ID: 947

Preference and Perception of Bioresources among Green Leafy Vegetable Farmers in Selected States in Nigeria

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Abstract

Vegetable production in Nigeria holds significant nutritional and economic importance; however, the increasing reliance on inorganic fertilizers and pesticides to meet growing demand has raised concerns about soil degradation, environmental sustainability, and the long-term productivity of farming systems. Bioresources such as Compost (CM), Vermicompost (VC), Biochar (BC), Farmyard Manure (FYM), and Biopesticides (BP) offer sustainable alternatives capable of improving soil fertility and supporting resilient agricultural production. Yet, their adoption remains limited, underscoring the need to understand farmers' awareness, perceptions, and preferences regarding bioresource use in green leafy vegetable production. This study investigated farmers' awareness and perceptions of bioresources, their preferences for different bioresource types, and the challenges associated with bioresource utilization. Primary data were collected through a cross-sectional survey of 300 green leafy vegetable farmers, selected using a multistage sampling procedure, and analyzed using descriptive statistics and preference ranking techniques. Findings revealed varying levels of awareness, with farmers knowledgeable about BC (98%), FYM (86%), CM (86%), and BP (81%), while VC recorded no awareness (0%). Despite this awareness, the inability to utilize bioresources remained high, as 79%, 75%, 65%, 60%, and 39% of farmers could not use VC, BC, CM, BP, and FYM, respectively. Regarding constraints, few farmers (18–20%) perceived higher labor requirements, limited awareness, and technical complexity as barriers, while approximately 50% strongly disagreed that bioresources demanded additional labor or were less effective than conventional alternatives. Preference analysis showed that inorganic fertilizer ranked first among farm inputs, followed by organic manure, poultry manure, and cow dung, while biochar and vermicompost received the lowest preference rankings. Among factors influencing input choice, crop yield ranked highest, followed by extension agents' recommendations and resource availability. The study concludes that while awareness of bioresources is relatively high, farmers' practical ability to use them remains low. Therefore, improving access to practical demonstrations and yield-benefit evidence through extension services is recommended to enhance bioresource adoption and promote sustainable vegetable farming systems in Nigeria.

Keywords: *Bioresources, perception, preference, green leafy vegetables, sustainable agriculture, Nigeria.*

1.0 Introduction

Globally, farmers rely heavily on chemical fertilizers and pesticides to improve crop yields and quality (Baweja et al., 2020). However, improper or excessive use of these substances carries significant consequences, including leaching, runoff, and volatilization, all of which degrade agricultural lands (Chaitra et al., 2021). In Africa, the Food and Agriculture Organization reported that inorganic fertilizer use nearly doubled between 2001 and 2021, reaching 7.6 million tonnes, yet application per cropland area remains the lowest at approximately 25 kg/ha, or about 5 kg per capita (FAOSTAT, 2021). This low level of use has been attributed to poor affordability, limited availability, and heavy reliance on traditional practices that do not incorporate inorganic fertilizers (FAOSTAT, 2021). Taken together, these realities — both the risks of overuse and the constraints on access — underscore the need for alternative, locally sourced sustainable soil nutrient management approaches.

To address these challenges, recent recommendations have emphasized the use of biological resources, commonly known as bioresources, as a means of enhancing soil nutrients and increasing crop productivity. Bioresources are naturally occurring products that can be effectively leveraged for sustainable farming (Dlamini et al., 2022; Abiala et al., 2020). Examples include compost, vermicompost, biochar, green manure, farmyard manure, and biopesticides. These resources help amend the soil, recycle nutrients, improve soil organic matter content, and promote the biological activity of soil fauna. Crucially, they also enhance the adaptive capacity of crops and improve soil productivity amid climate uncertainties, making them particularly valuable in the context of increasing climatic variability.

The vegetable sector is a key source of income, food supply, and nutrition, and has shown a significant impact on Nigeria's economic growth (Nwokoye et al., 2021; Plaisier et al., 2019). Nigeria's domestic vegetable production has grown rapidly over the past three decades, with recent figures indicating a national output of 16,330,610 tonnes (Statbase, 2024). Vegetables and fruits account for 13% of total food consumption in Nigeria — 11% vegetables and 2% fruit — a pattern consistent with other Sub-Saharan African (SSA) countries, and comparable to leading cereals such as rice (13%) and maize (7%) (Liverpool-Tasie et al., 2023). Global trends toward healthy eating and sustainability have further driven demand for vegetables and compelled local producers to respond to shifting consumer preferences (Statista, 2025). Against this backdrop, ensuring the sustainability of vegetable production, particularly Green Leafy Vegetable (GLV) production, is of both national and regional significance.

In pursuit of increased and sustainable vegetable output, bioresources offer a promising alternative capable of mitigating the effects of climatic variability and reducing excessive dependence on synthetic chemicals. The integration of sustainable

farm practices — including context-specific nutrient, pest, and weed management with reduced chemical use — has been well established in vegetable production (Behera et al., 2024; Farouque et al., 2024; Singh & Gohain, 2017). Specific bioresources have demonstrated measurable benefits: bio-fertilizers improve soil health, leading to higher yields and better product quality (Rao et al., 2014); compost has been shown to produce yields comparable to or exceeding those achieved with inorganic fertilizers and poultry manure, while improving soil organic carbon, structural stability, and biological properties (Chan et al., 2008; Chan et al., 2011; Donovan et al., 2014); and the integration of biopesticides in pest management has demonstrated effectiveness in controlling pests, reducing chemical pesticide use, and promoting natural enemy populations in tropical vegetable production (Srinivasan, 2012). Collectively, bioresource use ensures that even small or marginal land can produce high yields without depleting the natural resource base or relying excessively on inorganic inputs.

Despite these benefits, adoption of bioresources among farmers remains uneven. Studies by Adamu (2016), Ume et al. (2020), Oluwatosin (2020), Akinyemi and Daikwo (2022), and Ajakaiye (2023) reveal that a majority — at least 70% — of farmers use one or more forms of organic fertilizer, including cow, sheep, and goat dung, poultry manure, crop residues, compost, farmyard manure, and kitchen waste. Nevertheless, the overall rate of bioresource use remains low (Raimi et al., 2021; Araya et al., 2024), constrained by factors such as land tenure insecurity, lack of skills, transportation challenges, limited availability, weak farmer associations, and socioeconomic variables including age, income, and household size (Adamu, 2016; Ume et al., 2020; Oluwatosin, 2020; Ajakaiye, 2023). This indicates that significant opportunities in bioresource utilization remain unexplored, particularly in vegetable farming.

To harness the full benefits of bioresources and enhance the sustainability of Green Leafy Vegetable (GLV) production, it is essential to understand the availability of, perceptions toward, and preferences for specific bioresources among Green Leafy Vegetable Farmers (GLVFs). This study was restricted to green leafy vegetable farmers in South-west Nigeria cultivating Ugwu/fluted pumpkin leaves (Telfairia occidentalis), Jute mallow (Corchorus olitorius), Lagos spinach/Soko (Celosia argentea), and African spinach/Tete (Amaranthus hybridus). These are the predominant green leafy vegetables grown in the study area (Tichar et al., 2024). Bio-resources were limited to crop residues, refuse incorporation, compost, farmyard manure, biochars, vermicompost, and bio-pesticides, as these are most relevant to vegetable farmers. This study assumes that knowledge of bioresource use, challenges faced in their utilization, farmers' perceptions, and preferences for context-specific integrated nutrients can illuminate the opportunities and constraints that shape bioresource adoption among GLVFs. The findings will contribute to a broader discussion on the prospects of bioresources in vegetable farming, with implications for consumer health and safety, farmer welfare, and the long-term sustainability of vegetable production systems.

2.0 Materials and Methods

Study Area and Sampling Technique

The study was based on primary data collected through a cross-sectional survey from GLVFs who use at least one form of bioresources in the country. A multistage sampling procedure was used to select vegetable farmers for the survey. Oyo, and Ogun lead in commercialization and are known for the selected GLV production in the region (Tichar *et al*., 2024). The selected GLVs include Ugwu/fluted pumpkin leaves (Telfairia occidentalis), Jute mallow (Corchorus olitorius), Soko (Celosia argentea), and Tete / African spinach (Amaranthus hybridus). These are the predominant GLVs grown in the study area (Tichar *et al*., 2024). Bio-resources were limited to crop residue, incorporation of refuse, compost, farmyard manure, biochar, vermicompost, and bio-pesticides, as these are most relevant to vegetable farmers. In the first stage, two states (Oyo and Ogun) were purposively selected in the region. In the second stage, a purposive sampling technique was used to select three Agricultural Development Zones (ADPs), namely Ibadan/Ibarapa, Ilaro, and Ikenne, from the two (2) states based on vegetable production intensity. 300 green leafy vegetable farmers were selected from the three zones using simple random sampling technique.

Analytical Tools

Descriptive statistical tools were used to describe socioeconomic characteristics; analyze farmers' perceptions of the challenges of bioresources; assess the availability of bioresources; and analyze preferences for bioresource use choices and the factors considered when using bioresources. Tools used include frequency, percentage, 5-point likert scale and borda count method.

Following Saari (1985), Chen et al. (2016) and Saari (2023), borda count method was used to rank choices using their score. Given *N* bioresources and multiple farmers' preference, points *of N-l,N-2,.. .*, and *0* are assigned to the first-ranked, second-ranked, and last-ranked bioresources in each farmer's preference order. The points for each bioresources are summed across all farmers, and the most preferred resource is the one with the greatest total number of points. The option with the highest score is the most preferred.

Steps in analyzing involves;

1. assign points: Ist place is 6 points,2^{nd} =5 points; 3^{rd} =4 points; 4^{th} = 3 points; 5^{th} =2 points; 6^{th} =1 point
2. Calculate for each bio/resource variable: Total points = (Votes for 1st×6) + (votes for 2^{nd} ×5) + votes for 3^{rd} × 4) + (Votes for 4^{th} ×3) + (votes for 5^{th} × 2) + (votes for 6^{th} × 1)

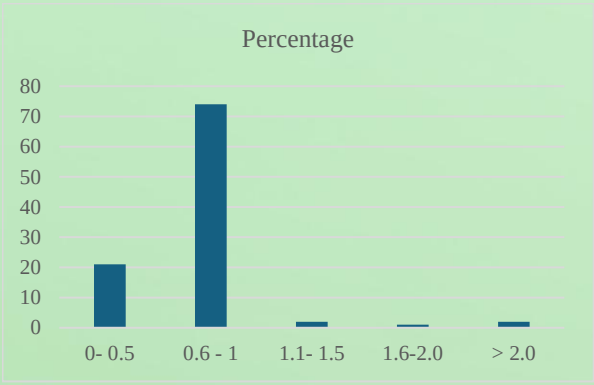
3.0 Result and Discussion

Socioeconomic Characteristics of GLVFs

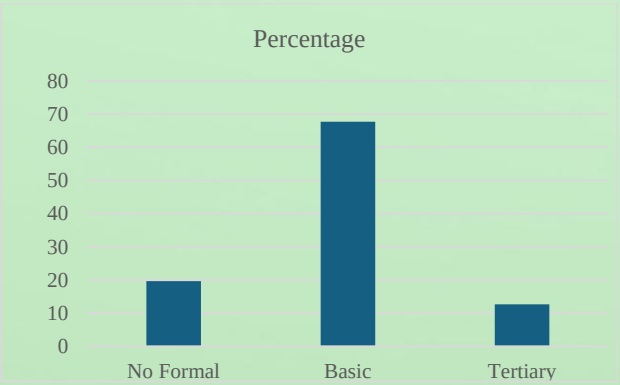
This section shows the household characteristics of farmers that has used bioresources in cultivating GLVFs in South-West Nigeria. The results show that 67.67% of farmers have basic education**,** 19.67% have no formal education, and 12.67% have tertiary education. This indicates that the majority of farmers possess at least a basic level of literacy, which may enhance their capacity to access agricultural information, use improved technologies, and implement better farm management practices. Education has consistently been identified as a key determinant of agricultural productivity because it enhances farmers' ability to process information and make informed production decisions. Recent empirical studies have shown that higher levels of

education significantly improve farmers' use of improved agricultural technologies and sustainable farming practices, thereby enhancing productivity and efficiency among smallholder farmers (Ruzzante *et al*., 2021; Fadeyi *et al*., 2022).

The distribution of household size indicates that 74% of respondents live in medium-sized households (4–6 members), 14.33% in large households (7 members and above), and 11.67% in small households (1–3 members). The mean household size of 5.14 persons suggests that most households fall within the moderate family size category typical of rural farming communities in Nigeria. Household size is an important determinant of labour availability in smallholder farming systems, as family members often provide labour for farm activities such as planting, irrigation, harvesting, and marketing. Larger households may therefore benefit from increased labour supply, which can improve farm productivity and reduce dependence on hired labour. However, large household sizes may also increase household consumption pressure, potentially affecting farm investment decisions. Gathala *et al.* (2021), stated that efficient labour management plays an important role in improving smallholder farm productivity. This calls for efficient labour management whereby few skilled family members are mobilized to adopt improved technology, members treated as staff on payroll and are combined with hired labour during critical production stages such as clearing and harvesting. Family members should also focus on high-value-added activities rather than low-productivity, high-substitutability roles. This will help maximize income and keep household consumption sustainable. When farmers focus on increasing yields far above the subsistence level using mechanized farm tools, improved technology, and processing, productivity will increase.

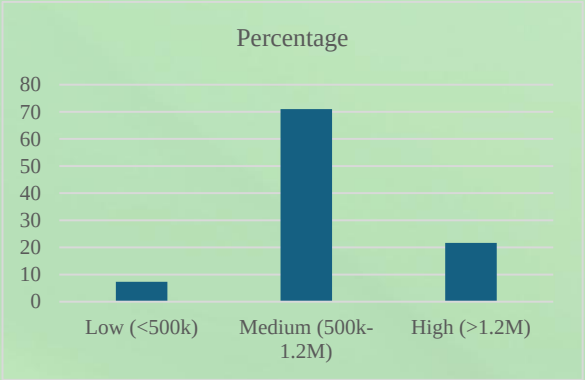


Farm Size

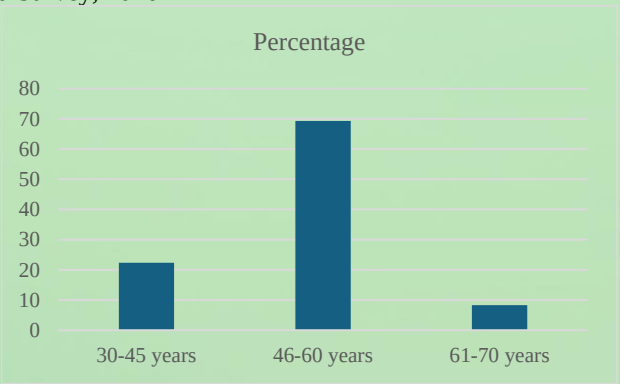


Educational Level

Source: Field Survey, 2026

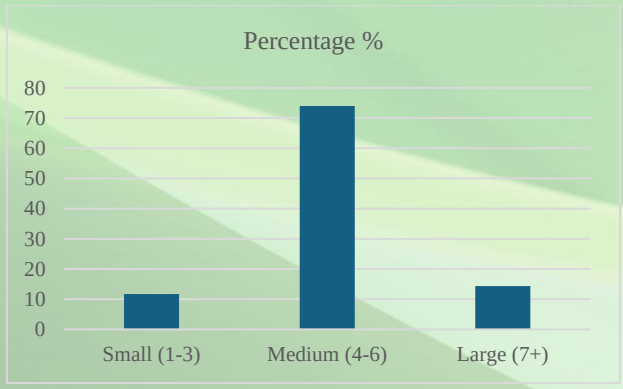


Farm Income



Age

Source: Field Survey, 2026



Household size

Source: Field Survey, 2026

The age distribution of farmers shows that 69.33% fall within the age range of 46–60 years**,** 22.33% are between 30–45 years**,** and 8.33% are between 61–70 years**,** with a mean age of approximately 51 years**.** This suggests that vegetable farming in the study area is largely dominated by older farmers. Farmers within this age category are generally expected to possess substantial farming experience, which can contribute positively to farm management and resource utilization. The relatively small proportion of younger farmers may reflect declining youth participation in agriculture, a trend widely reported in many developing countries (Geza *et al*., 2021; Njeru, 2017; Mukwedeya & Mudhara, 2024). The distribution of farm income indicates that 71% of farmers fall within the medium income category (₦500,000–₦1.2 million)**,** while 21.67% earn high farm income (above ₦1.2 million) and 7.33% earn low farm income (below ₦500,000)**.** The mean farm income of approximately ₦984,533 suggests that vegetable farming constitutes a moderately profitable agricultural activity in the study area. Vegetable production is often associated with higher returns than staple crop production due to its shorter production cycles and high market demand. Studies have shown that vegetable farming provides important income opportunities for smallholder farmers and contributes significantly to rural household livelihoods in Nigeria and other developing countries (Mukaila *et al*., 2022; Effiong *et al*., 2021).

3.1 Farmers' Awareness of Bioresources

Awareness in this context refers to the technical knowledge a farmer has. If a farmer knows how to use the technology, when to apply it and why it works**.** Awareness does not guarantee use. Farmers' awareness of agricultural technologies and sustainable farming practices plays a critical role in shaping their adoption decisions and overall resource-use efficiency. Table 1 presents the level of awareness of different bioresources among green leafy vegetable farmers in the study area. Results revealed that 80.67% of the farmers reported being aware of biopesticides, while 19.33% were not aware of them. Although awareness of biopesticides is relatively high, it remains lower than awareness levels for other organic inputs.

The results also showed that 86.33% of farmers are aware of farmyard manure, while 13.67% are not aware of it. Farmyard manure is one of the most widely used organic soil amendments in traditional farming systems and is often readily available in rural communities where livestock are present. The relatively high level of awareness observed in this study therefore reflects the long-standing use of manure as a natural soil fertility management practice.

The findings also reveal that 98.33% of the farmers are aware of biochar. This extremely high level of awareness may reflect recent efforts by research institutes such as Forestry Research Institute of Nigeria (FRIN), and several organizations including projects organized by Association of Common wealth Universities (ACU) and Futux Agri-consult to promote biochar as a sustainable soil amendment capable of improving soil fertility and enhancing carbon sequestration in agricultural systems. Similarly, 86.00% of the farmers reported being aware of compost, while 14% were not aware of it. Composting is a widely promoted sustainable agricultural practice that allows farmers to recycle organic waste materials into nutrient-rich soil amendments. The relatively high awareness level therefore indicates that many farmers in the study area are familiar with composting practices.

The results further show that 76.33% of farmers are aware of the incorporation of refuse as a soil management practice, while 23.67% are not aware of it. Although awareness of refuse incorporation is moderately high, the relatively larger proportion of farmers lacking awareness may reflect concerns about waste contamination or limited training on proper organic waste management techniques.

In addition, 90.33% of farmers reported awareness of crop residue management, while 9.67% indicated that they were not aware of it. Crop residue incorporation is an important component of sustainable soil fertility management because it helps maintain soil organic matter, improve soil structure, and enhance nutrient cycling. However, the results reveal a striking exception for vermicomposting, where none of the farmers reported being aware of vermicompost, indicating 100% lack of awareness of this practice in the study area. Vermicomposting involves the use of earthworms to convert organic waste materials into nutrient-rich organic fertilizer. Despite its potential benefits for improving soil fertility and crop productivity, the complete lack of awareness suggests that this technology has not been effectively disseminated among farmers in the study area.

Table 1: Percentage Awareness of Bioresources

Variable	*Aware*	*Not aware*
Vermicompost	0	100
Biopesticides	80.67	19.33
Farmyard manure	86.33	13.67
Biochar	98.33	1.67
Compost	86.00	14.00
Incorporation of refuse	76.33	23.67
Crop residue	90.33	9.67

Source: Field Survey, 2025/26

3.2 Farmers' Technical Ability to Use Bioresources

The ability of farmers to effectively utilize bioresources is a critical factor influencing the adoption of sustainable agricultural practices and the efficient use of natural resources in farming systems. While awareness and availability of bioresources are important prerequisites for adoption, farmers' technical knowledge and capacity to apply these resources correctly ultimately determine their effectiveness in improving soil fertility, crop productivity, and environmental sustainability. Table 2 therefore examines farmers' reported ability to utilize various bioresources used in vegetable production.

The results indicate generally low levels of technical ability across several bioresource practices, suggesting that although some farmers may be aware of these practices, many lack the practical skills required for effective implementation. The findings show that 79.00% of farmers reported having no ability to use vermicompost, while only 4.67% indicated high ability, 14% reported low ability, and 2.33% indicated very low ability. This suggests that vermicomposting techniques remain relatively unfamiliar to many farmers in the study area. Vermicompost production and application often require specific knowledge of organic waste management, earthworm culture, and soil nutrient management, which may limit its adoption among farmers who lack adequate technical training.

The findings further reveal that 59.67% of farmers reported no ability to use biopesticides, while 19.33% reported low ability, 11.33% indicated very low ability, 6.33% reported high ability, and 3.33% reported very high ability. Biopesticides require knowledge of pest identification, correct dosage, and proper application timing, which may explain the limited technical ability reported by many farmers. Insufficient training and limited extension support may therefore constrain the adoption of biological pest management practices in vegetable production systems.

The results also indicate that 47.33% of farmers reported no ability to use irrigation systems, while 21.67% indicated very low ability, 19.67% reported low ability, 5.67% reported high ability, and 5.67% indicated very high ability. Irrigation management requires knowledge of water scheduling, irrigation methods, and efficient water use techniques. Limited technical knowledge may therefore reduce farmers' ability to optimize water use in vegetable production, potentially affecting crop yields and resource-use efficiency.

For farmyard manure, 39.00% of farmers reported no ability to use it, while 23.67% indicated very low ability, 12.33% reported low ability, 6.33% indicated high ability, and 18.67% reported very high ability. Although farmyard manure is traditionally used in many farming systems, proper application techniques such as appropriate application rates, and timing require technical knowledge to ensure optimal benefits for soil fertility and crop productivity.

Also, the results reveal that 75% of farmers reported no ability to use biochar, while 16.33% reported low ability, 7.33% indicated high ability, 1.00% reported very low ability, and 0.33% indicated very high ability. Despite the growing recognition of biochar as a sustainable soil amendment, its effective use requires knowledge of appropriate production methods and application rates. The high proportion of farmers lacking the ability to use biochar may therefore limit its potential benefits in improving soil fertility and resource-use efficiency.

The findings also show that 65.33% of farmers reported no ability to use compost, while 23.00% reported low ability, 4.33% indicated very low ability, 5.33% reported high ability, and 2.00% indicated very high ability. Composting is an important organic waste recycling practice that improves soil organic matter and nutrient availability. However, the relatively low ability reported by farmers suggests that many may lack knowledge regarding compost preparation and application techniques. In terms of refuse incorporation, 45.67% of farmers reported no ability, while 16.33% indicated very low ability, 16.67% reported low ability, 4.67% indicated high ability, and 16.67% reported very high ability. This distribution suggests moderate variability in farmers' ability to recycle organic waste materials for soil fertility management.

Finally, the results show that 40.67% of farmers reported no ability to manage crop residues, while 24.67% indicated very low ability, 10.67% reported low ability, 5.33% indicated high ability, and 18.67% reported very high ability. Crop residue management is an important component of sustainable soil management because it helps maintain soil organic matter and improve nutrient cycling.

Table 2: Percentage Technical Ability to Use Bioresources

Ability to use bioresources					
Variable	Not at all	High	Low	Very low	Very high
Vermicompost	79.00	4.67	14.00	2.33	0
Biopesticides	59.67	6.33	19.33	11.33	3.33
Farmyard manure	39.00	6.33	12.33	23.67	18.67
Biochar	75.00	7.33	16.33	1.00	0.33
Compost	65.33	5.33	23.00	4.33	2.00
Incorporation of refuse	45.67	4.67	16.67	16.33	16.67
Crop residue	40.67	5.33	10.67	24.67	18.67

Source: Field Survey, 2025/26

3.3 Source of Bioresources

Access to agricultural inputs is strongly influenced by the channels through which farmers obtain them. Understanding the sources from which farmers acquire bioresources provides important insights into the functioning of input supply systems, knowledge diffusion mechanisms, and the role of farmer networks in promoting sustainable agricultural practices. Table 3 presents the distribution of respondents by the sources from which they obtain the various bioresources used in green leafy vegetable production. The results revealed that farmers' groups constitute the most important source of bioresources across most categories, highlighting the significance of collective farmer organizations in facilitating access to sustainable agricultural inputs. For instance, 68% of farmers obtained vermicompost through farmers' groups, compared with 17.33% from farm markets, 10.33% from extension workers, and 4.33% from farms. This suggests that organized farmer networks play a central role in the distribution of vermicomposting materials.

The findings also show that 58.67% of farmers obtained biopesticides through farmers' groups, 19.33% from farm markets, 18.33% from extension workers, and 3.67% from farms. The relatively high reliance on farmer groups for accessing biopesticides may reflect the technical nature of these inputs, as adoption often requires training and demonstration. For irrigation-related resources, 59% of farmers reported sourcing them from farmers' groups, 14.33% from farm markets, 12.33% from extension workers, and 14.33% from farms. Irrigation infrastructure and equipment often involve relatively high investment costs; thus, farmer groups may serve as effective platforms for collective investment or shared ownership of irrigation equipment.

In the case of farmyard manure, however, the pattern differs slightly. The results show that 36.33% of farmers obtained farmyard manure from farm markets, 30.67% from farmers' groups, 18% from farms, and 15% from extension workers. This suggests that farmyard manure may be more readily available through informal market channels because it is widely available as livestock waste in rural communities. The results further reveal that 65.67% of farmers sourced biochar through farmers' groups, 17% from farm markets, 13% from extension workers, and 4.33% from farms. Biochar production and application often require technical guidance, which may explain the central role of farmer groups in providing access to these resources.

For compost, 59.33% of farmers reported obtaining it from farmers' groups, 20.33% from farm markets, 14.67% from extension workers, and 5.67% from farms. Composting practices are often promoted through farmer training programs and cooperative initiatives aimed at improving soil health and recycling organic waste materials. In contrast, refuse incorporation and crop residue management show relatively higher reliance on farm markets and farms as sources. Specifically, 42.67% of farmers obtained refuse-related resources from farm markets, 32.33% from farmers' groups, 15.67% from extension workers, and 9.33% from farms. Similarly, 38% of farmers obtained crop residue resources through farmers' groups, 34% from farm markets, 15.67% from farms, and 12.33% from extension workers. These patterns suggest that locally available organic materials may be obtained through multiple informal channels rather than formal supply systems.

Table 3: Source of Bioresources

Source of purchase				
Variable	Farm market	Extension workers	Farms	Farmers' Group
Vermicompost	17.33	10.33	4.33	68
Biopesticides	19.33	18.33	3.67	58.67
Farmyard manure	36.33	15	18	30.67
Biochar	17	13	4.33	65.67
Compost	20.33	14.67	5.67	59.33

Source: Field Survey, 2026

3.4 Perceived Challenges in the Use of Bioresources among Green Leafy Vegetable Farmers

Table 4 presents farmers' perceptions of the challenges associated with using bioresources in green leafy vegetable production. Understanding these constraints is important because farmers' perceptions significantly influence the adoption and sustained use of environmentally friendly agricultural inputs. The results show that although bioresources have potential environmental and soil fertility benefits, several practical and economic challenges may limit their widespread adoption among farmers. The results indicate that a substantial proportion of respondents strongly disagreed (55.33%) with the statement that bioresource use requires more labour than synthetic fertilizers, while only a smaller proportion strongly agreed. This suggests that most farmers do not perceive labour demand as a major constraint to the use of bioresources. However, a notable proportion of respondents expressed neutrality or agreement (19.33%), indicating that labour requirements may or may not pose a challenge for some farmers. Bioresource management practices such as composting, manure handling, and residue retention often involve additional labour inputs compared to the relatively simple application of synthetic fertilizers. Similarly, 56.67% of respondents strongly disagreed that bioresources are too expensive compared to synthetic inputs, suggesting that farmers generally perceive bioresources as relatively affordable. This may be attributed to the fact that many bioresources, such as farmyard manure, compost, and crop residues, are locally available and can be obtained at little or no monetary cost. However, the availability of such materials may still vary depending on farm size, livestock ownership, and access to organic materials.

The perception that bioresources are less effective than synthetic fertilizers appear to be mixed among the respondents. While 53.33% strongly disagreed with this statement, about 17.67% agreed, indicating that some farmers question the effectiveness of bioresource. This perception may arise because organic inputs often release nutrients more slowly than synthetic fertilizers and may require longer periods before noticeable improvements in crop yield are observed. In the case of biopesticides, it may require multiple usage for effectiveness. 49.67% of respondents strongly disagreed that the preparation and application of bioresources is time-consuming, although a relatively high proportion expressed neutrality or agreement. This indicates that time requirements associated with compost preparation, or manure processing, application is a constraint for certain farmers. Smallholder farmers often operate under tight labour schedules, especially during peak planting and harvesting periods, which may affect their willingness to engage in practices perceived as time intensive. The results also showed that 51.67% of respondents strongly disagreed with the statement that bioresources take longer to show results compared to synthetic inputs. Nevertheless, a considerable share of respondents expressed neutral or positive agreement with the statement.

Table 4a: Perceived Challenges in Using Bioresources

Variable	*SA*	*D*	*N*	*SD*	*A*
Bioresource use requires more labor than synthetic fertilizers	20	1.67	19.33	55.33	3.67
They are too expensive compared to synthetic ones	15	5.33	21.33	56.67	1.67
They are not as effective as synthetic ones	18.33	7.67	3	53.33	17.67
Preparation and application is time consuming	22.33	6.33	20.67	49.67	1
It takes longer to show results than synthetic ones	18.33	6.67	19.67	51.67	3.67
Yield is not certain or inconsistent	12.67	5	19.67	54	8.67
Benefits of using bioresources do not justify extra cost	21.67	9	21	45.33	3
Most farmers in my community still prefer synthetic agrochemicals	9.33	2.67	0.67	65.33	22

Source: Field Survey, 2026

Table 4b: Reliability Test for Perceived Challenges in Using Bioresources

			95% CI	
Coefficient	Estimate	Std. Error	Lower	Upper
McDonald's ω	0.906	0.008	0.890	0.922
Cronbach's α	0.889	0.010	0.870	0.909

Source: Field Survey, 2026

Another perceived challenge relates to yield uncertainty. 54% of respondents strongly disagreed that yields from bioresource use are uncertain or inconsistent, suggesting that many farmers are confident in the productivity benefits of bioresources. However, a smaller proportion expressed concern regarding yield variability. Such perceptions may arise from differences in application techniques, quality of organic materials, or variability in soil conditions. The statement that the benefits of bioresources do not justify their additional costs was strongly disagreed with by 45.33% of respondents, suggesting that most farmers recognize the potential advantages of bioresource use. Nevertheless, some agreement among respondents indicates that economic considerations still influence adoption decisions. Results revealed that 65.33% of respondents strongly disagreed that most farmers in their communities prefer synthetic agrochemicals, while 22% agreed. This indicates that while bioresources are gaining acceptance among farmers, synthetic agrochemicals remain widely used in many farming communities due to their rapid effectiveness, convenience, and familiarity.

Lastly, the Cronbach's alpha reliability coefficients for the constraint construct ranged from 0.87 to 0.91 with an average reliability coefficient of 0.89.

3.5 Bioresource Preference Among Green Leafy Vegetable Farmers

Table 5 presents the preference ranking of different bioresources used by green leafy vegetable farmers in the study area. The ranking was determined using a point-based scoring system, where higher points indicate greater preference among the respondents. The result revealed that clear differences exist in their levels of preference. Inorganic fertilizer ranked first with 1971 points**,** making it the most preferred input among the farmers. Inorganic fertilizers are often preferred because they provide rapid nutrient availability and immediate yield responses**,** which are particularly important for short-cycle crops such as green leafy vegetables. These crops typically require quick nutrient uptake to achieve optimal growth within relatively short production periods. Recent studies on vegetable production systems in Sub-Saharan Africa have reported similar patterns, in which farmers prioritize inorganic fertilizers due to their rapid effects on crop yield and productivity (Olumba et al., 2024). The second-most-preferred bioresource is organic manure (cow dung and poultry dung**)**, with 1633 points**.** Organic manure is widely used in smallholder farming systems because it improves soil structure, enhances soil organic matter, and promotes long-term soil fertility. In addition to providing essential plant nutrients, organic manure improves soil microbial activity and moisture retention, both of which are essential for sustainable crop production. The relatively high preference for organic manure suggests that farmers recognize its benefits for maintaining soil productivity. Recent research has highlighted the importance of integrating organic manure with inorganic fertilizers to achieve sustainable soil fertility management and improve agricultural productivity (Iqbal *et al*., 2019; Abab *et al*., 2023). For example, it leads to more soybean yield compared to using chemical fertilizers alone (Wu *et al*., 2024)

The results further show that biopesticides ranked third with 923 points**,** indicating relatively lower preference compared to nutrient-related inputs. Biopesticides are biological agents used to control pests and diseases in an environmentally sustainable manner. Although they are safer alternatives to synthetic pesticides, their adoption among smallholder farmers remains relatively limited in many developing countries due to concerns about their effectiveness, availability, and the technical knowledge required. Recent studies suggest that improving farmers' awareness and access to biopesticides could significantly enhance their adoption in sustainable farming systems.

Similarly, compost ranked fourth with 837 points, indicating moderate preference among farmers. Compost is widely recognized as an important organic soil amendment that improves soil fertility, structure, and microbial activity. However, compost's relatively low ranking may be attributed to the labor-intensive nature of preparation and the time required to produce it before it can be applied to crops. In many smallholder farming systems, farmers prefer inputs that deliver quicker results with less labor. Vermicompost ranked fifth with 793 points**,** suggesting limited adoption among the farmers. Vermicompost is produced through the decomposition of organic materials by earthworms and is considered a highly nutrient-rich organic fertilizer. Despite its benefits, its relatively low preference may stem from the technical knowledge and management requirements associated with vermicomposting systems. An integrated application of vermicompost, other bioresources, and soluble inorganic fertilizers yields optimal results, leading to significant improvements in plant growth, yield, and soil properties (Sande *et al*., 2024).

Finally, biochar ranked sixth with 708 points**,** making it the least preferred bioresource among the respondents. Biochar is a carbon-rich material produced from the pyrolysis of biomass and is known to improve soil fertility, water retention, and carbon sequestration. However, the low preference observed in this study may reflect limited awareness, accessibility challenges, and the relatively recent introduction of biochar technologies in smallholder farming systems**.** Recent studies indicate that the adoption of biochar remains limited in many developing countries due to knowledge gaps and lack of demonstration programs that showcase its benefits to farmers (Ndugwa & Omusula, 2025).

Table 5: Bioresource Preference among Green Leafy Vegetable Farmers

Variable	*Points*	*Rank*
Inorganic fertilizer	1971	1st
Organic manure (cow dung or poultry)	1633	2nd
Biopesticides	923	3rd
Compost	837	4th
Vermicompost	793	5th
Biochar	708	6th

Source: Field Survey, 2026

3.6 Factors Considered when using Bioresources

Table 6 presents the factors green leafy vegetable farmers consider when deciding whether to use bioresources in their farming activities. The ranking was determined using a point-based scoring approach, with higher points indicating greater importance in farmers' decision-making. Crop yield was ranked the most important factor influencing farmers' use of

bioresources, with a total of 1751 points. This suggests that farmers primarily adopt bioresource practices when they perceive they can enhance crop productivity. In smallholder farming systems, production decisions are often strongly influenced by expected yields because farmers depend heavily on crop output for both income and household food security. Recent studies on sustainable agriculture emphasize that farmers are more likely to adopt environmentally friendly inputs when they observe clear productivity benefits (Olumba *et al*., 2024). This indicates that improving awareness of the yield benefits of bioresources could significantly enhance their adoption among vegetable farmers.

The recommendation by extension agents ranked second with 1749 points**,** highlighting the important role of agricultural extension services in influencing farmers' adoption of bioresource practices. Extension agents serve as a key source of information and technical guidance on improved agricultural technologies and sustainable farming practices. Their recommendations often shape farmers' perceptions regarding the effectiveness and reliability of agricultural inputs. Recent evidence from Sub-Saharan Africa shows that effective extension services significantly improve farmers' adoption of sustainable land management practices and environmentally friendly farming technologies (Abab et al., 2023). This finding underscores the critical role of agricultural advisory systems in promoting the use of bioresources among farmers. Factor availability ranked third with 1734 points, indicating that farmers are more likely to use bioresources when such materials are readily available. Accessibility of agricultural inputs plays an important role in shaping farmers' adoption behavior, particularly in rural areas where supply chains may be limited. Bioresources such as organic manure, compost, and crop residues are often locally sourced, and their availability can significantly influence their utilization in farming systems. Studies on sustainable farming systems have shown that farmers' adoption of organic inputs is strongly influenced by the availability and accessibility of such resources (Ndugwa & Omusula, 2025).

The factor health ranked fourth with 1725 points**,** suggesting that farmers consider the potential health implications of agricultural inputs when making production decisions. Bioresources are often perceived as safer alternatives to synthetic agrochemicals, which have been associated with various health risks for farmers and consumers. Increasing awareness about food safety and environmental sustainability may therefore encourage farmers to adopt bioresource-based practices. Recent research indicates that concerns about food safety and environmental health are increasingly influencing farmers' adoption of sustainable agricultural practices across developing countries. Similarly, safety was ranked fifth with 1695 points**,** further reinforcing the importance of health and environmental considerations in farmers' decision-making processes. Bioresource inputs are generally perceived as environmentally friendly and less harmful compared to chemical fertilizers and pesticides. This perception aligns with growing global concerns regarding the environmental and ecological impacts of intensive chemical input use in agriculture.

Convenience ranked sixth with 1401 points**,** indicating that farmers also consider the ease of using bioresources in their farming activities. Some bioresource practices, such as compost preparation or organic manure application, may require additional labor or time, which can affect farmers' willingness to adopt them. In many smallholder farming systems, labor availability and management complexity often influence the adoption of sustainable farming practices. Soil improvement ranked seventh with 1238 points, suggesting that while farmers recognize the soil fertility benefits of bioresources, this factor is not the primary motivation for their use. Bioresources are well known for enhancing soil structure, organic matter content, and long-term soil fertility. However, smallholder farmers often prioritize immediate productivity gains over long-term improvements in soil health. Recent studies on sustainable land management have found that farmers are more likely to adopt soil-improvement practices when they observe direct, short-term economic benefits (Adéchian & Baco, 2025).

The factor price ranked eighth with 1230 points, indicating that cost considerations play a relatively minor role in farmers' decisions to use bioresources. This may be because many bioresources, such as manure and crop residues, are locally available and relatively inexpensive compared with synthetic agricultural inputs. As a result, farmers may focus more on the effectiveness and availability of bioresources than on their cost.

Finally, distance ranked ninth with 977 points**,** making it the least important factor influencing farmers' bioresource use. Although distance may affect the transport of bulky materials such as manure or compost, the relatively low ranking indicates that farmers have access to bioresources within a reasonable distance of their farms. Nevertheless, logistical constraints associated with transporting organic materials over long distances may still discourage their use in certain situations.

Table 6: Factors Considered when using Bioresources

Variable	*Points*	*Rank*
Crop yield	1751	1st
Recommendation by extension agents	1749	2nd
Availability	1734	3rd
Health	1725	4th
Safety	1695	5th
Convenience	1401	6th
Soil improvement	1238	7th
Price	1230	8th
Distance	977	9th

Source: Field Survey, 2026

Conclusion and Recommendations

This study provides valuable insights into the bioresources used by GLVFs in Nigeria. It identifies bioresources such as compost, farmyard manure, biochar, biopesticides, and vermicompost used by GLVFs cultivating indigenous GLV species. Its novelty lies in evaluating complementary bioresources used or integrated into GLV production, identifying perceived challenges associated with these bioresources, their sources, farmers' preferences for bioresource use, and the factors considered when using them. This is crucial for sustainable GLV production amid environmental uncertainties. By bridging

this gap, challenges identified with bioresources can be addressed. Also, factors considered for using bioresources can be enhanced, and opportunities harnessed.

The bioresource use pattern indicates that simpler, well-known bioresources (farmyard manure and biopesticides) are more commonly used, while more specialized ones (compost, vermicompost, biochar) lag behind. Findings suggest that significant number of GLVFs had constraints such as benefits not justifying extra costs incurred; labor requirement is more; time involved in preparation is longer; effectiveness is low; and yield is not consistent when compared with synthetic inputs. A considerable number of farmers agree that these constraints limit bioresource use. While most of these bioresources are locally sourced and produced, this helps reduce purchase costs. Bioresources are mostly used as a complement to reduce costs and augment nutrient requirements for vegetable growth, not to incur additional costs. Also, farmers tend to prefer inputs that are widely recognized and provide immediate yield benefits, such as inorganic fertilizers and organic manure (cow dung and poultry manure). Meanwhile, newer or more technically demanding bioresource technologies, such as biochar and vermicompost, remain less widely adopted.

Among the factors considered when using bioresources, productivity, extension agents' influence, and resource availability are the most important in shaping farmers' decisions to use them. In particular, crop yield expectations and extension service recommendations appear to play critical roles in shaping farmers' decisions to adopt bioresource-based farming practices. It is therefore recommended that agricultural extension services be strengthened; farmers' access to productivity information should be improved, and the use of bioresources as an effective agricultural practice should be promoted among GLVFs.

References

Abab, S. A., Senbeta, F., & Negash, T. T. (2023). The Effect of Policy and Technological Innovations of Land Tenure on Small Landholders' Credit-Worthiness: Evidence from Ethiopia. *Land*, *12*(5), 1055. https://doi.org/10.3390/land12051055

Abiala, M., Akanmu, A., Oribhaboise, A., & Aroge, T. (2020). Combined Effects of Ocimum gratissimum and Soil-borne Phytopathogenic Fungi on Seedling Growth of Quality Protein Maize. Adv. Biol. Biotechnol. 2020, 23, 25–32.

Adéchian, S. A & Baco, M. N. (2025). How Does Land Tenure Security Contribute to the Sustainable Development of Rural Households? Evidence From Benin (West Africa). Front. Sustain. Food Syst. 9:1621537. doi: 10.3389/fsufs.2025.1621537

Baweja, P., Kumar, S., & Kumar, G. (2020). Fertilizers and pesticides: Their impact on soil health and environment. In Soil Health; Springer: Berlin/Heidelberg, Germany, 2020; pp. 265–285. Berry, S. (2017). Struggles over land and authority in Africa. Afr. Stud. Rev. 60 (3), 105–125. https://doi.org/10.1017/asr.2017.96.

Behera, S. R, Pandey R., Bhatt, H., & Mehta, T. (2024). Advanced Vegetable Farming Practices.

Behera, S. R, Pandey R., Bhatt, H., & Mehta, T. (2024). Crop Rotation in Vegetable Production.

Chaitra, A., Ahuja, R., Sidhu, S., & Sikka, R. (2021). Importance of Nano Fertilizers in Sustainable Agriculture. Environ. Sci. Ecol. Curr. Res. 2021, 5, 1029.

Chan, K. Y., Dorahy, C. G., Wells, T., Fahey, D., Donovan, N. J., Saleh, F. F., & Barchia, I. M. (2008). Use of Garden Organic Compost in Vegetable Production Under Contrasting Soil status. Crop & Pasture Science, 59, 374-382. https://doi.org/10.1071/AR07255

Chan, K. Y., Orr, L. M., Fahey, D., & Dorahy, C. G. (2011). Agronomic and Economic Benefits of Garden Organics Compost in Vegetable Production. Compost Science & Utilization, 19, 104 - 97. https://doi.org/10.1080/1065657X.2011.10736984

Dlamini, S. P., Akanmu, A. O., & Babalola, O. O. (2022). Rhizospheric Microorganisms: The Gateway to a Sustainable Plant Health. Front. Sustain. Food Syst. 2022, 6, 925802

Donovan, N. J., Saleh, F. F., Chan, K. Y., Eldridge, S. M., Fahey, D., Muirhead, L., Mészáros, I., & Barchia, I. M. (2014). Use of Garden Organic Compost in a Long-term Vegetable Field Trial: Biological Soil Health. https://doi.org/10.17660/ACTAHORTIC.2014.1018.3

Effiong, J. B., Aboh, C. L., & Aya, C. F. (2021). Perception of Farmers on the Contribution of Vegetables to Livelihoods in Yakurr Local Government Area, Cross River State, Nigeria. *Global Journal of Pure and Applied Sciences*, *27*(2), 85–91. https://doi.org/10.4314/gjpas.v27i2.1

Fadeyi, O., Ariyawardana, A., & Aziz., A. (2022). Factors Influencing Technology Adoption among Smallholder Farmers: A Systematic Review in Africa. *Journal of Agriculture and Rural Development in the Tropics and Subtropics* 123(1):13-30 DOI:10.17170/kobra-202201195569

Faruoque, M. G., Uddin, M. N., Roy, D., Rahman, S., Kabir, K. H., & Donaldson J. L (2024). Enhancing Safe Vegetable Cultivation Through Capacity Development: Exploring the Need for Low-External-Input Utilization among Farmers in Bangladesh. Volume 4, 2024 https://doi.org/10.1016/j.wds.2024.100161

Gathala, M. K., Laing, A. M., Tiwari, T. P., Timsina, J., Islam, M. S., & Chowdhury, A. K. (2020). Enabling Smallholder Farmers to Sustainably Improve Their Food, Energy and Water Nexus While Achieving Environmental and Economic Benefits. Renewable and Sustainable Energy Reviews, 120, 109645. Available from: https://doi. org/10.1016/j.rser.2019.109645

Geza, W., Ngidi, M., Ojo, T., Adetotro, A. A., Slotow, R. & Mabhaudhi, T. (2021). Youth. Participation in Agriculture: A Scoping Review Sustainability. Aug 14;13(16):9120. Doi:10.3390/su13169120

Iqbal, A., He, L., Khan, A., Wei, S., Akhtar, K., Ali, I., Ullah, S., Munsif, F., Zhao, Q., & Jiang, L. (2019). Organic Manure Coupled with Inorganic Fertilizer: An Approach for the Sustainable Production of Rice by Improving Soil Properties and Nitrogen Use Efficiency. *Agronomy*.

Liverpool-Tasie, L. S., Yau, R., Ibrahim, A., L, Bashir, A. Y., Olutunmogun, V., Oyediji, O. T., Martins, I. E., Onyeneke, R., Amadi, M., Emenekwe, C., Wineman, A., Belton, B., Tasie, O., Ellis, P., & Reardon, T. (2023). Transformation of Vegetable Value Chains in Nigeria: Spatial and Seasonal Lengthening & Intensification. Working Paper for Research Supporting African MSMEs to Provide Safe and Nutrition Food (RSM2SNF)

Mukaila, R., Falola, A., Akanbi, S., Usman O., Obetta, A., Egwue, L., & Onah, T. L. (2022). Effects of Vegetable Production on Income and Livelihood of Rural Households in Nigeria. *Mustafa Kemal Üniversitesi Tarım Bilimleri Dergisi*, *27*(2), 213-223. https://doi.org/10.37908/mkutbd.1067195

Mukwedeya, B. & Mudhara, M. (2024). Factors affecting Rural Youth Participation in the Smallholder Farming Sector. *Journal of Agriculture, Food Systems, and Community Development.* Vol 13, No 4 DOI: https://doi.org/10.5304/jafscd.2024.134.014

Ndugwa, R. P., & Omusula, C. K. (2025). Institutional Frameworks, Policies, and Land Data: Insights from Monitoring Land Governance and Tenure Security in the Context of Sustainable Development Goals in Kenya, Rwanda, Uganda, and Zambia. *Land*, *14*(5), 960. https://doi.org/10.3390/land14050960

Njeru, L. K. (2017). Youth in Agriculture; Perceptions and Challenges for Enhanced Participation in Kajiado North Sub- County, Kenya. *Greener Journal of Agricultural Sciences* 7(8):203-209 DOI: 10.15580/GJAS.2017.8.100117141

Nwokoye, E., Ojukwu, E., Kalu, C. & Metu, A. (2021). Effects of Vegetable Exports on Nigeria's Economy. *International Journal of Development and Economic Sustainability*. 23-38. 10.37745/ijdes.13.

Olumba C. N & Olumba, C. C (2025). Enhancing the Adoption Intensity of Sustainable Land Management Practices in Southeast Nigeria: The Role of Education and Mediating Factors of Trust and Belief. Volume 33, Issue 5. October 2025. Pages 7387-7404. https://doi.org/10.1002/sd.3458

Rao, K. M., Singh, P., Ryingkhun, H. B., & Maying, B. (2014). Use of Bio-fertilizers in Vegetable Production. *Indian Horticulture Journa*l, 4, 73-76.

Ruzzante, S., Labarta, R., Bilton, A. (2021). Adoption of Agricultural Technology in the Developing World: A Meta-Analysis of the Empirical Literature, World Development, Volume 146, 2021. https://doi.org/10.1016/j.worlddev.2021.105599.

Sande, T., Tindwa, H., Alovisi, A., Shitindi, M., & Semoka, J. (2024). Enhancing Sustainable Crop Production through Integrated Nutrient Management: A Focus on Vermicompost, Bio-enriched rock phosphate, and Inorganic fertilizers – A Systematic Review. *Frontiers in Agronomy*. https://doi.org/10.3389/fagro.2024.1422876.

Singh, A. K., & Gohain, I. (2017). Integrated Crop Management to Enhance Vegetable Productivity and Farm Income through INM and IPM Practices. *Asian Journal of Crop Science*. 12(1): 165-168. Doi: 10.15740/HAS/TAJH/12.1/165-168

Srinivasan, R. (2012). Integrating Biopesticides in Pest Management Strategies for Tropical Vegetable Production. *Journal of Biopesticides*. https://doi.org/10.57182/jbiopestic.5.0.36-45

Statbase (2024). Vegetable Production in Nigeria. Retrieved from https://statbase.org/data/nga-vegetable-production/

Statista (2025). Fresh Vegetables Nigeria. https://www.statista.com/outlook/cmo/food/vegetables/fresh-vegetables/nigeria?srsltid=AfmBOorKbMIWrmMlxVhVJCzXpV4w1l8ypKjheYk8Ccsl82iHNKzSQx4R#global-comparison

Statista(2025).VegetablesWorldwide. https://www.statista.com/outlook/com/food/vegetables/worldwide. 2025 April 20.

Tichař, T., Agbara, C., Ali, H., Amailo, J., Dijkxhoorn, Y., Herens, M., & Saavedra, Y. (2024). Horticulture Sector Roadmap for Southwest Nigeria; Assessing the Current and Potential Future of the Horticulture Sector in the Six States. Wageningen Centre for Development Innovation, Wageningen University & Research. Report WCDI-24-376. Wageningen.

Wu, Z., Chen, X., Lu, X., Zhu, Y., Han, X., Yan, J., Yan, L., & Zou, W. (2024). Impact of combined organic amendments and chemical fertilizers on soil microbial limitations, soil quality, and soybean yield. *Plant and Soil, 507*, 317 - 334. https://doi.org/10.1007/s11104-024-06733-4.