured using six agro-waste categories: crop residues, poultry droppings, fruit and vegetable peels, cocoa pods/shells, palm kernel shells, and cassava peels. Respondents rated their awareness on a four-point scale of Very High Awareness (4), High Awareness (3), Low Awareness (2), and Very Low Awareness (1). Scores were summed to obtain an awareness index. The mean awareness score was used as the cut-off point, with respondents scoring equal to or above the mean classified as having high awareness and those scoring below the mean classified as having low awareness.

Agro-waste utilisation was measured using six utilisation practices: compost/manure production, animal feed, biogas or fuel generation, mulching, pest and disease control, and mushroom or vegetable cultivation. A score of one (1) was assigned to each utilisation practice adopted and zero (0) otherwise. The scores were summed to generate a utilisation index. Respondents whose scores were equal to or above the mean utilisation score were classified as high utilisers, while those below the mean were classified as low utilisers.

Perceived benefits of agro-waste utilisation were assessed using six benefit indicators rated on a four-point scale of Large Extent (4), Moderate Extent (3), Low Extent (2), and No Extent (1). Mean scores and standard deviations were computed and used to rank the benefits.

Frequency counts, percentages, means, and standard deviations were used to summarise respondents' socio-economic characteristics, awareness levels, utilisation practices, and perceived benefits. Pearson Product-Moment Correlation (PPMC) was used to determine the relationship between selected continuous socio-economic variables (age, farming experience, and farm size) and agro-waste utilisation. Chi-square (χ^2) analysis was employed to examine the association between selected categorical variables (sex, marital status, educational level, livestock farming enterprise, and awareness level) and agro-waste utilisation. Statistical significance was determined at the 5% level.

Results and Discussion

Awareness of Agro-Waste Utilisation among Respondents

Table 1 reveals that respondents had a relatively high level of awareness of agro-waste utilisation. A large proportion of the respondents reported high to very high awareness of crop residues (85.4%), poultry droppings (83.3%), fruit/vegetable peels (72.9%), and palm kernel shells (68.8%). However, awareness was comparatively lower for cocoa pods/shells (53.5%) and cassava peels (46.5%). Conversely, more than half of the respondents reported low to very low awareness of cassava peels (62.5%), while 46.5% indicated low to very low awareness of cocoa pods/shells.

The high awareness recorded for crop residues and poultry droppings may be due to their widespread generation and utilisation in farming activities. The relatively lower awareness of cocoa pods/shells and cassava peels suggests limited knowledge of their potential utilisation among the respondents. This finding implies that awareness of agro-waste utilisation varies across waste types, with farmers being more familiar with agro-wastes commonly available within their production systems. The result agrees with Akinbile et al. (2024), who reported that farmers' awareness influences the utilisation of agricultural waste resources. The finding also corroborates Izuogu et al. (2023), who noted that awareness and access to information are important determinants of farmers' adoption of agricultural innovations

Table 1. Level of Awareness of Agro-waste Utilisation

Agro-wastes	Very high (%)	High (%)	Low (%)	Very low (%)
Crop residues	59	26.4	11.8	2.8
Poultry droppings	46.5	36.8	13.9	2.8
Fruit/vegetable peels	38.9	34	19.4	7.6
Cocoa pods/shells	25.7	27.8	38.9	7.6
Palm kernel shells	43.1	25.7	20.8	10.4
Cassava peels	19.4	27.1	43.1	19.4

Utilisation of Agro-Waste among Respondents

Figure 1 shows the various utilisation practices adopted by the respondents. A majority of the respondents sold agro-waste (61.8%), and used it as compost or manure (57.6%), while half (50.0%) of the respondents fed it to animals. However, 40.3% left agro-waste to rot naturally, while 25.7% disposed of it through burning. Only a few respondents reported outright disposal (1.4%) or throwing it away (0.7%).

The findings suggest that most respondents recognised agro-waste as a valuable resource with economic and agricultural benefits. The use of agro-waste for composting, livestock feeding, and sale reflects efforts toward resource recycling, income generation, and sustainable farm management. However, the continued practice of burning and leaving agro-waste to decompose indicates that some farmers have not fully adopted improved utilisation methods. This finding agrees with Akinbile et al. (2024), who reported that farmers utilise agricultural waste for productive and environmentally safe purposes when adequate awareness and knowledge exist. The result also supports Koul et al. (2022), who observed that limited technical knowledge and access to processing technologies often constrain the efficient utilisation of agricultural wastes.

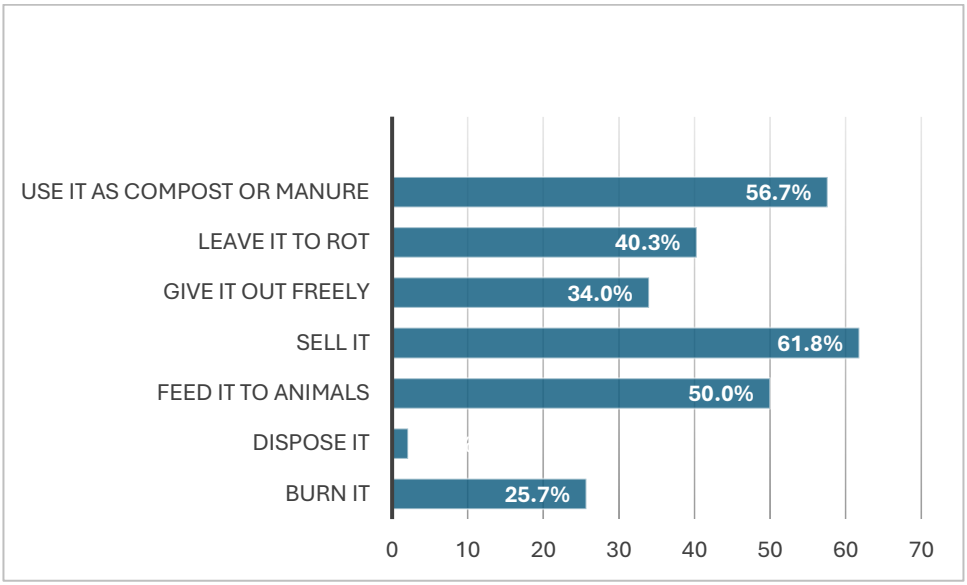

Figure 1: Current Utilisation of Agrowaste Innovations

Perceived Benefits of Agro-Waste Utilisation on Farming

Table 2 shows that respondents perceived agro-waste utilisation to provide several benefits to farming activities. Nearly half (48.6%) of the respondents indicated that agro-waste utilisation reduced the cost of fertiliser and other farm inputs to a large or moderate extent, while 43.8% reported that it improved soil fertility to a large or moderate extent. Similarly, 34.0% perceived that agro-waste utilisation increased farm income to a large or moderate extent. However, only 30.6% reported increased crop yield to a large or

moderate extent, while 69.4% perceived this benefit to a low extent. Furthermore, 41.6% indicated that agro-waste utilisation reduced waste disposal problems to a large or moderate extent, whereas 36.8% reported no such benefit. Notably, 45.8% of the respondents reported no noticeable impact from agro-waste utilisation.

The findings suggest that farmers primarily value agro-waste utilisation for its potential to reduce production costs and improve soil fertility. The relatively low perception of benefits to crop yield and farm income may indicate that many respondents have not utilised agro-waste technologies sufficiently or consistently to realise their full agronomic and economic benefits. This finding aligns with Koul et al. (2022) and Agbede (2025), who reported that farmers are more likely to perceive the productive benefits of organic waste utilisation after sustained and regular application over time. The result also supports Akinbile et al. (2024), who found that awareness and utilisation of agricultural waste practices influence farmers' perceptions of their productive and environmental benefits.

Table 2: Perceived benefits of agro-waste utilisation on farming

Agro-wastes	Large extent (%)	Moderate extent (%)	Low extent (%)	No extent (%)
Increased crop yield	4.9	25.7	69.4	0
Improved soil fertility	6.3	37.5	52.0	3.5
Reduced the cost of fertiliser or inputs	9.0	39.6	47.9	3.5
Reduced waste disposal problems	5.5	36.1	21.5	36.8
Increased farm income	8.3	25.7	62.5	3.5
No noticeable impact	9.0	14.6	30.6	45.8

Influence of Socio-economic Factors on Adoption of Agro-Waste Utilisation

Table 3 reveals that farm size had a positive and significant relationship with the adoption of agro-waste utilisation practices ($r = 0.170$, $p < 0.05$), while livestock farming enterprise had a positive and significant association with the adoption of agro-waste utilisation ($\chi^2 = 19.768$, $p = 0.001$). However, age, farming experience, educational level, marital status, and sex did not significantly influence adoption.

The positive relationship between farm size and adoption of agro-waste utilisation practices suggests that farmers with larger holdings were more likely to utilise agro-

wastes. Larger farms generate more agricultural residues and provide greater opportunities for their use as compost, organic manure, or livestock feed. The finding aligns with Kamanda et al. (2022), who reported that resource endowments influence the adoption of agricultural innovations.

The significant association between livestock enterprise and agro-waste utilisation indicates that livestock farmers were more likely to adopt agro-waste practices than non-livestock farmers. This may be because crop residues, cassava peels, and other agro-wastes can be used as livestock feed, while animal wastes can be recycled as organic manure. The finding corroborates Akinbile et al. (2024), who found that livestock farmers were more disposed to adopting agricultural waste utilisation practices

Table 3: Socio-economic factors influencing the Utilisation of agro-waste

Variables	**Pearson Correlation**
Age	-0.100
Farming experience	0.024
Farm size	0.170*
	Chi-square
Education	3.128
Marital status	3.17
Sex	2.547
Livestock farming	19.768*

* p<0.05

Relationship Between Awareness of Agro-waste Benefits and Utilisation

Table 4 shows a significant association between awareness of agro-waste benefits and its utilisation among the respondents ($\chi^2 = 8.97$). This indicates that farmers who were more aware of the benefits of agro-waste utilisation were more likely to adopt the practice. The finding agrees with Akinbile et al. (2024), who reported that awareness significantly influenced farmers' utilisation of poultry waste for productive and environmentally safe purposes. Similarly, Izuogu et al. (2023) found that access to information enhanced farmers' utilisation of agricultural innovations. The result underscores the importance of extension services and training programmes in promoting agro-waste utilisation.

Table 3: Relationship between Awareness and Utilization of Agro-waste utilization

Variable	**χ^2**	**DF**
Awareness and utlisation of Agro-waste	8.97*	1

*P ≤ 0.05

Conclusion and Recommendations

Smallholder farmers in Ekiti State demonstrated relatively high awareness of commonly available agro-waste resources, particularly crop residues and poultry droppings. However, adoption of agro-waste innovations varied across waste types, and some farmers still used environmentally unsustainable disposal practices. Agro-waste utilisation mainly contributed to reduced production costs and efficient resource use, while farm size, livestock farming enterprise, and awareness level significantly influenced adoption. Enhancing access to information, training, and appropriate utilisation technologies is therefore essential for sustainable food production and environmental management.

Agricultural extension services should strengthen farmer education and training on the productive and value-added utilisation of agro-waste resources, particularly less-utilised materials such as cassava peels and cocoa pods/shells. Extension programmes should also promote integrated crop–livestock farming systems, given the significant influence of livestock enterprise on agro-waste utilisation. Furthermore, extension agencies and relevant government institutions should encourage sustainable agro-waste management practices and discourage environmentally harmful disposal methods through targeted awareness and capacity-building programmes.

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