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SOIL FERTILITY MANAGEMENT PRACTICES OF SMALLHOLDER FARMING COMMUNITIES IN NASARAWA STATE, NIGERIA

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ABSTRACT: *This study assessed soil fertility management practices among smallholder farming communities in five Local Government Areas (LGAs) of Nasarawa State, Nigeria. A total of 150 respondents were selected using multistage sampling technique. Data were collected using semi-structured questionnaires, capturing information on socioeconomic characteristics, soil fertility practices, and challenges. The results showed that 93.33% of respondents in Lafia LGA and 96.67% in Obi LGA practiced soil conservation methods, with the most common techniques being cover cropping, used by 86.67% of farmers in Obi, and organic manure application, adopted by 100% of respondents in Akwanga, Doma, and Nassarawa Eggon LGAs. Chemical fertilizer usage was relatively lower, ranging from 6.67% in Obi to 50% in Lafia. Major challenges faced by farmers included inadequate knowledge of soil management, identified by 100% of respondents in Akwanga, and high fertilizer costs, reported by 70% of respondents in Lafia and Obi LGAs. Education played a significant role in adopting soil fertility practices, as respondents with tertiary education were more likely to employ modern techniques like conservation tillage and agroforestry. Despite these practices, limited access to organic materials and technical knowledge hindered broader adoption of Integrated Nutrient Management (INM). The study highlighted the need for tailored interventions, such as farmer education and capacity building, to improve soil health and agricultural productivity. These findings provided a foundation for developing policies that promote sustainable farming practices, ensuring long-term food security in Nasarawa State and Nigeria as a whole.*

KEYWORDS: Conservation, Fertility, Management, Organic manure, Productivity.

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INTRODUCTION

Agriculture plays a vital role in enhancing food security, generating income, and improving livelihoods across Africa, including Nigeria (Jayne & Sanchez, 2021). Soil fertility is a critical determinant of agricultural productivity, particularly for smallholder farming communities, which rely heavily on sustainable land use for their livelihoods (Kwadzo & Quayson, 2021). In Nigeria, smallholder farmers contribute significantly to food production; however, declining soil fertility and soil health have emerged as significant barriers to achieving sustainable agricultural productivity, especially in sub-Saharan Africa (Giller, 2020). In Nigeria, where soil remains the primary medium of production, the agricultural sector employs between 60-80% of the population, making it the backbone of the economy (Nwuneli, 2010; Omorogiuwa *et al*., 2014). Yet, the challenge of soil degradation poses a serious threat to the country's agricultural sustainability and food security (Adebayo & Ojo, 2012). These issues are particularly pronounced in Nasarawa State, which lies within the middle Benue Trough, a region known for its agricultural potential. Nasarawa State is predominantly agrarian, with a diverse range of smallholder farming communities engaging in crop cultivation and animal husbandry (Salau *et al*., 2013; Abiodun, 2022). The state's fertile alluvial soils, deposited by the seasonal flooding of the River Benue, offer opportunities for agricultural expansion. However, soil fertility varies across the state, influenced by factors such as topography, land use history, and climate (Obi *et al*., 2023; Onwuka *et al*., 2020). The productivity and efficiency of smallholder farmers, who constitute the majority of Nigeria's farming population, are influenced by multiple factors, such as soil fertility, quality of inputs, farm management practices, and socioeconomic conditions. Agricultural productivity in Nigeria, and more broadly across Africa, has consistently lagged behind that of other continents like Europe, America, and Asia (Ritchie, 2022). Among the key factors contributing to this disparity is the declining fertility of soils, which underscores the need for innovative soil fertility management practices that are accessible to smallholder farmers (Mowo *et al*., 2000; Douthwaite *et al*., 2002; Giller *et al*., 2015).

Despite the development of various technological and institutional innovations aimed at addressing soil fertility degradation, these solutions have not been widely adopted by smallholder farmers. In Nigeria, the Federal Government through the Central Bank of Nigeria (CBN) had in the past and current times implemented several intervention programmes to boost productivity in the agricultural sector. Some of these interventions include Fertilizer Subsidy Programme, Agricultural Credit Guarantee Scheme (ACGS), Commercial Agricultural Credit Scheme (CACS) and the current Anchor Borrower's Programme (ABP), among others. The low adoption rate can be attributed to several factors, including the disconnect between the innovations and the farmers' specific contexts, lack of resources, and limited inclusion of farmers in the development process (Wennik *et al.,* 2000; Douthwaite *et al*., 2002; Andersson & D'Souza, 2014). As a result, there is an urgent need to understand current approaches locally adopted by farmers' inorder to effectively develop new approaches that are both effective and inclusive in addressing soil fertility challenges. Smallholder farmers in Nasarawa State employ various traditional and modern soil fertility management techniques using their indigenous knowledge. Understanding the soil fertility management practices of smallholder farming communities in Nasarawa State is crucial for developing policies and interventions that promote sustainable land use and improve agricultural

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productivity. This study assessed the current soil fertility management practices of smallholder farmers, evaluated their effectiveness, and identified factors influencing their adoption. By doing so, the study would contribute to enhancing the resilience of farming communities in Nasarawa State, ensuring long-term soil health and food security.

METHODOLOGY

Study Area

The study area, Nasarawa State, lies between latitudes 7° 20' and 9° 38' North and longitudes 7° 20' and 1° 0' East (Figure 1). It is bordered by Benue State to the south, Kogi State to the west, the Federal Capital Territory (FCT), Abuja, to the northwest, Kaduna and Plateau States to the northeast, and Taraba State to the southeast. Nasarawa State is situated within the middle portion of the Nigerian Benue Trough, a sedimentary basin, and comprises thirteen Local Government Areas (Obaje *et al*., 2006). The state covers a total land area of 26,875.59 square kilometers and, according to the 2006 population census, has a population of about 1,826,883, with a density of approximately 67 persons per square kilometer. The topography of Nasarawa State includes hills, dissected terrain, undulating plains, and lowlands. It has fertile alluvial soils deposited by the seasonal flooding of the River Benue (Lyam, 2000). The state's climate is typical of the tropical zone, with a maximum temperature of 81.7°F and a minimum of 16.7°F. Annual rainfall ranges between 131.73 cm and 145 cm, with the dry season occurring from November to April and the rainy season from April to October (Yusufu, 2017; Audu *et al*., 2018). The cold harmattan winds blow across the state from the northeast during the months of December, January, and February. Nasarawa State falls within the southern Guinea Savanna vegetation belt, which is characterized by an open forest of trees and tall grasses, along with some undergrowth. Gallery forests are found along rivers and streams that drain the area (Lyam, 2000).

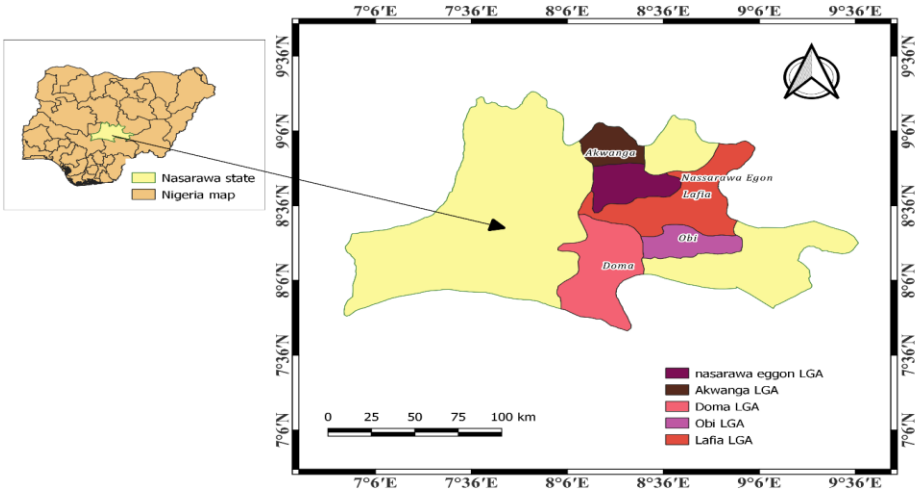

Figure 1: Map of Nasarawa State

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Data Collection

Multistage sampling technique was used for data collection in the study area. First, five (5) Local Government Areas (LGAs) were selected from Nassarawa State. In the second stage, five (5) farming communities were chosen from each selected LGA. In the third stage, ten (10) farmers, both male and female were randomly selected from each community, totaling 150 respondents for the study. Quantitative data were collected using semi-structured and validated questionnaires. These questionnaires captured information on the farmers' socioeconomic characteristics, current soil fertility management practices, soil conservation methods in the study areas and problems associated with soil fertility management practices.

RESULTS AND DISCUSSIONS

The demographic characteristics of the respondents' showed that the majority of respondents across the five Local Government Areas (LGAs) were male, with the highest male participation in Lafia LGA (76.67%) and Doma LGA (75.86%) (Table 1). Female respondents were more prevalent in Akwanga LGA, where 56.67% were women, showing a somewhat balanced gender representation. This male dominance in farming roles may reflect traditional gender roles in agriculture confirming the assertion of Sobola *et al*. (2015) that farming is male dominated in Nigeria because of the laborious nature. However, female participation is still significant, particularly in areas like Akwanga, indicating the vital role women play in soil fertility management. Most respondents were married, with 100% of the participants in Akwanga LGA reporting being married, followed by 90% in Obi LGA and 89.65% in Doma LGA. A small proportion were single or divorced, with 16.12% of the respondents in Nassarawa Eggon LGA being single. The high percentage of married individuals implies that these household heads are duty bound to provide for their family hence their seriousness about their farming occupation, which can influence soil fertility practices and implementation of certain techniques. Household size varied significantly among the LGAs, with Akwanga LGA having the largest households, where 100% of respondents reported having between 10-13 members. In contrast, smaller households (3-5 members) were more common in Lafia (16.67%) and Obi (13.33%) LGAs. Household size is an important factor in determining the labor availability for farm activities. Larger households may have more hands available to implement labor-intensive fertility practices such as composting or mulching. This result is consistent with the findings of Adekunle (2009) who reported large family size among farmers in Nigeria for farm labor supply. Educational attainment among respondents varied widely. Akwanga LGA had a higher percentage of individuals with no formal education (67.86%); this explains the reasons for larger family size in the area as lack of formal education leads to low adoption of family planning while Doma LGA had the highest proportion of tertiary-educated respondents (82.76%). The varying education levels across the LGAs suggest differences in access to formal knowledge on soil fertility management practices. Research has shown that education plays a crucial role in the adoption of new technology (Riddell & Song, 2017). Farmers with higher education, particularly in Doma LGA, may be more inclined to adopt scientific approaches to soil management, while those with less education may rely more on traditional practices. Farming was the predominant occupation

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across all LGAs, with Akwanga (75%) and Obi (80.56%) having the highest proportions of farmers. Civil service was a significant occupation in Doma LGA (78.31%). The reliance on farming as the major source of livelihood emphasizes the need for sustainable soil fertility practices to ensure long-term productivity. Most respondents in all LGAs inherited their farmland, with Akwanga LGA having the highest proportion (77.55%). Leasing of land was also common, especially in Lafia LGA (36.11%) and Obi LGA (33.33%) (Figure 2). The mode of land acquisition can impact the type of soil fertility management practices employed, as those who lease land may not be willing to invest in long-term fertility-enhancing measures such as agroforestry or crop rotation, unlike those who inherit land and have a longer-term perspective. Acquisition through Inheritance is also a major challenge of land fragmentation as pointed out by Sobola *et al*. (2015) that farmers with small landholding as a result of land fragmentation may be reluctant in adopting farm practices involving incorporation of woody perennials. Respondents generally had significant farming experience, with the highest proportion of those having between 5-10 years of experience in all LGAs. Akwanga (40%) and Obi (30%) had substantial numbers of newer farmers with less than five years of experience (Figure 3). This indicates a mix of experienced and newer farmers, which may affect the adoption of soil fertility practices. Experienced farmers are more likely to rely on established methods, while newer farmers may be more open to modern practices if they receive adequate extension services.

Table1: Socio-economic Characteristics of the Respondents

	Lafia L.G.A	**Obi L.G.A**	**Akwanga L.GA**	**Doma L.GA**	**Nassarawaeggon L.G.A**
Variables	**Freq. (%)**	**Freq. (%)**	**Freq. (%)**	**Freq. (%)**	**Freq. (%)**
Sex					
Male	23 (76.67)	17 (56.67)	13 (43.33)	23 (75.86)	18 (61.29)
Female	7 (23.33)	13 (43.33)	17 (56.67)	7 (24.13)	12 (38.71)
Chi-Square p-value 0.034 significant (P<0.05)					
Marital Status					
Married	21 (70)	27 (90)	30 (100)	26 (89.65)	21(67.74)
Single	3 (10)	3 (10)	0 (0)	2 (6.89)	5 (16.12)
Divorce	2 (6.67)	0 (0)	0 (0)	0 (0)	2 (6.45)
Widow/Widower	4 (13.33)	0 (0)	0 (0)	1 (3.45)	3 (9.67)
Household Size					
3-5	5 (16.67)	4 (13.33)	0 (0)	1 (3.45)	6 (19.35)
6-9	17 (56.66)	7 (23.33)	0 (0)	14	13 (13.79)

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10-13	5 (16.67)	15 (50)	30 (100)	(48.27) 10 (34.48)	9 (29.03)
>13	0 (0)	1 (3.33)	0 (0)	0 (0)	0 (0)
Education level					
No formal education	5 (16.67)	2 (6.9)	19 (67.86)	0 (0)	7 (22.58)
Primary education	3 (10)	8 (27.59)	9 (32.14)	1 (3.45)	5(16.13)
Secondary education	12 (40)	14 (48.28)	(0)	4 (13.79)	11 (35.48)
Tertiary education	10 (33.33)	5(17.24)	0 (0)	24 (82.76)	8 (25.81)
Major Occupation					
Farming	25 (73.53)	29 (80.56)	30 (75)	3 (10.34)	27 (81.82)
Trading	5 (14.71)	6 (16.67)	10 (25)	3 (10.34)	4 (12.12)
Civil servant	4 (11.76)	0 (0)	0 (0)	23 (78.31)	2 (6.06)
Craftsman	0 (0)	1 (2.78)	0 (0)	0 (0)	0 (0)

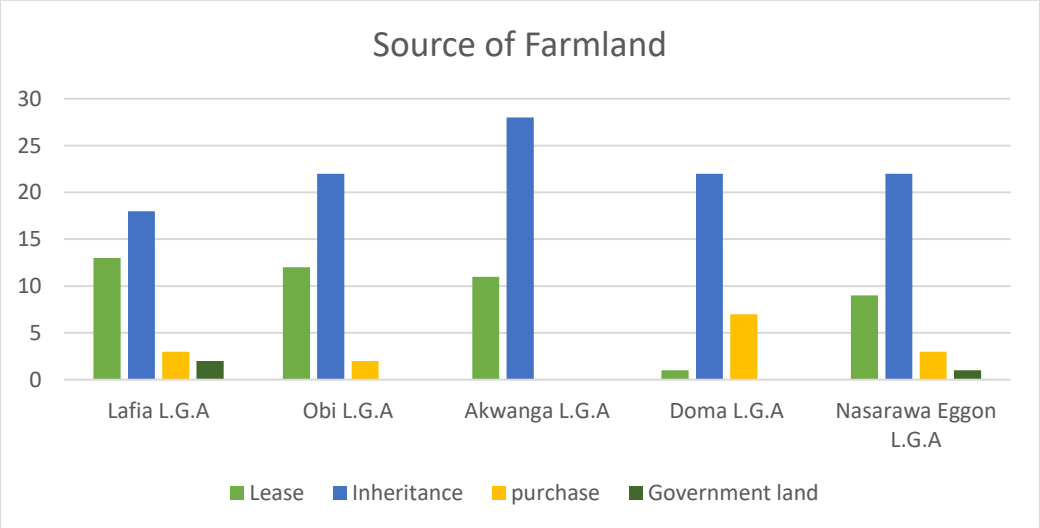

Figure 2: Land Tenure Systems in the Study Area

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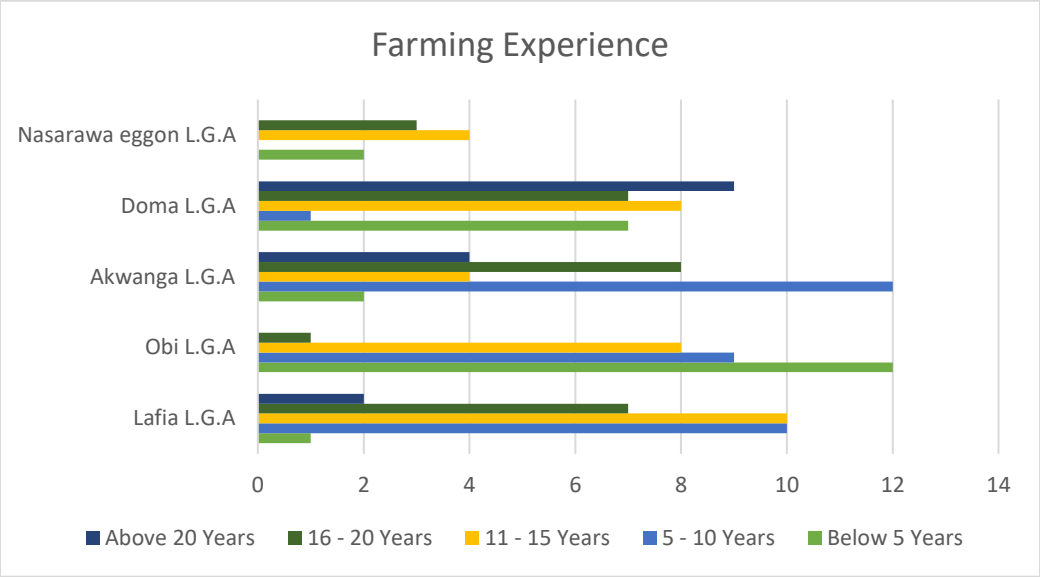

Figure 3: Farming Experience of Respondents in the Study Area

The types of soil conservation practices varied across the LGAs, with farmers employing multiple techniques to enhance soil quality and prevent degradation (Table 2). Cover cropping was the most commonly practiced technique, particularly in Obi LGA, where 86.67% of respondents reported using it. Similarly, Lafia (70%), Doma (50%), and Nassarawa Eggon (43.33%) also saw significant use of cover cropping. Snapp *et al*. (2005) observed that cover cropping enhances crop production and provides multiple benefits, including soil erosion control, improved organic matter, and enhanced soil moisture retention. This was further supported by Kaspar and Singer (2011) who surmised that soil bulk density was enhanced through the roots of cover crops. Akwanga LGA had the lowest cover cropping usage (30%), further indicating the lower adoption of conservation practices in this area. The use of organic fertilizers was widespread in Akwanga LGA, with 66.67% of respondents incorporating them into their farming practices. Nassarawa Eggon (60%) and Lafia (26.67%) also showed significant usage of natural fertilizers. This suggests a reliance on organic materials like manure or compost, which improves soil structure and fertility without the negative effects associated with chemical fertilizers. Singer *et al.* (2012) stated that organic fertilizers are a sustainable source of nutrients because of the slow rate of nutrient release during decomposition. This is also in line with the findings of Lee (2010) who observed that organic fertilizer also enhances soil forming processes. Authors have identified contour plowing for its benefit in reducing soil erosion by plowing along the contours of the land, which was more prominent in Doma LGA, where 40% of farmers used this technique (Amhold, 2013; Gownand'Mwangi *et al*., 2010). Lafia (23.33%) and Nassarawa Eggon (16.67%) also recorded moderate usage of contour plowing. This practice is especially beneficial in sloped areas where soil erosion is a major concern, and its prevalence in Doma suggests the presence of such terrains in the area. The practice

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of terracing was least commonly employed across the LGAs, with the highest usage reported in Lafia (20%) and Nassarawa Eggon (13.33%).

Obi and Akwanga LGAs reported minimal to no use of terracing, which could be due to the specific landscape characteristics or the labor-intensive nature of this practice, Deng *et al*. (2020) recommended horizontal terracing for soil and water conservation management. However Dorren and Rey (2003) suggested that combination of terracing with other soil conservation method enhances soil development and maintenance of soil moisture content. Conservation tillage was another practice used by respondents, particularly in Obi LGA, where 30% reported using this technique. Derpsch (2003) stated that conservation tillage involves minimal soil disturbance, hence helps preserve soil structure, moisture and enhances soil organic carbon. Its moderate usage in Nassarawa Eggon (23.33%) and Lafia (20%) indicated an awareness of the benefits of reducing tillage for soil health. This is in support of the report of Busari *et al*. (2015) who stated that conservation tillage serves as a natural sink for environmental pollutants and increases soil organic carbon sequestration. However, its non-adoption in Akwanga (0%) could again reflect the limited engagement with soil conservation practices in this area. The widespread adoption of soil conservation practiced in most of the study area, particularly in Obi, Lafia, and Doma LGAs, highlighted the farmers' awareness of the importance of these techniques in maintaining soil fertility and reducing erosion. The correlation coefficient (Table 3) showed a positive and significant relationship between educational status of respondents and adoption of soil conservation methods ($r = 0.905$; $p \leq 0.05$). However, the low adoption in Akwanga LGA pointed to the lack of formal education of the majority of respondents in the study area. Method of pest control in the study area (Figure 4). The findings from this study highlighted a heavy reliance on chemical pesticides for pest and disease control across the studied LGAs with usage rates between 83.33% and 100% across all LGAs. The highest usage was recorded in Akwanga and Doma, where 100% of the respondents employed chemical pesticides. This trend aligned with the findings of Mlambo *et al*. (2019), who noted that the use of chemical pesticides remains the dominant pest control strategy in Nigerian agricultural systems, particularly in regions where access to other control methods is limited. However, the high dependence on chemical pesticides raises concerns about environmental degradation and potential health hazards, as emphasized by Ntow *et al*. (2006), who reported the adverse effects of pesticide residues on soil, water quality, and non-target organisms. Biological control methods were sparingly used, with the highest adoption in Lafia (33.33%) and Nassarawa Eggon (26.67%). This low usage is consistent with findings from Midega *et al*. (2018), who noted that biological control remains underutilized in many African farming systems due to limited knowledge, availability of biocontrol agents, and technical challenges associated with their use. The low adoption of biological control in Akwanga and Doma, despite their high pesticide usage, underscores the need for increased awareness and capacity-building initiatives aimed at promoting eco-friendly pest management strategies. Manual removal, another non-chemical method, was scarcely practiced, with only Lafia in Nassarawa Eggon reporting 10% adoption rates. This is consistent with research by Balas *et al.* (2022), who observed that labor-intensive pest control methods, such as manual removal, are often perceived as less efficient and more time-consuming compared to chemical solutions. The low adoption of manual removal in most LGAs highlights the preference for quicker, more effective pest control solutions like chemical pesticides, despite their associated risks.

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Table 2: Soil Conservation Practice in the Study Area

	Local Government Areas				
	Lafia	Obi	Akwanga	Doma	Nassarawa Eggon
Variables	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)
Soil conservation Practice					
Yes	28 (93.33)	29 (96.67)	10 (33.33)	29 (96.67)	22 (73.33)
No	2 (6.67)	1 (3.33)	20 (66.67)	1 (3.33)	8 (26.67)
Types of soil conservation practices					
Terracing	6 (20)	2 (6.67)	0 (0)	0 (0)	4 (13.33)
Cover Cropping	21 (70)	26 (86.67)	9 (30)	15 (50)	13(43.33)
Contour Ploughing	7 (23.33)	2 (6.67)	1 (3.33)	12 (40)	5 (16.67)
Irrigation	8(26.67)	2 (6.67)	20 (66.67)	1 (3.33)	18 (60)
Conservation Tillage	6(20)	9 (30)	0 (0)	3 (10)	7 (23.33)
Soil Conservation and Educational Level		Correlation Coefficient		P- Value	
		0.56		-0.13	

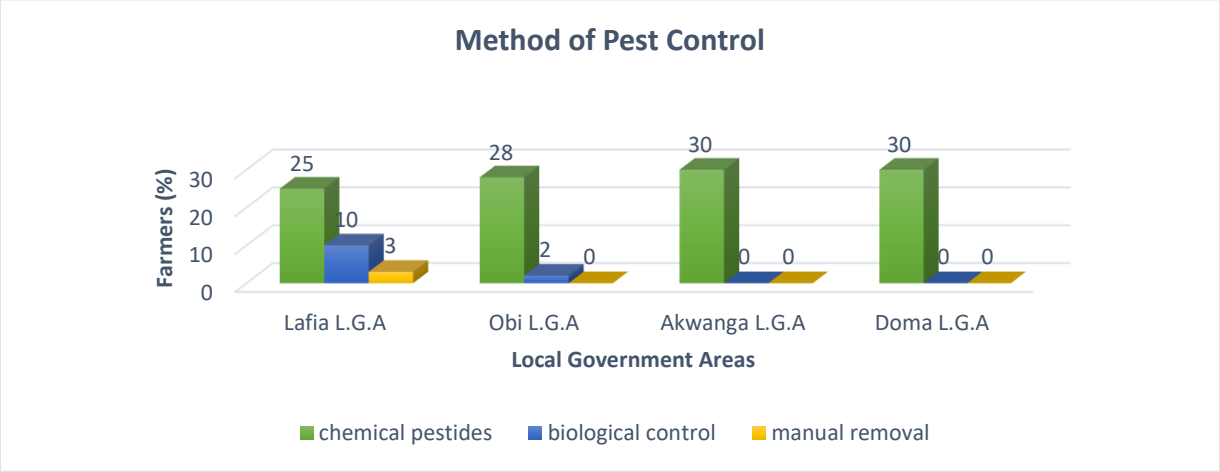

Figure 4: Method of Pest Control in the Study Area

Soil fertility management method in the study área is shown in Table 3. The results indicated that organic manure application and agroforestry systems are the most widely adopted soil fertility management practices in four Local Government Areas (LGAs) in the study area, particularly in Akwanga, Doma, and Nassarawa Eggon, with adoption rates as high as 100% in Akwanga while chemical application was higher (66.67%) in Lafia LGA which implies the availability and high purchasing power of the farmers in Lafia LGA. Organic soil fertility management practices are

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known to offer long-term benefits by improving soil structure, enhancing water retention, and promoting biodiversity (Mbow *et al*., 2014). Agroforestry, in particular, provides the added advantage of diversifying income through the cultivation of trees alongside crops, thereby improving livelihoods while simultaneously conserving the environment (Dagarn & Tewari 2017). In Lafia, 43% of respondents practice crop rotation, a method that is essential for maintaining soil fertility by alternating crops with different nutrient demands. Crop rotation reduces pest and disease buildup and improves soil structure (Bullock, 1992). Its adoption rate suggests farmers' understanding of its benefits among farmers in the region, but there is still potential for greater uptake in other LGAs.

66.67% and 33.3% of farmers in Lafia and Akwanga LGA adopt usage of Chemical fertilizer in soil fertility enhancement. This could be because chemical fertilizers can provide immediate nutrient availability to crops; however, according to Bationo *et al*. (2012), long-term use without complementary organic inputs can lead to soil degradation and reduced fertility in the long run. The relatively low use of chemical fertilizers in other LGAs in the study area could be as a result of the high cost of fertilizer and not many farmers could afford it. Integrated Nutrient Management (INM), which combines the use of organic and inorganic inputs to optimize soil fertility, is largely absent in the LGAs, except for moderate use (20%) in Nassarawa Eggon. The lack of adoption of INM suggests a lack of technical knowhow and access to resources needed to implement such practices which is a holistic approach that enhances nutrient use efficiency and minimizes environmental impacts (Vanlauwe *et al*., 2011).

Problems associated with soil fertility management practices in the study área is shown in (Figure 3). Inadequate knowledge, high cost of chemical fertilizer, limited Access to organic fertilizer and land tenure insecurity. 70% to 100% of respondents across the five LGAs (ranging from identified inadequate knowledge of soil management as a key challenge. In particular, Akwanga had the highest proportion of respondents (100%), indicating a critical lack of awareness or technical know-how in this LGA. Other areas like Lafia (93.33%), Obi (83.33%), and Nassarawa Eggon (86.67%) also report significant gaps. This result is consistent with the findings of Vanlauwe et al 2011 who stated that knowledge gaps often hinders the adoption of sustainable soil fertility practices. Vanlauwe et al. (2011) emphasized that without proper knowledge, even available resources may not be optimally utilized. High cost of chemical fertilizers was identified as a major challenge in Lafia (70%) and Obi (70%), but 30% of respondents in Akwanga and Doma saw it as a challenge. This suggests that chemical fertilizers are less affordable for resource poor farmers in the study area. Studies have shown that high fertilizer costs are a common barrier to improving soil fertility in many parts of Africa (Bationo et al., 2012). Limited access to organic matter appears to be a major issue in Obi (76.67%), while it is less of a concern in Doma (6.67%). The challenge of limited access in Obi and Lafia could be due to inadequate livestock production, poor waste management, or the high labor costs associated with gathering organic material (Tittonell & Giller, 2013). Land tenure insecurity is reported as a minor issue, with only Lafia (3.33%) and Nassarawa Eggon (6.67%) registering concerns about this challenge. This indicated that, in the majority of LGAs studied, land tenure is relatively stable and does not present a significant obstacle to soil fertility management

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Table 3: **Soil Fertility Management Practices in the Study Areas**

	Local Government Areas				
Soil Fertility Management Practices	Lafia **Freq. (%)**	Obi **Freq. (%)**	Akwanga **Freq. (%)**	Doma **Freq. (%)**	Nassarawa Eggon **Freq. (%)**
Crop Rotation	13(43.33)	6 (20)	6 (20)	7 (23.33)	1 (3.33)
Organic Manure application	14 (46.67)	21 (70)	30 (100)	25 (83.33)	28 (93.33)
Chemical Fertilizer Application	20 (66.67)	3 (10)	10 (33.33)	10 (33.34)	4 (13.34)
Integrated Nutrient Management	0 (0)	0 (0)	0 (0)	0 (0)	6 (20)
Agroforestry System	14 (46.67)	21 (70)	30 (100)	25 (83.33)	28 (93.33)
Mulching	7 (23.33)	1 (3.33)	0 (0)	1 (3.33)	1 (3.33)

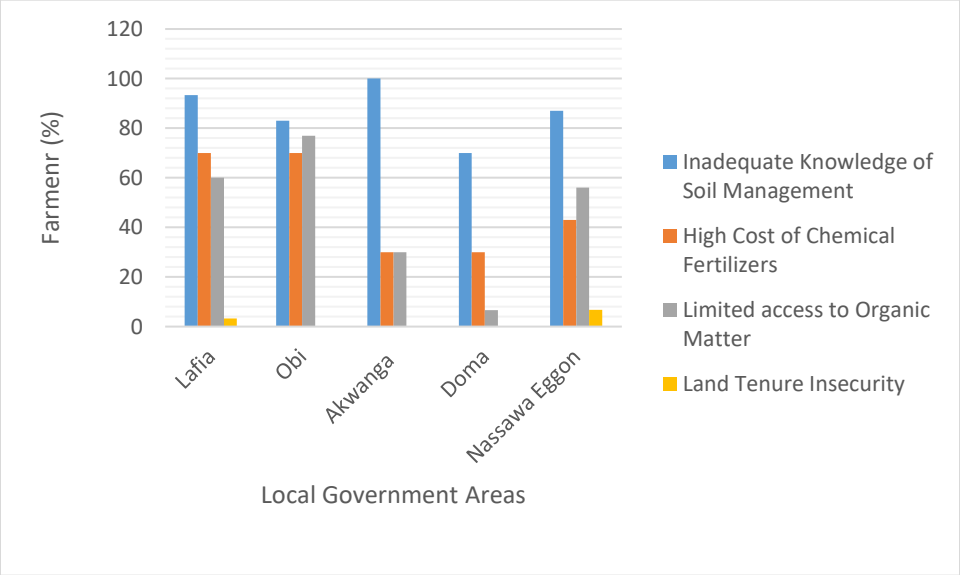

Figure 3: Challenges Hindering Soil Fertility Management Practices in the Study Area

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CONCLUSION

The study on soil fertility management practices of smallholder farming communities in Nasarawa State revealed a diverse range of approaches, reflecting the varied socioeconomic conditions and knowledge levels across the local government areas (LGAs). Key practices include cover cropping, agroforestry, organic manure application, and crop rotation, all of which contribute to enhancing soil fertility and sustainability. However, the reliance on chemical fertilizers and pesticides, combined with limited knowledge and resource constraints, hinders the adoption of more sustainable practices like integrated nutrient management (INM). Challenges such as high fertilizer costs, limited access to organic materials, and inadequate knowledge on soil management were common across most LGAs. The findings underscored the need for a tailored approach to address these challenges and promote sustainable farming practices to improve soil health, agricultural productivity, and food security in Nasarawa State. We therefore recommend educating farmers about sustainable soil fertility management practices such as integrated nutrient management, agroforestry, and conservation tillage. Continued research into localized, innovative soil fertility management techniques that are affordable and context-specific is essential. Collaboration between research institutions and farmers should be strengthened to ensure practical, evidence-based solutions are developed and implemented.

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Conflict of Interest

The author affirms that there are no conflicts of interest related to this manuscript. Additionally, we certify that this submission is original work and is not currently under review by any other journal.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

Abiodun, T. I. (2022). Use of Climate Smart Agricultural Practices among Smallholder Arable Crop Farmers of Nassarawa State, Nigeria (Master's thesis, Kwara State University, Nigeria).

Adebayo, P. F., and Ojo, E. O. (2012). Food security in Nigeria: An overview. European Journal of Sustainable Development, 1(2), 199-199.

Article DOI: 10.52589/AJENSR-MAZFEION
DOI URL: https://doi.org/10.52589/AJENSR-MAZFEION

Andersson, J. A., and D'Souza, S. (2014). From adoption claims to understanding farmers and contexts: A literature review of Conservation Agriculture (CA) adoption among smallholder farmers in Southern Africa. Agriculture, Ecosystems & Environment, 187, 116-132.
Arnhold, S. (2013). Soil erosion and conservation potential of row crop farming in mountainous landscapes of South Korea.
Audu, E. B., Saidu, S., Yahaya, T. I., Musa, S. D., Magaji, J. Y., and Agye, A. (2021). Relationship between mean surface wind pattern and heavy rainfall days in Guinea Savanna Ecological Zone of Nigeria. Gombe Journal of Geography and Environmental Studies, 2(2).
Balas, P. R., Makavana, J. M., Mohnot, P., and Chauhan, P. M. (2022). Future Trends and Problems of Automation in Weed Control Systems: A Research. Food Security: Global Challenges, 42-47.
Bationo, A., Hartemink, A., Lungu, O., Naimi, M., Okoth, P., Smaling, E., and Waswa, B. (2012). Knowing the African soils to improve fertilizer recommendations. In Improving Soil Fertility Recommendations in Africa Using the Decision Support System for Agrotechnology Transfer (DSSAT) (pp. 19-42).
Bullock, D. G. (1992). Crop rotation. Critical Reviews in Plant Sciences, 11(4), 309-326.
Busari, M. A., Kukal, S. S., Kaur, A., Bhatt, R., and Dulazi, A. A. (2015). Conservation tillage impacts on soil, crop, and the environment. International Soil and Water Conservation Research, 3(2), 119-129.
Dagar, J. C., and Tewari, V. P. (2017). Evolution of agroforestry as a modern science. In Agroforestry: Anecdotal to Modern Science (pp. 13-90).
Deng, C., Zhang, G., Liu, Y., Nie, X., Li, Z., Liu, J., and Zhu, D. (2021). Advantages and disadvantages of terracing: A comprehensive review. International Soil and Water Conservation Research, 9(3), 344-359.
Derpsch, R. (2003). Conservation tillage, no-tillage, and related technologies. In Conservation Agriculture: Environment, Farmers' Experiences, Innovations, Socio-Economy, Policy (pp. 181-190). Dordrecht: Springer Netherlands.
Dorren, L., and Rey, F. (2004). A review of the effect of terracing on erosion. In Briefing Papers of the 2nd SCAPE Workshop (pp. 97-108). C. Boix-Fayons and A. Imeson.
Douthwaite, B., Manyong, V. M., Keatinge, J. D. H., and Chianu, J. (2002). The adoption of alley farming and Mucuna: Lessons for research, development, and extension. Agroforestry Systems, 56, 193-202.
Giller, K. E. (2020). The food security conundrum of sub-Saharan Africa. Global Food Security, 26, 100431.
Giller, K. E., Tittonell, P., Rufino, M. C., Van Wijk, M. T., Zingore, S., Mapfumo, P., and Vanlauwe, B. (2011). Communicating complexity: Integrated assessment of trade-offs concerning soil fertility management within African farming systems to support innovation and development. Agricultural Systems, 104(2), 191-203.
Gowland-Mwangi, J., Oloo, J. O., and Maina, S. W. (2010). The effectiveness of farmer field schools' extension methodology in conserving soil and water using contour plowing, unploughed strips, and farmyard manure. Problems of Education in the 21st Century, 26, 52.
Jayne, T. S., and Sanchez, P. A. (2021). Agricultural productivity must improve in sub-Saharan Africa. Science, 372(6546), 1045-1047.
Kwadzo, M., and Quayson, E. (2021). Factors influencing the adoption of integrated soil fertility management technologies by smallholder farmers in Ghana. Heliyon, 7(7).
Lee, J. (2010). Effect of application methods of organic fertilizer on growth, soil chemical properties, and microbial densities in organic bulb onion production. Scientia Horticulturae, 124(3), 299-305.

Article DOI: 10.52589/AJENSR-MAZFEION
DOI URL: https://doi.org/10.52589/AJENSR-MAZFEION

Lyam, A. (2000). Nasarawa State. Nigeria: A People United, A Future Assured. Survey of States, 2(2).
Mbow, C., Smith, P., Skole, D., Duguma, L., and Bustamante, M. (2014). Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. Current Opinion in Environmental Sustainability, 6, 8-14.
Midega, C. A., Pittchar, J. O., Pickett, J. A., Hailu, G. W., and Khan, Z. R. (2018). A climate-adapted push-pull system effectively controls fall armyworm, *Spodoptera frugiperda* (J.E. Smith), in maize in East Africa. Crop Protection, 105, 10-15.
Mlambo, S., Mubayiwa, M., Tarusikirwa, V. L., Machekano, H., Mvumi, B. M., and Nyamukondiwa, C. (2024). The fall armyworm and larger grain borer pest invasions in Africa: Drivers, impacts, and implications for food systems. Biology, 13(3), 160.
Mowo, J. G., Janssen, B. H., Oenema, O., German, L. A., Mrema, J. P., and Shemdoe, R. S. (2006). Soil fertility evaluation and management by smallholder farmer communities in Northern Tanzania. Agriculture, Ecosystems & Environment, 116(1-2), 47-59.
Ntow, W. J., Gijzen, H. J., Kelderman, P., and Drechsel, P. (2006). Farmer perceptions and pesticide use practices in vegetable production in Ghana. Pest Management Science, 62(4), 356-365.
Nwuneli, N. O. (2010). A look at agriculture and agribusiness in Nigeria. In An Interview by Forum Grain De Sel (No. 52).
Obi, J. C., Ibia, T. O., and Eshiet, P. B. (2016). Effect of land use on potassium form of coastal plain sands of Nigeria. Chemistry and Ecology, 32(3), 238-258.
Obaje, N. G., Attah, D. O., Opeloye, S. A., and Moumouni, A. (2006). Geochemical evaluation of the hydrocarbon prospects of sedimentary basins in Northern Nigeria. Geochemical Journal, 40(3), 227-243.
Omorogiuwa, O., Zivkovic, J., and Ademoh, F. (2014). The role of agriculture in the economic development of Nigeria. European Scientific Journal, 10(4).
Onwuka, J. C., Nwaedozie, J. M., and Terna, P. T. (2020). Fertility status of selected agricultural soils along major roads in Nassarawa Eggon and Doma areas of Nasarawa State, North Central Nigeria. Journal of Chemical Society of Nigeria, 45(4).
Ritchie, H. A move to local food systems would only have a small impact on reducing greenhouse gas emissions.
Salau, S. A. (2013). Cropping intensification and technical inefficiency of maize-based farming households in Southern-Guinea Savanna (SGS) of Nigeria.
Singh, T. B., Ali, A., Prasad, M., Yadav, A., Shrivastav, P., Goyal, D., and Dantu, P. K. (2020). Role of organic fertilizers in improving soil fertility. Contaminants in Agriculture: Sources, Impacts, and Management, 61-77.
Vanlauwe, B., Kihara, J., Chivenge, P., Pypers, P., Coe, R., & Six, J. (2011). Agronomic use efficiency of N fertilizer in maize-based systems in sub-Saharan Africa within the context of integrated soil fertility management. Plant and soil, 339, 35-50.
Yusufu, F. A., & Abenu, A. (2019). A comparative study of soil properties under different soil management practices in Lafia region, Nassarawa State, Nigeria. Zaria Geographer, 26(1), 56-69.

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