

Assessment of Farming Practices and Agrochemical Use in Oju Local Government Area, Benue State, Nigeria: A Descriptive Perspective

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DOI: <https://doi.org/10.51584/IJRIAS.2026.11090006>

Received: 18 September 2026; Accepted: 23 September 2026; Published: 29 September 2026

ABSTRACT

Agricultural intensification and increasing reliance on agrochemicals have raised concerns about sustainable farming practices, soil quality and environmental health in rural communities. This study assessed farming practices and agrochemical use among farmers in Oju Local Government Area of Benue State, Nigeria, with a view to providing location-specific evidence for sustainable agricultural management. A descriptive cross-sectional survey design was adopted. Data were collected from 120 farmers across seven communities, namely Oju, Ibilla, Ukpa, Iyeché, Owo, Oboru and Uwokwu, using structured questionnaires and field observations. Data were analysed using frequency counts, percentages, means and standard deviations in SPSS Version 27. The findings revealed that farming was predominantly small-scale and rain-fed, with 43.3% of respondents cultivating 1–3 hectares and 73.3% relying on rainfall for agricultural production. Arable cropping constituted the dominant farming practice (35.0%). Agrochemical use was widespread, with 70.8% of respondents reporting its application. Among users, 45.9% applied agrochemicals more than three times, while 43.5% had 11–20 years of experience using agrochemicals. Farmers perceived declining soil fertility ($M = 3.82$), pollution of nearby water bodies ($M = 3.80$) and persistent soil residues ($M = 3.74$) as major environmental concerns. Although 63.3% were aware of organic alternatives, 84.2% expressed willingness to adopt soil-friendly practices. The study concludes that strengthening agricultural extension services, promoting integrated pest management and improving access to sustainable farming alternatives are essential for reducing environmental risks while maintaining agricultural productivity in Oju LGA.

Keywords: Farming practices; agrochemicals; sustainable agriculture; soil quality; Oju LGA.

INTRODUCTION

Agriculture remains central to global food security, rural livelihoods and economic development, but the challenge of increasing agricultural production without undermining environmental quality and human well-being has become increasingly important. Agricultural intensification has contributed substantially to increases in food production, yet intensive production systems can also generate soil degradation, biodiversity loss, water pollution, pesticide resistance and risks to human health when external inputs are poorly managed (Tilman et al., 2002; Pretty & Bharucha, 2014; Pretty, 2018). Consequently, contemporary agricultural development increasingly emphasises sustainable intensification, in which productivity is improved while adverse environmental and social consequences are minimised. This requires not only technological innovation but also appropriate farmer knowledge, efficient resource management and context-specific farming practices (Pretty & Bharucha, 2014; Pretty et al., 2018). The need to reconcile productivity with environmental sustainability is particularly important in smallholder farming systems, where farmers often operate under constraints relating to land, finance, extension services, market access and agricultural inputs.

Agrochemicals constitute an important component of modern agricultural production because fertilisers, herbicides, insecticides, fungicides and other crop-protection products can reduce nutrient deficiencies, control weeds and pests, and protect crops from diseases. Their use, however, presents a sustainability challenge when application rates, timing, handling and disposal are inappropriate (Meena et al., 2020; Devi et al., 2022). Recent

Food and Agriculture Organization (FAO) statistics indicate that global agricultural pesticide use reached approximately 3.73 million tonnes of active ingredients in 2023, representing a substantial increase over previous decades (FAO, 2025). Updated FAOSTAT information further indicates that pesticide use remains a major component of contemporary agricultural production systems, while recognising its potential to contaminate soil and water and adversely affect non-target organisms and human health (FAO, 2026). The issue is therefore not simply whether agrochemicals are used, but whether their selection, application, storage and disposal are consistent with good agricultural and environmental practices. Integrated pest management (IPM), improved nutrient management, biological and cultural control, and other agroecological approaches have consequently been promoted as ways of maintaining agricultural productivity while reducing unnecessary dependence on synthetic chemical inputs (Pretty & Bharucha, 2015; Pretty, 2018).

These concerns are particularly relevant in developing-country agricultural systems, where smallholder farmers constitute a substantial proportion of agricultural producers and frequently face limited access to formal agricultural information and technical support. In such settings, farmers' decisions concerning agrochemical use may be influenced by pest pressure, perceived effectiveness, input prices, availability, advice from agrochemical retailers and fellow farmers, extension contact and previous farming experience. Consequently, the presence of agrochemicals within a farming system does not necessarily indicate that farmers are using them according to recommended practices. Rather, the sustainability implications depend on the combination of farming practices and the manner in which inputs are used (Staudacher et al., 2020; Tudi et al., 2021; Oshingbade et al., 2025). Evidence from different parts of sub-Saharan Africa demonstrates that inadequate knowledge, weak extension support and unsafe handling practices can contribute to inappropriate pesticide management (Pretty & Bharucha, 2015). Understanding these practices at the farm and community levels is therefore necessary for designing interventions that are both environmentally appropriate and socially acceptable.

Nigeria provides an important context for examining these issues because agriculture remains a major livelihood activity and the country's diverse agroecological conditions support the production of cereals, legumes, roots and tubers, vegetables and tree crops. National agricultural survey data demonstrate the widespread use of agricultural inputs, including inorganic fertilisers, insecticides, herbicides, fungicides and other crop-protection products (National Bureau of Statistics [NBS], 2025). The 2023 National Agricultural Sample Survey, for example, records multiple categories of pesticides and herbicides among agricultural inputs, illustrating the importance of chemical crop protection within Nigerian farming systems. However, the availability and use of these inputs raise concerns about the capacity of farmers to apply them safely and efficiently. Recent Nigerian studies have documented gaps between farmers' knowledge and actual pesticide-management practices. For example, research among smallholder farmers in Ogun State found that information from pesticide stakeholders was associated with farmers' pesticide-handling knowledge and behaviour, highlighting the importance of accessible and reliable information for safer pesticide use (Madaki, M. et al., 2024).

Evidence from other Nigerian production systems reinforces the need to examine agrochemical use as part of a broader assessment of farming practices. Imoloame et al. (2024), for instance, found that integrated pest-management practices among okra farmers in Kwara State were associated with differences in pesticide-residue occurrence, while limited farmer knowledge of IPM remained a concern. Research on pesticide safety among farmers in northern Nigeria has likewise identified deficiencies in occupational safety knowledge and practices during pesticide application (Adejimi et al., 2021). In southwestern Nigeria, recent evidence has also shown considerable regional variation in pesticide-use patterns and the factors influencing farmers' choices, suggesting that pesticide-use behaviour cannot be adequately understood through national-level statistics alone (Madaki et al., 2024). These findings suggest that the assessment of agrochemical use should be grounded in the specific agricultural, socioeconomic and institutional circumstances of individual farming communities.

The situation is especially pertinent in Benue State, widely recognised for its agricultural importance within Nigeria. The state's farming systems are dominated by smallholder production and include the cultivation of crops such as yam, cassava, maize, rice, soybean, groundnut and other food and cash crops. The importance of agricultural inputs in the state is reflected in recent government agricultural programmes, including the planned distribution of fertilisers, agrochemicals, knapsack sprayers and improved seeds to farmers for the 2026 cropping season. At the same time, empirical evidence from Benue indicates that farmers' crop-protection

practices vary considerably. Tologbonse and Adekunle (2018), for example, reported differing levels of adoption of recommended cowpea-protection practices among rural farmers in Benue State, with extension agents constituting an important source of information. Research in parts of Benue South has also documented concerns about herbicide use, including limited use of personal protective equipment and reliance on information from fellow farmers rather than formal training among some respondents (Abakpa et al., 2024).

Despite these studies, important geographical and empirical gaps remain. Existing Nigerian literature has tended to focus on particular crops, pesticide-handling behaviour, occupational health, pesticide residues or specific agricultural zones. Such studies provide valuable evidence, but they do not necessarily explain the broader configuration of farming practices and agrochemical use within individual rural communities. Moreover, evidence from Benue State has largely concentrated on particular crops, parts of the state or specific dimensions of agrochemical use (Ojo, 2016; Okafoagu, et al., 2017; Oshatunberu, et al., 2023; Faasema, & Chia, 2025). There is consequently limited empirical evidence that provides a descriptive account of how farmers in Oju Local Government Area select and use agricultural inputs, the types of agrochemicals employed, the purposes for which they are applied, and the farming practices through which these inputs are incorporated into crop production. This geographical gap is important because farming practices and agrochemical-use behaviour are shaped by local crop choices, pest conditions, socioeconomic circumstances, access to agricultural information and extension services, and the availability of inputs.

Oju Local Government Area provides an appropriate setting for addressing this gap because its predominantly rural agricultural communities depend substantially on crop production for livelihoods and food provision. Yet, without locally specific evidence, it is difficult to determine whether prevailing farming practices are consistent with principles of sustainable agricultural production or whether agrochemical use may be creating avoidable environmental and occupational risks. A descriptive assessment is therefore an essential first step before attempting to explain determinants or model the environmental consequences of agrochemical use. Establishing empirical evidence on the characteristics of farming practices, types and patterns of agrochemical use, sources of information, and farmers' approaches to handling and application can provide a baseline for subsequent interventions, extension programming and environmental management.

Accordingly, this study assesses farming practices and agrochemical use among farmers in Oju Local Government Area of Benue State, Nigeria. By providing a location-specific description of agricultural practices and agrochemical-use patterns, the study seeks to fill an important empirical gap in the Nigerian literature and provide evidence for promoting safer, more efficient and environmentally sustainable agricultural practices in the study area. The study also contributes to the broader sustainable-intensification discourse by demonstrating why agricultural-input management needs to be examined at the local scale, where the interaction between farmer behaviour, agricultural productivity and environmental sustainability becomes most tangible.

MATERIALS AND METHODS

2.1 Study Area

Oju LGA is located in the southern part of Benue State in North-Central Nigeria. It lies between latitudes 6°40'00''N to 7°50'00''N and longitude 8°05'00''E to 8°40'00''E, occupying a transitional terrain between the southern Guinea savanna and the Cross River plains. It shares boundaries with several other LGAs and states: To the north: Obi LGA and Gwer East LGA, To the east: Konshisha LGA to the south: Izzi LGA of Ebonyi State. To the west: Ado LGA and parts of Cross River State as shown (Figure 1).

The topography of Oju is moderately undulating, with elevations ranging from 150 meters to over 350 meters above sea level, forming part of the Benue trough hinterlands and extending eastward toward the Obudu-Cameroon Highlands. The terrain is generally gently rolling, particularly in the central and western parts of the LGA (around Idekpa, Owo, and Uwokwu), interspersed with low inselbergs and isolated hillocks in the east (in Oboru, Okudu, and Itogo), which are residual features of basement complex rocks that resisted weathering (Ofomata, 1975; Iloeje, 1981). The topographic gradient becomes more rugged as one approaches the border areas with Cross River State, reflecting a shift from sedimentary plains to crystalline basement highlands. Its geology comprises Precambrian Basement Complex rocks and Cretaceous sedimentary formations, which

influence topography, drainage, soil development and erosion. Oju experiences a tropical wet-and-dry climate, with annual rainfall of about 1,200–1,800 mm and mean temperatures of 26–32°C. The vegetation is predominantly Southern Guinea Savanna, although extensive human activities have transformed parts of the natural vegetation into derived savanna and fragmented landscapes. Soils include Ferralsols, Luvisols, Lixisols, Vertisols and Lithosols/Regosols, with considerable variation in fertility, drainage and susceptibility to erosion.

Agriculture is the dominant economic activity in Oju and is largely based on smallholder, rain-fed and mixed subsistence farming. Major crops include cassava, yam, maize, soybean, groundnut, cowpea and vegetables, with cassava increasingly becoming dominant because of its tolerance to poor soils and variable rainfall. Traditional practices such as fallowing, crop rotation, residue retention and ash application are increasingly being replaced or supplemented by continuous cultivation and mineral fertiliser use, resulting in declining soil organic matter and nutrient depletion. Livestock production exists but is weakly integrated with crop production, limiting the recycling of manure and nutrients. Consequently, the combination of intensive smallholder farming, soil fertility decline, climatic variability and increasing reliance on agrochemicals makes Oju LGA an appropriate setting for investigating the effects of agrochemical use on soil quality.

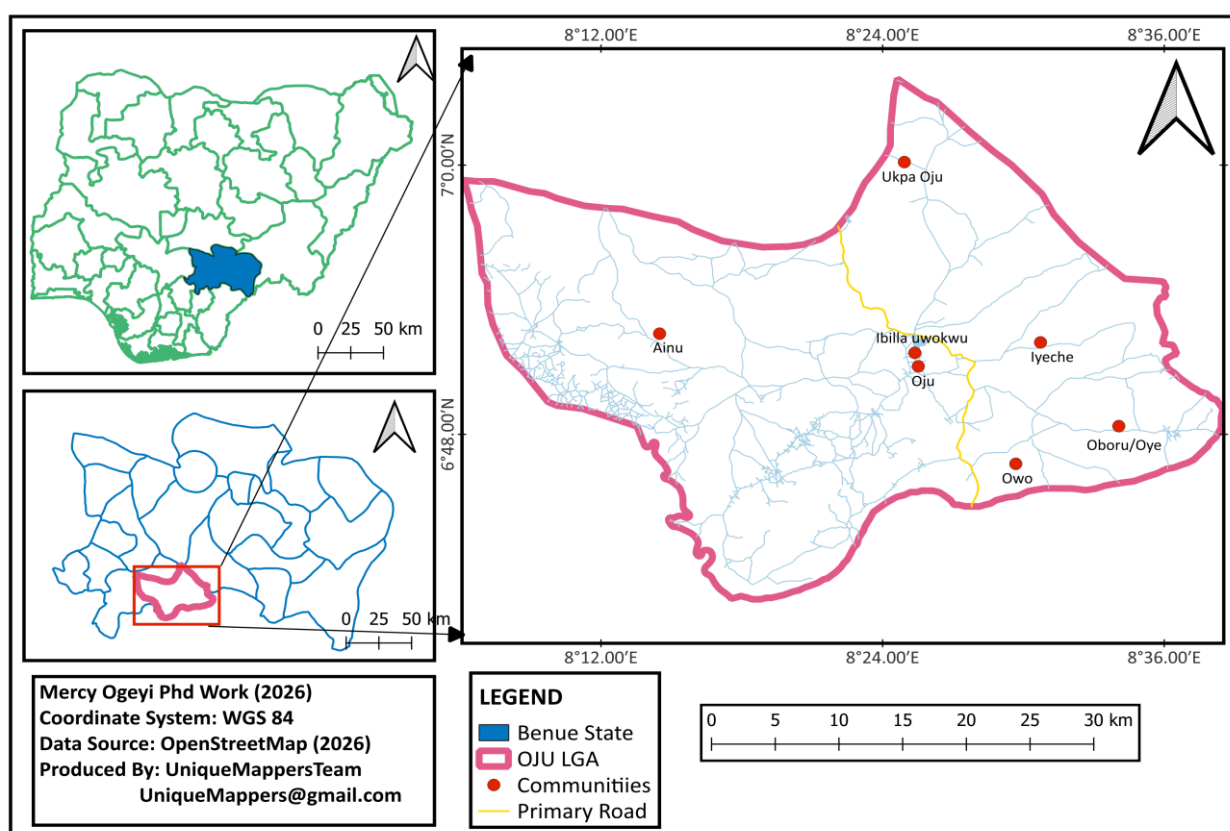


Figure 2: Study Communities in Oju Local Government Area of Benue State.

2.2 Methods

The study adopted a descriptive cross-sectional survey design to assess farming practices and agrochemical use among farmers in Oju Local Government Area of Benue State. The study population comprised crop farmers in Oju, Ibilla, Ukpa, Iyeche, Owo, Oboru and Uwokwu communities. A multistage sampling procedure was used to obtain adequate geographical representation of the farming communities. At the first stage, Oju LGA was purposively selected because of its predominantly agricultural economy and use of agricultural inputs. At the second stage, the seven farming communities were selected, after which 120 farmers were purposively sampled across the selected communities. Data were obtained primarily through a structured questionnaire administered to the sampled farmers and supplemented by field observations where necessary. The questionnaire collected information on farmers' socio-demographic characteristics, farming practices, irrigation, agrochemical use, types and purposes of agrochemicals, frequency and duration of use, sources of information, safety practices,

and perceptions concerning agrochemical use. The study also assessed farmers' awareness of organic alternatives and their willingness to adopt soil-friendly practices.

The questionnaire responses were coded and analysed using SPSS Version 27. Frequency counts, percentages, means and standard deviations were used to summarise farmers' characteristics and describe the major patterns of farming and agrochemical use across the study communities. Community-level comparisons were also made to identify variations in agrochemical application and farmers' experience with agrochemicals. The descriptive approach provided a location-specific assessment of farming practices and agrochemical-use patterns among farmers in Oju LGA.

2.3 Methodological Limitations

This study has some limitations that should be considered when interpreting the findings. First, the assessment of the environmental effects of agrochemical use was based on farmers' perceptions rather than direct laboratory measurements of soil and water quality. Thus, reported observations concerning declining soil fertility, soil hardening, reduction in soil organisms, pesticide residues and pollution of nearby water bodies represent respondents' perceptions and cannot, on their own, be interpreted as measured evidence of environmental contamination or causal effects of agrochemical use. Second, the cross-sectional design provides a description of farming practices and agrochemical-use patterns at the time of the survey but does not establish temporal or causal relationships between agrochemical application and changes in soil or environmental conditions. Third, the purposive selection of the study communities and respondents may limit the generalisability of the findings beyond the surveyed communities. Nevertheless, the study provides useful location-specific baseline evidence on farming practices, agrochemical use and farmers' perceptions that can inform further environmental assessment and agricultural extension interventions.

RESULTS AND DISCUSSION

3.1 Results

3.1.1 Socio -Demographic Characteristics of Respondents

The result of socio -demographic characteristics of respondents is presented in Table 1. The result indicates that respondents were predominantly adults, with those aged 35–44 years constituting the largest proportion (28.3%), followed by 45–54 years (25.8%), 55 years and above (20.9%), 25–34 years (18.3%), and below 25 years (6.7%). Males constituted 68.3% of the respondents, while females accounted for 31.7%. Most respondents were married (69.2%), while 15.0% were single, 9.2% widowed and 6.6% divorced. Educational attainment was mainly secondary (34.2%) and primary (30.8%), while 20.0% had no formal education, 10.0% had tertiary education and 5.0% had adult education. Farming was the predominant occupation (48.3%), followed by farming and trading (26.7%), farming and civil service (15.0%), and other occupations (10.0%). Household sizes were mainly 4–6 members (38.3%) and 7–9 members (32.5%), followed by 10 or more members (16.7%) and 1–3 members (12.5%).

Table 1: Socio-Demographic Characteristics

Variable	Category	Frequency	Percentage
Age Group (Years)	< 25	8	6.7
	25–34	22	18.3
	35–44	34	28.3
	45–54	31	25.8
	≥ 55	25	20.9
	Total	120	100

Sex	Male	82	68.3
	Female	38	31.7
	Total	120	100
Marital Status	Single	18	15
	Married	83	69.2
	Widowed	11	9.2
	Divorced	8	6.6
	Total	120	100
Educational Level	No formal education	24	20
	Primary education	37	30.8
	Secondary education	41	34.2
	Tertiary education	12	10
	Adult education	6	5
	Total	120	100
Major Occupation	Farming only	58	48.3
	Farming and Trading	32	26.7
	Farming and Civil Service	18	15
	Farming and Other Occupations	12	10
	Total	120	100
Household Size	1–3	15	12.5
	4–6	46	38.3
	7–9	39	32.5
	≥ 10	20	16.7
	Total	120	100

Source: Author's analysis, 2026.

3.1.2 Farming Practices

The results of farming practices (farm sizes, types of farming practices, use of irrigation system by farmers) are presented in Tables 2 to 4. The result revealed that farm sizes were predominantly 1–3 ha (43.3%), followed by 4–6 ha (25.8%), less than 1 ha (15.0%), and 7 ha or more (15.9%). Arable cropping was the most common farming practice (35.0%), followed by arable and mixed cropping (28.3%), arable and tree cropping (16.7%), and combined arable, mixed and tree cropping (13.3%). Irrigation use was relatively low, with only 26.7% of respondents using irrigation compared with 73.3% who relied mainly on rain-fed farming.

Table 2. The Distribution of Farm Size

Farm Size (ha)	Frequency	Percentage
<1	18	15
1–3	52	43.3
4–6	31	25.8

≥ 7	19	15.9
Total	120	100

Source: Author's Field Survey, 2026

Table 3: Distribution of Respondents by Types of Farming Practices

Type of Farming Practiced	Frequency	Percentage
Arable crops only	42	35.0
Arable and Mixed crops	34	28.3
Arable and Tree crops	20	16.7
Arable, Mixed and Tree crops	16	13.3
Others	8	6.7
Total	120	100.0

Source: Author's Field Survey, 2026

Table 4: Distribution of Irrigation Use by Farmers Across the Seven Communities

Community	Number of Respondents	Yes	Yes (%)	No	No (%)
Oju	17	4	23.5	13	76.5
Ibilla	17	5	29.4	12	70.6
Ukpa	17	4	23.5	13	76.5
Iyeche	17	5	29.4	12	70.6
Owo	17	5	29.4	12	70.6
Oboru	18	5	27.8	13	72.2
Uwokwu	17	4	23.5	13	76.5
Total	120	32	26.7	88	73.3

Source: Author's Field Survey, 2026

3.1.3 Agrochemical use by farmers

The results of agrochemical use by farmers are presented in Table 5 to 7. The results indicate that agrochemical use was widespread, with 70.8% of respondents reporting its application compared with 29.2% who did not (Table 5). Among users, repeated application was common, with 45.9% applying agrochemicals more than three times, 30.6% twice, 29.4% three times and 10.6% once (Table 6). Regarding experience, 43.5% had 11–20 years of agrochemical-use experience, 29.4% had more than 20 years, 28.2% had 5–10 years, and 14.1% had less than five years of experience (Table 7).

Table 5: Distribution of farmers by Use of Agrochemicals

Community	Applied Agrochemicals n(%)	Did Not Apply Agrochemicals n(%)	Total n (%)
Oju	12 (70.6)	5 (29.4)	17 (100.0)
Owo	13 (76.5)	4 (23.5)	17 (100.0)
Ibilla	14 (82.4)	3 (17.6)	17 (100.0)

Ukpa	12 (70.6)	5 (29.4)	17 (100.0)
Oboru	13 (72.2)	5 (27.8)	18 (100.0)
Uwokwu	11 (64.7)	6 (35.3)	17 (100.0)
Iyeche	10 (58.8)	7 (41.2)	17 (100.0)
Total	85 (70.8)	35 (29.2)	120 (100.0)

Source: Author's Field Survey, 2026

Table 6: Community Distribution of the Frequency of Agrochemical Application

Community	Once n (%)	Twice n (%)	Three Times n (%)	More Than 3 Times n (%)	Total n (%)
Oju	0 (0.0)	2 (2.4)	5 (5.9)	10 (11.8)	17 (20.0)
Owo	0 (0.0)	2 (2.4)	5 (5.9)	10 (11.8)	17 (20.0)
Ibilla	0 (0.0)	2 (2.4)	5 (5.9)	10 (11.8)	17 (20.0)
Ukpa	1 (1.2)	4 (4.7)	5 (5.9)	3 (3.5)	13 (15.3)
Oboru	1 (1.2)	4 (4.7)	5 (5.9)	3 (3.5)	13 (15.3)
Uwokwu	2 (2.4)	4 (4.7)	0 (0.0)	3 (3.5)	9 (10.6)
Iyeche	5 (5.9)	8 (9.4)	0 (0.0)	0 (0.0)	13 (15.3)
Total	9 (10.6)	26 (30.6)	25 (29.4)	39 (45.9)	85 (100.0)

Source: Author's Field Survey, 2026

Table 7: Community Distribution of Respondents by Years of Agrochemical Use

Community	<5 Years n (%)	5–10 Years n (%)	11–20 Years n (%)	>20 Years n (%)	Total n (%)
Oju	0 (0.0)	1 (1.2)	8 (9.4)	8 (9.4)	17 (20.0)
Owo	0 (0.0)	2 (2.4)	9 (10.6)	6 (7.1)	17 (20.0)
Ibilla	1 (1.2)	2 (2.4)	9 (10.6)	5 (5.9)	17 (20.0)
Ukpa	2 (2.4)	7 (8.2)	4 (4.7)	0 (0.0)	13 (15.3)
Oboru	2 (2.4)	7 (8.2)	4 (4.7)	0 (0.0)	13 (15.3)
Uwokwu	2 (2.4)	2 (2.4)	2 (2.4)	3 (3.5)	9 (10.6)
Iyeche	5 (5.9)	3 (3.5)	1 (1.2)	3 (3.5)	12 (14.1)
Total	12 (14.1)	24 (28.2)	37 (43.5)	25 (29.4)	85 (100.0)

Source: Author's Field Survey, 2026

3.1.4 Awareness of Organic Alternatives and Willingness to Adopt Soil-Friendly Practices

The results of awareness of organic alternatives and willingness to adopt soil-friendly practices are presented in Tables 8 -10. The result indicates that awareness of organic alternatives was reported by 63.3% of respondents, with a mean score of 1.63 and standard deviation of 0.48. Willingness to adopt soil-friendly practices was higher, with 84.2% expressing willingness and a mean score of 1.84 (SD = 0.37). Respondents generally recognised the potential effects of agrochemicals on soil and the environment. Declining soil fertility recorded the highest mean score (M = 3.82), followed by pollution of nearby water bodies (M = 3.80), persistence of pesticide residues in soil (M = 3.74), and the perceived soil-fertility benefits of fertilisers (M = 3.73). Soil hardening (M = 3.69), reduction in soil organisms (M = 3.67), increased soil erosion (M = 3.58), and reduced yield over time (M = 3.43) also received relatively high mean scores.

Table 8: Awareness of Organic Alternatives

Response	Frequency	Percentage
Yes	76	63.3
No	44	36.7
Total	120	100

Mean = 1.63; Standard Deviation = 0.48

Source: Author's Field Survey, 2026

Table 9: Willingness to Adopt Soil-Friendly Practices

Response	Frequency	Percentage
Yes (2)	101	84.2
No (1)	19	15.8
Total	120	100

Mean = 1.84; Standard Deviation = 0.37

Source: Author's Field Survey, 2026

Table 10: Perceived Effects of Agrochemicals on Soil Quality

Statement	SA	A	N	D	SD	Mean
Fertilizers improve soil fertility	38	44	14	16	8	3.73
Chemicals harden the soil	41	39	12	18	10	3.69
Agrochemicals reduce soil organisms	36	42	18	14	10	3.67
Agrochemicals reduce yield over time	29	38	21	20	12	3.43
Pollute nearby water bodies	40	46	13	12	9	3.80
Residues remain in soil long	37	45	16	14	8	3.74
Soil erosion increases with high use	33	41	19	17	10	3.58
Decline in soil fertility observed	42	44	12	14	8	3.82

Source: Author's Field Survey, 2026

3.2 Discussion

The socio-demographic profile indicates that farming in the study area is predominantly undertaken by mature, married and male respondents. The concentration of respondents within the 35–54-year age groups suggests that agricultural production is largely undertaken by economically active adults with considerable farming experience. The relatively low educational attainment, with 54.2% having either no formal or only primary education, is also important because access to formal education can influence farmers' ability to interpret agrochemical labels, understand application instructions and access information on alternative farming practices. This interpretation is consistent with Issa et al. (2015), who found that education and farming experience were

important factors associated with farmers' adoption of recommended agrochemical practices in Kaduna and Ondo States. Similarly, Apeh et al. (2024), in a six-state Nigerian study involving 840 farmers and agrochemical marketers, identified inadequate education and training, financial constraints and weak enforcement as factors contributing to inappropriate agrochemical practices.

The predominance of small and medium-sized farms and the low level of irrigation use suggest that agricultural production in the study area remains largely smallholder and rain-fed. This pattern is important in interpreting agrochemical use because farmers operating small farms may depend heavily on purchased inputs to maintain crop productivity under variable environmental conditions. The predominance of rain-fed agriculture may also increase farmers' sensitivity to seasonal variability and crop losses, potentially encouraging reliance on readily available external inputs. Evidence from Nigerian smallholder farming systems similarly shows that farm characteristics, resource availability and household conditions influence farmers' decisions concerning sustainable agricultural practices. For example, Okojie et al. (2023) found that socioeconomic characteristics were associated with farmers' adoption and intensity of organic farming in southeastern Nigeria.

The finding that 70.8% of respondents used agrochemicals demonstrates their substantial importance in local agricultural production. This is consistent with Apeh et al. (2024), who reported that approximately 99% of farmers in their multi-state Nigerian sample used agrochemicals, including inorganic fertilisers and pesticides. The relatively high level of agrochemical use in the present study is also comparable with evidence from southeastern Nigeria, where Apeh et al. (2018) reported that 74% of farmers used inorganic fertilisers compared with 26% using organic fertilisers. These findings suggest that synthetic agricultural inputs remain deeply embedded in smallholder production systems in Nigeria.

The frequency of application provides a particularly important finding. Among agrochemical users, 45.9% reported application more than three times, while 29.4% reported three applications and 30.6% reported two applications. This indicates that repeated application is common and raises concerns about cumulative exposure and possible environmental effects. Recent evidence from northern Nigeria supports this concern. A study of 1,556 tomato producers found substantial non-compliance with recommended pesticide-management practices, including inappropriate disposal of pesticide containers and harvesting within recommended pre-harvest intervals. Likewise, a 2026 study of farmers in parts of the Niger and Kaduna catchments reported limited knowledge of agrochemical hazards, with only 35% aware of pesticide restrictions and fewer than 9% able to correctly classify pesticide compounds.

The long experience of respondents in agrochemical use is also noteworthy. In the present study, 43.5% had 11–20 years of experience and a further 29.4% had more than 20 years of experience. Long-term experience does not necessarily imply correct or environmentally safe application. Indeed, the findings of Hassan et al. (2025) in Bunkure LGA, Kano State, showed that 78% of farmers had used agrochemicals for more than four years and 76% applied them more than twice annually. Although 61% were aware of agrochemical effects on soil quality, 94% believed that agrochemicals affected soil quality, showing that awareness can coexist with continued intensive use.

The respondents' perceptions of soil impacts are broadly supported by recent empirical evidence. The high mean score for observed decline in soil fertility (3.82) is particularly important because it suggests that farmers are noticing changes in soil productivity or condition despite continuing to use agrochemicals. Hassan et al. (2025) examined soil samples alongside farmer perceptions in northwestern Nigeria and assessed organic carbon, phosphorus, nitrogen, cation exchange capacity and exchangeable bases. Their findings demonstrate the value of combining farmers' perceptions with direct soil measurements when evaluating the environmental implications of agrochemical use.

The high perception that agrochemicals pollute nearby water bodies (mean = 3.80) is also consistent with the wider Nigerian evidence on environmental contamination. Akinsete and Saliu (2026), analysing soils from selected farms and farmers' household surroundings in southwestern Nigeria, detected 41 pesticide compounds comprising organochlorines, organophosphates, carbamates and pyrethroids. The study reported the presence of several highly hazardous compounds and some banned residues, thereby demonstrating that pesticide use can result in measurable soil contamination. Similarly, a study of organochlorine pesticide residues in agricultural

soils in southern Nigeria found that only 37.6% of farmers had received training on safe pesticide application, further highlighting the environmental-management implications of pesticide use.

The perception that agrochemicals reduce soil organisms (mean = 3.67) is also supported by recent Nigerian experimental evidence. Research conducted on pesticide-treated farm soils in Bayelsa State examined changes in bacterial abundance and diversity following pesticide application, demonstrating the relevance of pesticide use to soil microbial communities. Thus, the respondents' perception of declining soil organisms is environmentally plausible, although the present survey alone cannot establish the magnitude or direction of actual changes in soil microbial populations.

The relatively high mean score for soil hardening (3.69) and the perception that soil erosion increases with high agrochemical use (3.58) indicate that farmers associate intensive chemical use with broader soil degradation. However, these relationships should be interpreted cautiously because the survey measures perceptions rather than experimentally established causal effects. The distinction is important because agrochemicals may influence soil properties through several pathways, while erosion is also affected by vegetation cover, tillage, slope, rainfall intensity and land-management practices. The present findings therefore provide evidence of farmers' environmental perceptions rather than direct measurements of soil degradation.

An important finding is that respondents simultaneously recognised the beneficial role of fertilisers in improving soil fertility (mean = 3.73) and perceived several negative consequences of agrochemical use. This apparently contrasting perception is understandable because farmers may distinguish between the short-term agronomic benefits of fertiliser application and longer-term environmental consequences of inappropriate or excessive use. Hassan et al. (2025) similarly found that most farmers in Bunkure perceived agrochemicals as having an effect on soil quality, while many considered their effects positive. The finding reinforces the need for sustainable nutrient management rather than simply advocating complete withdrawal of fertilisers and other agricultural inputs.

The finding that 63.3% of respondents were aware of organic alternatives and 84.2% were willing to adopt soil-friendly practices is encouraging. It suggests that a substantial proportion of farmers may be receptive to interventions aimed at reducing dependence on synthetic inputs. The willingness level is higher than the 71.5% reported by Okonta et al. (2023) among arable crop farmers in Oyo State. Their study also found that knowledge and perception were significantly related to willingness to adopt organic farming, while inadequate credit and limited access to organic inputs were important barriers.

The present result is further supported by Ikuerowo and Tehinloju (2021), who found that awareness of bio-organic technology was inadequate among many arable farmers in Ondo State, but that education, access to information, farmer-group membership and extension visits increased the likelihood of adoption. Similarly, a study in southeastern Nigeria found that information about organic farming was an important determinant of adoption: farmers who knew what organic farming entailed were more likely to adopt organic farming and allocate more land to it. These findings suggest that the 63.3% awareness recorded in the present study provides a useful foundation, but awareness needs to be converted into practical knowledge, access to inputs and sustained adoption.

The willingness of 84.2% of respondents to adopt soil-friendly practices is also consistent with evidence from Oyo State and other parts of Nigeria. Okonta et al. (2023) found that farmers were generally willing to adopt organic farming, although inadequate credit and access to organic inputs constrained adoption. In Ondo State, farmers also demonstrated positive perceptions of organic agriculture, particularly regarding its contribution to soil fertility and reduction of health hazards associated with synthetic inputs. However, Adebisi and Olabisi (2022) caution that adoption of organic farming in Nigeria is shaped by interconnected economic, knowledge, institutional and market factors. Thus, willingness should not be interpreted as equivalent to actual adoption.

Similarly, evidence from organic leafy vegetable production in southwestern Nigeria indicates that adoption decisions are shaped by livelihood assets, institutional factors, gender-related conditions, competing livelihood activities and farmers' vulnerability contexts. This suggests that interventions in the study area should go beyond awareness campaigns and address the practical conditions that determine whether farmers can substitute or

complement synthetic inputs with soil-friendly alternatives. Recent evidence from Abia State likewise indicates that training, education, farming experience and age influence adoption of organic and agroecological practices, while credit limitations, input costs, technical difficulties and poor market information constrain adoption.

CONCLUSION AND RECOMMENDATIONS

The study concludes that farming in Oju Local Government Area is predominantly smallholder, male-dominated and largely rain-fed, with most farmers cultivating 1–3 ha and relying mainly on arable cropping. Agrochemical use is widespread, as 70.8% of respondents reported using agrochemicals, while repeated application was common, with 45.9% applying them more than three times. The relatively long duration of agrochemical use among respondents indicates that chemical inputs have become well established within local farming systems. At the same time, farmers demonstrated considerable awareness of the potential environmental implications of agrochemical use, particularly declining soil fertility ($M = 3.82$), pollution of nearby water bodies ($M = 3.80$), persistence of residues in soil ($M = 3.74$), and reduction in soil organisms ($M = 3.67$). Although 63.3% were aware of organic alternatives, the much higher proportion willing to adopt soil-friendly practices (84.2%) suggests a positive disposition towards more sustainable agricultural practices. However, willingness does not necessarily translate into adoption, particularly where farmers face limitations in knowledge, extension support, access to appropriate alternatives and financial resources.

The study therefore recommends that agricultural extension services in Oju LGA should be strengthened to provide practical training on correct agrochemical selection, dosage, timing, application, storage and disposal, with particular emphasis on the risks associated with repeated application. Farmers should also be encouraged to adopt integrated pest management, crop rotation, organic soil amendments, residue management and other soil-friendly practices that can complement or reduce dependence on synthetic inputs. Extension programmes should give special attention to farmers with limited formal education by using demonstrations and locally understandable communication materials. Government and relevant agricultural agencies should improve farmers' access to organic inputs, soil-testing services, affordable extension support and appropriate irrigation technologies, while community-based awareness programmes should promote protection of soil and nearby water resources. Finally, future studies should complement farmers' perceptions with laboratory analysis of soil, water and agrochemical residues to establish the actual environmental effects of agrochemical use in Oju LGA.

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